9th International Conference onKnowledge Innovation and Invention 2026

2nd Artificial Intelligence and Smart Technology Applications Symposium

August 14-16, 2026
Tohoku University, Sendai, Japan

9th International Conference on Knowledge Innovation and Invention 2026 (ICKII 2026)

2nd Artificial Intelligence and Smart Technology Applications Symposium (AISTA 2026)

Sendai, Japan
August 14–16, 2026

Organized by:

Lunghwa University of Science and Technology, Taiwan
International Institute of Knowledge Innovation and Invention (IIKII)
IEEE Tainan Section Sensors Council (IEEE TSSC)

Sponsored by:

Southern Taiwan University of Science and Technology, Taiwan

Technically co-sponsored by:

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Welcome

Welcome to the 9th International Conference on Knowledge Innovation and Invention 2026 (ICKII 2026) and the 2nd Artificial Intelligence and Smart Technology Applications Symposium (AISTA 2026).

ICKII 2026 and AISTA 2026 is jointly organized by Tohoku University, Lunghwa University of Science and Technology, the International Institute of Knowledge Innovation and Invention (IIKII), and the IEEE Tainan Section Sensors Council (IEEE TSSC). The conference provides an interdisciplinary platform for researchers, engineers, and professionals to exchange knowledge, present recent advances, and explore emerging developments in science and engineering.

The conference covers a broad range of topics, including Information Technology, Innovation Design, Bioengineering, Communication Science and Engineering, Industrial Design, Creative Design, Applied Mathematics, Computer Science, Electrical and Electronic Engineering, Mechanical and Automation Engineering, Green Technology and Architecture Engineering, Material Science, and other related fields. Researchers and practitioners from both academia and industry are warmly invited to participate. Through presentations, discussions, and professional exchanges, ICKII 2026 and AISTA 2026 aims to promote interdisciplinary collaboration, encourage the development of new ideas, and create opportunities for future academic and industrial partnerships.

ICKII 2026 and AISTA 2026 received a total of 380 submissions, of which 286 papers were selected and registered for presentation at the conference. Participants come from countries and regions including Canada, China, Hong Kong, Italy, Japan, Kazakhstan, Korea, Macau, Malaysia, Taiwan, the Philippines, and the United States. The accepted papers cover a wide range of research topics and are organized into 15 Regular Sessions and 6 Invited Sessions. We are delighted to see such broad international participation and believe that ICKII 2026 and AISTA 2026 will further strengthen academic exchange and foster lasting connections among researchers and professionals from around the world.

I would like to express my sincere gratitude to all participants, organizing committee members, and everyone who has contributed to making this event possible. I sincerely hope that ICKII 2026 and AISTA 2026 will provide each of you with valuable opportunities to exchange knowledge, discover new perspectives, establish meaningful professional connections, and create memorable experiences.

Friends and colleagues, welcome to ICKII 2026 and AISTA 2026!

Cheng-Fu Yang

Prof. Cheng-Fu Yang, Ph. D.
Department of Chemical and Materials Engineering,
National University of Kaohsiung, Taiwan
Conference Chairman of ICKII 2026
August 14, 2026

Conference Topics

Regular

A. Material Science & Engineering
B. Communication Science & Engineering
C. Computer Science & Information Technology
D. Computational Science & Engineering
E. Electrical & Electronic Engineering
F. Mechanical & Automation Engineering
G. Green Technology & Architecture Engineering
H. Internet & IOT technology
I. Applied Mathematics
J. Innovation Design & Creative Design
K. Industrial Design &Design Theory
L. Cultural & Creative Research
M. Additive Manufacturing
N. Bioengineering
O. Artificial intelligence
P. Smart technology applications
Q. Others

Invited

IV1. Special Session on Post-Quantum Secure Edge Intelligence and AIoT Applications for Smart Society
IV2. AIoT-Enabled Multimodal Perception Systems and Applications
IV3. Artificial Intelligence and Smart Technology Applications Symposium (AISTA 2026)
IV4. Deep Learning on Computer Vision
IV5. Neuromorphic Humanoid Robotics & Event-Driven Intelligence SDK
IV6. AI Technology, Applications and Innovation for knoWledge-based and Advanced Networking (AI-TAIWAN)

Content

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Lunghwa University of Science and Technology, Taiwan

International Institute of Knowledge Innovation and Invention (IIKII)

IEEE Tainan Section Sensors Council (IEEE TSSC)

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Prof. Wei-Ling Hsu, Jiaying University, China

Sessions

Regular

A. Material Science & Engineering
B. Communication Science & Engineering
C. Computer Science & Information Technology
D. Computational Science & Engineering
E. Electrical & Electronic Engineering
F. Mechanical & Automation Engineering
G. Green Technology & Architecture Engineering
H. Internet & IOT technology
I. Applied Mathematics
J. Innovation Design & Creative Design
K. Industrial Design &Design Theory
L. Cultural & Creative Research
M. Additive Manufacturing
N. Bioengineering
O. Artificial intelligence
P. Smart technology applications
Q. Others

Invited

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IV2. AIoT-Enabled Multimodal Perception Systems and Applications
IV3. Artificial Intelligence and Smart Technology Applications Symposium (AISTA 2026)
IV4. Deep Learning on Computer Vision
IV5. Neuromorphic Humanoid Robotics & Event-Driven Intelligence SDK
IV6. AI Technology, Applications and Innovation for knoWledge-based and Advanced Networking (AI-TAIWAN)

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Hung-Duen Yang, Ph. D.

Chair Professor,
Department of Physics,
National Sun Yat-Sen University, Taiwan

- Outstanding Research Award, National Science Council, Taiwan (2004)
- President of National Sun Yat-Sen University, Taiwan (2008 – 2016)
- Minister of Science and Technology, Taiwan (2016 – 2017)
- The 65th Academic Award of the Ministry of Education, Taiwan (2021)

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Department of Electronic Engineering,
National Formosa University, Yunlin, Taiwan

Chair of IEEE Tainan Section Sensors Council

Keynote Speaker

Qiang Chen, Ph. D.

Professor,
School of Engineering, Tohoku University, Japan

Liquid Crystal-Based Beam-Steerable Reflectarray Antennas: Achievements and Challenges

This report outlines our research on the development of liquid crystal-based beam-steerable reflectarray antennas, addressing the achievements and challenges, including the characterization of the dielectric constant of liquid crystals at RF frequencies, the design of a bias circuit network for 2D beam steering, and the development of a unit cell with low reflection loss and fast response time.

Keynote Speaker

Sheng-Tzong Cheng, Ph. D.

President,
National Taitung University, Taiwan

Strategies and Initiatives for Building an"AI Garden"

Artificial intelligence should be viewed not merely as a technological breakthrough, but as a comprehensive strategy for building stronger communities. Using the concept of an "AI Garden," this keynote presents a framework that integrates AI infrastructure, talent cultivation, data governance, local innovation, cultural sustainability, and social resilience. It argues that places like Taitung, often considered geographically remote or resource-constrained, are uniquely positioned to become testbeds for meaningful AI innovation. If AI can address real-world challenges in such communities, it can become a force for dignity, resilience, and inclusive growth.

The presentation follows four interconnected themes: global AI literacy, industry transformation, local AI strategy, and social impact. It begins by examining why AI literacy is becoming a universal competency, explores the rapid evolution of the AI ecosystem, demonstrates how National Taitung University can cultivate an AI Garden tailored to local needs, and concludes by emphasizing that the ultimate success of AI lies not in impressive demonstrations, but in creating sustainable ecosystems that continuously benefit society.

Participation Guideline

1. Official Languages

The official language of ICKII 2026 is English. All presentations, including Q&A sessions, must be delivered in English.

2. Guideline for Participants

2.1. Conference Venue and Time:

- **Location:** Aobayama East Campus, School of Engineering, Tohoku University, Japan
  (6-6, Aramaki Aza Aoba, Aoba-ku, Sendai, Miyagi, Japan)
- **Time Zone:** Conference schedules are **listed** in Local Standard Time (GMT+09:00).

2.2. Conference Kit:

- A conference kit, containing the final program and name badge, will be provided to participants during check-in at the Registration/Information Desk.

2.3. Lunch Time:

- Lunch will be provided from 12:00- 12:30 p.m. on August 14, 2026 (GMT+09:00).

2.4. Banquet Time:

- The banquet entry time is from 17:50 to 18:10 on August 14, 2026 (GMT+09:00).

3. Guidelines for Presenters

3.1. Paper Sequence:

- Presenters and session chairs are required to adhere to the paper sequence as outlined in the Final Program. This ensures that participants can switch between sessions without missing any papers of interest.

3.2. Presentation Time:

- **Oral Presenters:** Each oral presenter is allocated 10 minutes: 7 minutes for the presentation and 3 minutes for discussion.
- **Poster Presenters:** Each poster presenter is allocated 60 minutes.
- **Important Note:** Any content involving political statements, territorial claims, national symbols, or other sensitive issues is strictly prohibited in all presentations.

3.3. Presentation Language:

- All ICKII 2026 papers must be presented in English.

3.4. Equipment:

- Notebook PCs and LCD projectors will be available in every session room. Please note that there will be no Internet connection or email login services. Presenters are requested to prepare their presentation files in MS PowerPoint format on a flash drive and upload the files to the PC in the session room before the session begins.

3.5. Special Requests:

- For any special requests, please contact the Conference Secretary Desk, session chairs, or any session aids.

Paper Presentation Guideline

1. Enrollment at the Conference Reception Desk:

- Participants must enroll at the registration counter with only the first paper ID. The second paper ID does not need to be enrolled at the counter.

2. On-Site Oral Paper Presentation:

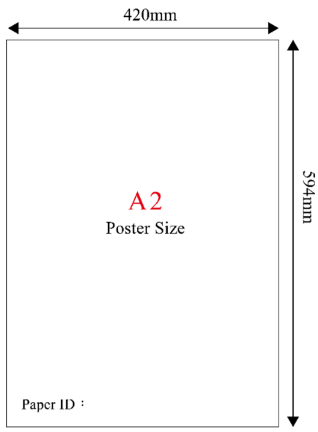
- Each paper is allocated 10 minutes for presentation, including discussion time. A maximum of 12 slides for the presentation is recommended. Presentation files should be saved on a flash drive and brought to the conference before the sessions begin.
- **Important Note:** Any content involving political statements, territorial claims, national symbols, or other sensitive issues is strictly prohibited in all presentations.

3. Online Oral Paper Presentation via Zoom Meetings (Remote):

- Each paper is allocated 10 minutes for presentation, including discussion time. A maximum of 12 slides for the presentation is recommended. Online oral presentations should be conducted remotely via Zoom Meetings and Google Meet. Online presenters must change their display name to "*Paper No._Full English Name*" on online sessions.

4. On-Site Poster Paper Presentation:

- **Poster Size:** A2 (420mm × 594mm).
- Each on-site poster is allocated 1 hour for presentation. Please prepare your poster according to the specified format, print it out, and bring it to the conference for presentation. Oversized posters will not be accepted.
- **Important Note:** Any content involving political statements, territorial claims, national symbols, or other sensitive issues is strictly prohibited in all presentations.



5. Online Poster Submission:

- Presenters of poster papers are requested to submit a soft copy of the poster to the poster submission system. Submitted Posters will be viewed and displayed online.

Conference Agenda

Venue: **Tohoku University, Japan** Language: **English**

Main Conference		
Friday, 14 August 2026		
09:00	09:30	Welcome Reception & Conference Registration
09:30	09:40	Opening Ceremony
09:40	10:00	Coffee Break
10:00	12:00	Onsite Oral & Poster Paper Sessions
10:00 ～ 12:00 Keynote Speech (Host: Chair Prof. Hung-Duen Yang)		
10:00	11:00	Keynote Speech 1: Prof. Qiang Chen
11:00	12:00	Keynote Speech 2: Prof. Sheng-Tzong Cheng
12:00 ～ 13:00 Lunch Break		
13:00	17:00	Oral & Poster Paper Sessions (In-Person)
13:00	17:00	Oral & Poster Paper Sessions (Remote)
14:30	16:00	Coffee Break
18:00	20:00	Conference Banquet & Best Conference Paper Awards

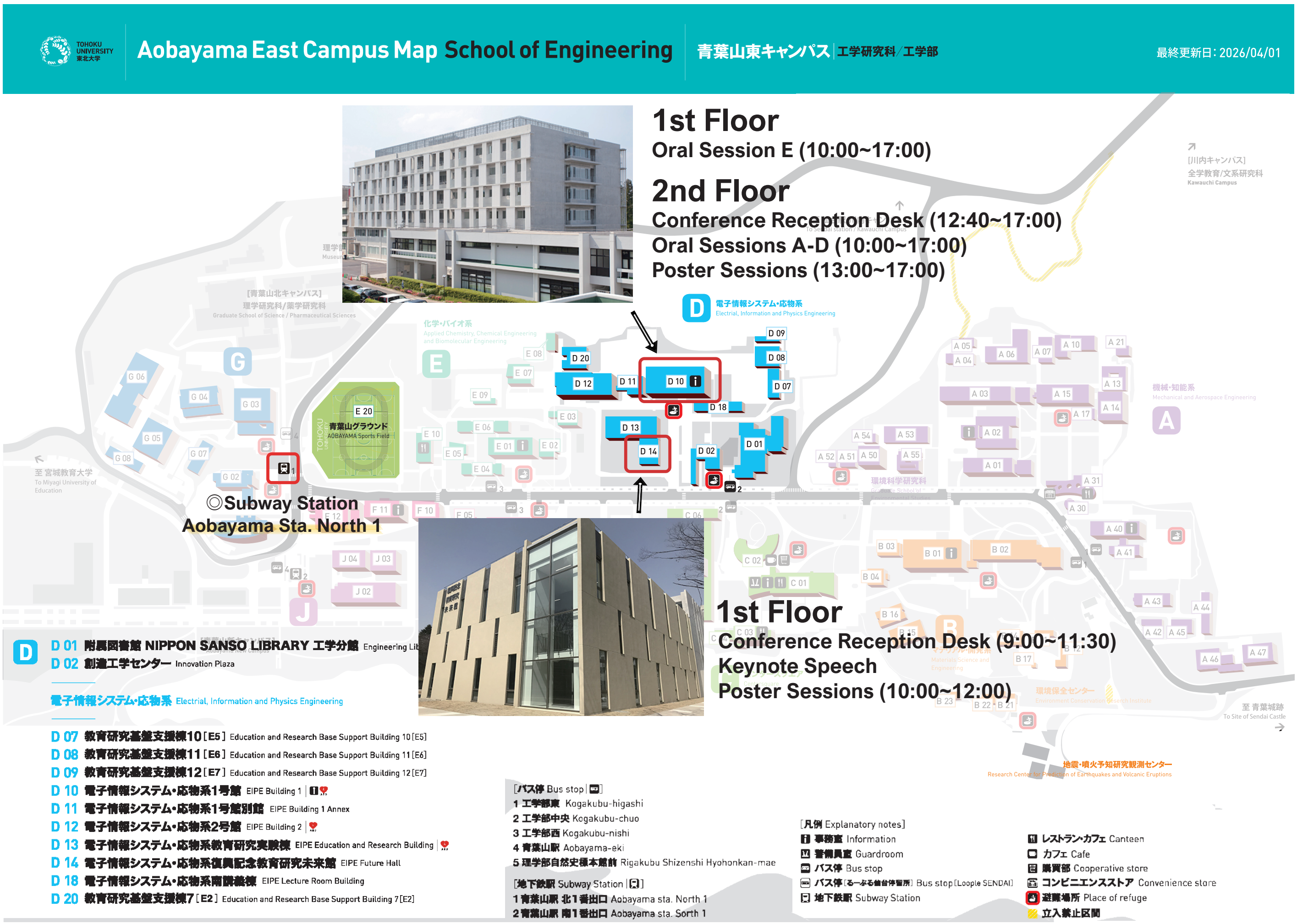
Main Conference	
Saturday, 15 August 2026	
09:00- 17:00	Online Oral Sessions & Online Poster Sessions (Remote)

Main Conference	
Sunday, 16 August 2026	
09:00- 17:00	Sponsor Showcase & Closing Ceremony

Venue

Aobayama East Campus, School of Engineering, Tohoku University, Japan

6-6, Aramaki Aza Aoba, Aoba-ku, Sendai, Miyagi, Japan



Onsite Oral Paper Schedule

Friday, 14 August 2026 (1st/2nd Floor, D10, Aobayama East Campus, School of Engineering, Tohoku University)					
	Session A (Room: 2A)	Session B (Room: 2B)	Session C (Room: 2C)	Session D (Utility Room)	Session E (Room: 1A)
10:00 | 11:00	A1	B1	C1	D1	E1
	K260171-IV6	K260253-J	K260231-C	K260013-H	K260259-E
	K260173-IV6	K260257-J	K260236-C	K260048-H	K260271-E
	K260174-IV6	K260276-J	K260284-C	K260050-H	K260163-B
	K260180-IV6	K260292-J	K260294-C	K260061-H	K260234-B
	K260206-IV6	K260348-J	K260302-C	K260160-H	
11:00 | 12:00	A2	B2	C2	D2	E2
	K260212-IV6	K260195-J	K260306-C	K260162-H	K260072-IV3
	K260213-IV6	K260203-J	K260307-C	K260199-H	K260076-IV3
	K260239-IV6	K260215-J	K260308-C	K260291-H	K260077-IV3
	K260240-IV6	K260219-J	K260313-C	K260310-H	K260083-IV3
	K260254-IV6	K260230-J	K260335-C	K260026-I	K260086-IV3
	K260303-IV6	K260244-J	K260362-C	K260102-M	K260088-IV3
13:00 | 14:00	A3	B3	C3	D3	E3
	K260022-G	K260135-J	K260032-C	K260091-N	K260098-IV3
	K260025-G	K260146-J	K260041-C	K260154-N	K260106-IV3
	K260056-G	K260172-J	K260060-C	K260179-N	K260118-IV3
	K260317-G	K260187-J	K260067-C	K260186-N	K260120-IV3
	K260380-G	K260192-J	K260070-C	K260208-N	K260150-IV3
14:00 | 15:00	A4	B4	C4	D4	E4
	K260356-A	K260089-J	K260074-C	K260006-IV1	K260220-IV3
	K260235-L	K260100-J	K260092-C	K260008-IV1	K260298-IV3
	K260299-L	K260103-J	K260129-C	K260016-IV1	K260337-IV3
	K260327-L	K260105-J	K260130-C	K260044-IV2	K260338-IV3
	K260117-K	K260128-J	K260131-C	K260045-IV2	K260353-IV3
15:00 | 16:00	A5	B5	C5	D5	E5
	K260191-L	K260030-F	K260147-C	K260112-IV4	K260033-O
	K260201-L	K260052-F	K260155-C	K260139-IV4	K260121-O
	K260204-L	K260152-F	K260156-C	K260158-IV4	K260210-O
	K260205-L	K260277-F	K260202-C	K260170-IV4	K260242-O
	K260216-L	K260285-F	K260221-C	K260176-IV4	
16:00 | 17:00	A6	B6	C6	D6	E6
	K260161-K	K260295-F	K260222-C	K260233-IV4	K260255-IV5
	K260228-K	K260344-F	K260224-C	K260238-IV4	K260262-IV5
	K260384-K	K260127-D	K260227-C	K260341-IV4	K260263-IV5
	K260256-IV3	K260132-D	K260275-B	K260078-B	K260264-IV5
		K260331-D	K260333-B	K260116-B	K260267-IV5

Onsite Poster Paper Schedule

Friday, 14 August 2026 (Aobayama East Campus, School of Engineering, Tohoku University)					
Venue: 1st Floor, D14		Venue: 2nd Floor, D10			
10:00—11:00	11:00—12:00	13:00—14:00	14:00—15:00	15:00—16:00	16:00—17:00
K260005-C	K260311-C	K260071-IV3	K260084-O	K260021-F	K260018-A
K260027-C	K260312-C	K260097-IV3	K260087-O	K260053-F	K260124-A
K260028-C	K260371-C	K260194-IV3	K260200-O	K260280-F	K260218-G
K260040-C	K260374-C	K260226-IV3	K260287-O	K260343-F	K260345-G
K260062-C	K260159-E	K260232-IV3	K260305-O	K260122-J	K260034-I
K260090-C	K260165-E	K260252-IV3	K260024-H	K260123-J	K260035-I
K260101-C	K260168-E	K260286-IV3	K260038-H	K260178-J	K260140-I
K260114-C	K260177-E	K260318-IV3	K260049-H	K260197-J	K260217-I
K260134-C	K260193-E	K260043-IV2	K260082-H	K260342-J	K260108-E
K260149-C	K260209-E	K260046-IV2	K260007-IV1	K260185-K	K260125-E
K260223-C	K260290-E	K260051-IV2	K260243-IV4	K260250-K	K260133-E
K260229-C	K260352-E	K260093-IV2	K260330-IV4	K260019-L	K260141-E
K260245-C	K260010-J	K260094-IV2	K260017-D	K260283-N	K260350-E
K260246-C	K260029-J	K260095-IV2	K260383-D	K260358-N	K260351-E
K260300-C	K260099-J	K260241-E	K260039-B	K260368-IV3	K260334-IV4

Online Oral and Poster Paper Schedule

Friday, 14 August 2026

Online Oral Paper Sessions

(ZOOM Meetings & Google Meet) (GMT+9:00, Japan Standard Time)

13:00—14:00	14:00—15:00	15:00—16:00
Session F		
F1	F2	F3
K260068-IV3	K260336-IV4	K260265-D
K260289-IV3	K260354-IV4	K260269-D
K260314-IV3	K260355-IV4	K260270-D
K260325-IV3	K260361-IV4	K260366-E
K260164-IV4	K260367-IV4	
Session G		
G1	G2	
K260073-C	K260181-J	K260296-K
K260251-C	K260196-K	
K260379-C	K260225-K	
K260036-I	K260138-L	
K260324-O	K260190-K	

Online Poster Paper Sessions

13:00—14:00	14:00—15:00	15:00—16:00	16:00—17:00
K260328-A	K260268-D	K260037-I	K260110-C
K260107-B	K260273-D	K260359-J	K260111-C
K260266-B	K260329-D	K260363-J	K260360-C
K260272-B	K260137-E	K260058-L	K260136-O
K260274-B	K260385-E	K260115-IV1	K260301-O
	K260064-G		

Paper Abstracts

https://www.ickii.org/abstract

Contact us

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K260005

Knowledge-Integrated Biologically Constrained Hybrid Forecasting for Agricultural Markets: Integrating Shelf-Life, Harvest Windows, and Time-Series Models

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Keywords: Agricultural Price Forecasting, Biologically Constrained Forecasting, Shelf-Life Modeling, Knowledge-Integrated AI, Synthetic Futures Modeling

Abstract:

Agricultural price volatility originates from seasonal harvest cycles, supply-chain dis-ruptions, and biological perishability. Conventional forecasting approaches often dis-regard these biological constraints and rely solely on statistical models. This work de-velops a biologically constrained hybrid forecasting framework by integrating (1) open price time-series data, (2) commodity-specific shelf-life metadata, and (3) seasonal harvest windows. The method adopts a dual-model architecture, assigning XGBoost to highly perishable commodities and Prophet to medium- and long-horizon commodities, guided by a shelf-life–driven selection rule. The framework treats biological feasibility as a knowledge-guided structural constraint governing forecasting horizon and model se-lection.

Experiments conducted on a publicly available multi-year dataset containing over 110 commodity categories demonstrate that perishable goods exhibit nonlinear short-term volatility whereas storable commodities follow seasonal patterns. Empirical evaluation further suggests a general tendency toward lower forecast error for longer-storage commodities within the evaluated subset. The proposed framework enables futures-like horizon selection, storage-arbitrage evaluation, and cross-domain integration with floral and horticultural supply chains. The architecture exemplifies knowledge-integrated AI by embedding biological and supply-chain metadata into statistical inference pipelines. The results highlight the suitability of combining machine learning and seasonal de-composition to form an AI-based synthetic futures structure for agricultural markets.

K260006

SMART-CAB-Smart Monitoring and Response Technology for Chinese CABbage

Chin-Feng Lee[1,a], Yung-She Lin[2,b], Jocelyn Etania Li[2,c], Ting-Yu Chen[2,d], Miao-Ying Lin[2,e] and Anis Ur Rehman[2,f]

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Keywords: Smart agriculture, Internet of Things (IoT), Artificial Intelligence (AI), YOLO, zero trust

Abstract:

Climate change and more frequent extreme weather events increase the vulnerability of eco-friendly farming practices that avoid or reduce pesticide use. At the same time, rural aging and labor shortages make traditional management based on manual field inspection difficult to sustain. Leafy vegetables such as Chinese cabbage are highly sensitive to temperature, humidity, soil moisture, and light intensity; without real-time monitoring and early warning, abnormalities are often detected only after visible damage has occurred. This study proposes SMART-CAB (Smart Monitoring and Response Technology for Chinese CABbage), an intelligent and secure agricultural system that integrates artificial intelligence, Internet of Things (AIoT) sensing, and a zero-trust security framework. SMART-CAB collects multi-source environmental data and crop images, applies deep-learning-based recognition models to detect growth anomalies and pest or disease symptoms, and supports remote monitoring with instant alerts. The system further incorporates automatic irrigation and environmental control logic, combined with role-based access control, to balance operational efficiency and information security. Experimental deployment indicates that SMART-CAB reduces the burden of manual inspection, shortens response time to plant diseases and environmental anomalies, and provides a practical pathway for smallholders to adopt intelligent, sustainable Chinese cabbage cultivation.

K260007

Post-Quantum Cryptography and Dual-Channel Consortium Blockchain-Based Fisheries Intellectual Property Licensing and Traceability System

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Keywords: Post-Quantum Cryptography (PQC), Hyperledger Fabric, Information Silos, Fishery Supply Chain

Abstract:

Due to the rapid growth of quantum computing technology, asymmetric cryptography, such as RSA and ECC, used in secure transmission methods, may be compromised by quantum algorithms. As a result, these algorithm failures can present potential security threats to high-value aquaculture research assets. The current fisheries industry itself also suffers from low intellectual property protection, insufficiently transparent technology licensing, and information silo issues due to heterogeneous data across organizations and a lack of trust mechanisms. To address these problems, the paper proposes a post-quantum secure fisheries governance architecture based on Hyperledger Fabric consortium blockchain technology, deploying post-quantum cryptographic algorithms to build a quan-tum-attack-resistant on-chain digital identity infrastructure and ensuring the intellectual property security of prototypes during encapsulation and licensing. Using a dual-channel isolation mechanism to isolate the core stakeholders, such as research institutions, intellec-tual property platforms, aquaculture operators, and testing institutions, and is fully carried out in the full link from identity registration, intellectual property protection, food safety inspection, to quality traceability, solves the problems of information barriers and vertical data integration caused by information asymmetry. An inclusive governance framework is proposed that fully realizes comprehensive data protection from research to the table.

K260008

Performance Analysis of Post-Quantum Digital Signatures on ARM Edge Computing Platforms

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Keywords: Post-Quantum Cryptography (PQC), ARM, Performance Analysis, Digital Signatures, Edge Computing

Abstract:

The advancement of quantum computing jeopardizes current cryptographic protocols. In response, NIST standardized Post-Quantum Cryptography (PQC) algorithms in 2024, accel-erating their deployment in IoT edge environments. While ML-KEM demonstrates stable computational efficiency and low power consumption, digital signatures remain the primary performance bottleneck. Specifically, the concurrent standardization of ML-DSA and SLH-DSA—which exhibit distinct disparities in computational complexity key sizes, and performance profiles proposes significant integration challenges for resource-constrained devices. Existing literature predominantly focuses on algorithmic latency or Key Encapsulation Mechanisms (KEM), often overlooking a systematic comparison of these two finalized signature standards regarding thermal impact and sustained performance.

This study utilizes Raspberry Pi 4B to evaluate ML-DSA and SLH-DSA. Beyond standard performanc metrics, we analyze the correlation between device temperature and system throughput under continuous verification workloads. The findings aim to provide concrete algorithm configuration recommendations for resource-constrained IoT security architectures, bridging the security gap in edge computing implementations.

K260010

A Study on the Development of Ergonomically Friendly and Labour-Saving Karakuri Mechanisms for Middle-Aged Operators in Traditional Manufacturing

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Keywords: Traditional Manufacturing Industry, Karakuri, Labour-Saving, House of Quality, Multiple Attribute Decision Making

Abstract:

In recent years, traditional manufacturing industries have been significantly influenced by demographic ageing, resulting in a workforce increasingly dominated by middle-aged operators aged between 40 and 50. Meanwhile, younger workers have shown a declining willingness to enter manufacturing occupations. However, most traditional manufacturing environments continue to rely on labour-intensive and highly repetitive tasks. Consequently, operators are often exposed to workloads that exceed their physical capacities over extended periods, increasing the risk of occupational injuries and chronic musculoskeletal disorders. This situation reveals a notable mismatch between current job design practices and ergonomic safety principles. In response, this study focuses on the actual operational contexts of middle-aged workers in traditional manufacturing settings and proposes a labour-saving and ergonomically friendly improvement approach centred on Karakuri. The research adopts the House of Quality within the framework of Quality Function Deployment as its core structure and integrates Multiple Attribute Decision Making methods, including the Fuzzy Logic and the Technique for Order Preference by Similarity to Ideal Solution, to develop a systematic Karakuri design framework. Through expert questionnaires administered to industry practitioners, operational requirements are identified and analysed to determine the relative importance of requirement dimensions and evaluation criteria. Based on these results, representative Karakuri design solutions are selected for prototype development and on-site validation. The proposed approach effectively reduces operational workload while enhancing safety and usability. The findings provide a quantitative basis for shopfloor improvement and equipment design in traditional manufacturing industries. Moreover, they assist enterprises in improving productivity while ensuring ergonomic safety and labour-saving performance, thereby facilitating the development of low-energy, human-centred manufacturing systems.

K260013

Prototype Design and Implementation of IoT Human-Machine Interface for Aquaponics System

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Keywords: Internet of Things (IoT), Aquaponics System, Human-Machine Interface (HMI), Arduino

Abstract:

In recent years, the concept of the Internet of Things (IoT) has gained significant attention, with a wide range of applications across various fields. Integrated IoT-based products enable a smart lifestyle that is more comfortable, energy-efficient, and health-oriented. This study introduces the development of an IoT-based aquaponics system, highlighting its design, functionality, and potential applications in sustainable agriculture. By constructing an aquaponics ecological environment, the proposed system integrates environmental sustainability and bright living, establishing a technology-driven monitoring and management framework that highlights its innovative approach.

The prototype system is developed based on an aquaponics ecosystem to establish a controlled ecological environment. An Arduino platform combined with multiple sensor modules, including temperature and water level sensors, is employed to construct an environmental monitoring system, enabling precise data collection and feedback for aquaponics management. Additionally, PCs and mobile devices are used to implement a graphical user interface (GUI) that facilitates scenario-based environmental control. All systems and modules are interconnected through wireless communication to establish data integration, allowing for real-time monitoring, management operations, and feedback control. Future work will extend the proposed concepts and implementations to innovative living industries and high-tech precision agriculture.

K260016

Ablation-Based Structural Sensitivity Analysis for EEG Filter Pruning

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Keywords: EEG Classification, Model Reduction, Ablation Analysis, Network Pruning

Abstract:

Model reduction is important for deploying EEG classification networks on resource-constrained brain–computer interface (BCI) platforms. Most existing pruning approaches rely on indirect indicators such as weight magnitude or gradient statistics, which may not accurately reflect the functional importance of individual model components. We propose an Ablation-Based Structural Sensitivity Analysis (SSA) framework that estimates component importance by directly measuring the accuracy degradation caused by disabling each filter. Using EEGNet on the BCI Competition IV-2a dataset, we obtain a baseline accuracy of 66.3% and compare SSA-guided per-layer pruning against random per-layer pruning under matched filter pruning ratios. SSA-guided pruning preserves baseline accuracy at a 20% filter pruning ratio (66.4% vs 66.3%), while matched random pruning drops to 59.2%. The results suggest that ablation-derived sensitivity provides an interpretable criterion for identifying removable structural redundancy in compact EEG CNNs.

K260017

Decision-Level Confidence Calibration for Robust Dental Car-ies Detection

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Keywords: YOLO, Dental caries detection, Object detection, Artificial intelligence

Abstract:

This study addresses the challenge of accurately detecting dental caries in radiographic images by developing a YOLO-based object detection framework for Caries and Deep Car-ies identification. Due to variations in lesion size and confidence distribution, model per-formance was further analyzed using recall–confidence and precision–confidence curves to investigate threshold-dependent behavior. The results revealed a clear trade-off between sensitivity and precision, highlighting the importance of decision-level optimization. An optimal confidence range between 0.35 and 0.45 was identified to achieve balanced detec-tion performance. This work emphasizes confidence calibration as a practical strategy for improving detection robustness and real-world deployment reliability.

K260018

Integrating of Carbon Capture Using Alkali Solutions with Waste Platinum Catalysts for Syngas Production

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Keywords: Carbon capture, Waste catalyst, Syngas, Microwave energy

Abstract:

Carbon Capture and Utilization (CCU) technologies are recognized as powerful tools for reducing greenhouse gas emissions and addressing global warming. This study explores an innovative approach by using alkali solutions as absorbents for carbon capture. The captured CO_2 is then processed with waste platinum catalysts under microwave induction to produce syngas. To support the reaction, micron-scale iron was introduced as a medium to transform microwave energy into the necessary thermal energy. Waste alkali solution concentrations of 1%, 3%, 5%, and 7% were tested, with CO_2 absorption levels ranging from 13,000 to 13,500 ppm. CO_2 breakthrough times were recorded at 2.3, 12.5, 18.6, and 29.7 minutes, respectively. For syngas production, the system operated at 450 W microwave power, with a CH_4/CO_2 inflow ratio of 10:10 mL/min and a 300-minute microwave duration, using 6 g of waste platinum catalyst and 0.8 g of micron iron as the energy absorption medium. The process achieved average hydrogen and carbon monoxide yields of 18.8% and 25.1%, respectively. This study presents a sustainable method that integrates carbon capture with syngas production, demonstrating not only the potential for creating high-value gases and chemicals but also the effective reutilization of waste resources. These findings contribute to advancing renewable energy technologies and fostering circular economy practices.

K260019

Innovative Instructional Design for Integrating Generative AI into Japanese Tourism Culture Courses: Centered on PBL and BYOD Strategies

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Keywords: Generative AI, Japanese Tourism Culture, Problem-Based Learning (PBL), Digital Guided Tour, Cross-disciplinary Learning

Abstract:

With the rapid development of artificial intelligence (AI) technology, higher vocational education is facing a critical moment of digital transformation. Confronted with the "digital generation" accustomed to using mobile devices, traditional classrooms often encounter challenges such as student distraction and digital interference. This project aims to adapt to this trend by proposing a teaching strategy that "turns resistance into assistance." It deeply integrates Generative AI into the "Tourism Japanese" course and utilizes a "Bring Your Own Device" (BYOD) strategy to transform students' digital habits into learning opportunities.

This research integrates Problem-Based Learning (PBL) and Situated Learning Theory to design an innovative curriculum titled "Roaming Japan AI Guided Tour Brochure." In teaching practice, Google Gemini is utilized for itinerary planning, Japanese guide script generation, and grammatical correction. Furthermore, video generation models such as Sora are incorporated to convert text into dynamic guided tour videos. This resolves the dilemma of traditional teaching, where frequent overseas field trips are unfeasible due to financial, spatial, and temporal constraints. The curriculum covers five major aspects of Japan—food, clothing, housing, transportation, and entertainment—guiding students from passive reception to active inquiry.

The research methodology analyzes teaching effectiveness through learning scales. Simultaneously, it is supplemented by qualitative assessments based on students' practical outcomes, including guided tour videos and web platform construction. The expected outcomes not only include improving students' oral expression and planning abilities in Tourism Japanese, but also aim to cultivate their cross-disciplinary competencies in utilizing AI tools for digital content marketing, thereby fulfilling the goals of practical application, innovation, and entrepreneurship in vocational education.

K260021

Engineering Design and Modular Prototyping of an Interactive Exhibition System for Ancient Astronomical Machinery: A Case Study of the Antikythera Mechanism

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Keywords: Antikythera Mechanism, ancient astronomical machinery, modular mechanism design, interactive exhibition system, prototype development, mechanical education.

Abstract:

This study proposes an engineering-oriented framework for the design and modular prototyping of an interactive exhibition system derived from ancient astronomical machinery, using the Antikythera Mechanism as the representative case. The objective is to transform reconstruction research on a historically complex gear-based device into manufacturable, operable, and scalable prototypes suitable for mechanical demonstration, exhibition support, and hands-on science communication. Rather than replicating the complete original reconstruction directly, the proposed method decomposes the mechanism into functionally independent subsystems and converts them into simplified modules while retaining essential kinematic, calendrical, and astronomical meanings.

The developed system contains three engineering layers: a full demonstration model for exhibition and assisted instruction, a 3D assembly animation for structural visualization, and three repeatedly assemblable material-package prototypes, namely the Stars Motions Simulator, the Calendar Computer, and the Multi-functional Calendar Plate. These prototypes respectively demonstrate periodic celestial motion, lunisolar calendar coordination, and integrated date–moon phase–solar/lunar mean motion display. In prototype development, emphasis is placed on mechanism decomposition, structural simplification, gear enlargement for assembly, process-cost consideration, assembly-sequence optimization, and component durability, so that the resulting modules can function not only as interactive teaching aids but also as reproducible cultural-creative products.

The results show that reconstruction knowledge of ancient machinery can be systematically translated into an interactive mechanical exhibition system with practical engineering value. The proposed design pathway provides a feasible approach for connecting historical mechanism research, modular mechanical design, prototype fabrication, and exhibition implementation, while extending the application of ancient astronomical machinery to science popularization and museum-based learning.

K260022

Tabular Feature Imaging for improving Solar Power Regression Models with Satellite Cloud Image

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Keywords: Solar Power Forecasting, Satellite Imagery, Tabular Data Imaging

Abstract:

While traditional solar forecasting models relying solely on tabular data perform well under stable weather, they fail to predict sudden power drops caused by cloud occlusion. This study argues that the root of this bottleneck is the lack of visual signals in the input data; therefore, incorporating satellite imagery is indispensable for high-precision forecasting.

To effectively fuse heterogeneous data, this study proposes a novel feature imaging method, termed "Barcode Imaging," to enable parallel processing alongside satellite images in a dual-branch CNN model. Furthermore, we adopt a two-stage learning framework, which utilizes predictions from the deep learning model as high-level features to be fed into an XGBoost model for final decision-making.

Experimental results confirm that the proposed multi-modal fusion framework significantly outperforms all baseline models relying solely on tabular data in prediction accuracy. Within this framework, our "Barcode Imaging" method surpasses the more complex DeepInsight method in performance. Moreover, the research discovered that in model stacking, features generated by a slightly weaker model can paradoxically yield greater performance gains for the final model, revealing that feature "complementarity" can be more critical than individual "accuracy."

Main Contributions:

Validated the critical value of satellite imagery in solar forecasting, proving that incorporating visual information is essential to break through the performance bottleneck of tabular-only models.

Constructed a high-performance two-stage fusion forecasting framework combining high-level features extracted by a deep learning model with XGBoost's decision-making power, significantly improving prediction accuracy.

Proposed and validated an efficient "Barcode Imaging" method, experimentally proven to outperform the more complex DeepInsight method, offering a lightweight yet effective strategy for tabular data feature engineering.

K260024

Human-Centric AI for Inclusive and Accessible Smart City Services

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Keywords: Artificial Intelligence, Smart Cities, Human Centric

Abstract:

Human-Centric Artificial Intelligence (HCAI) is emerging as a critical paradigm for ensuring that smart city technologies are inclusive, accessible, and aligned with diverse human needs. This paper proposes a comprehensive HCAI framework for inclusive and accessible smart city services, integrating user-centered design, adaptive AI models, and multimodal interaction systems. The framework leverages AI-driven analytics, Internet of Things (IoT) sensors, and edge computing to deliver personalized urban services across transportation, healthcare, public safety, and governance. Key components include explainable AI for transparency, assistive interfaces for differently-abled populations, and participatory data platforms to enhance citizen engagement. A hybrid methodology combining machine learning, natural language processing, and computer vision is employed to enable real-time context awareness and adaptive service delivery. Experimental results demonstrate improved service accessibility by 35%, increased citizen satisfaction by 28%, and reduced response times in public services by 22% compared to conventional smart city systems. The proposed approach also ensures compliance with ethical AI principles, including fairness, accountability, and privacy preservation. This study highlights the transformative potential of human-centric AI in bridging the digital divide and fostering equitable urban development, offering a scalable solution for next-generation inclusive smart cities aligned with sustainable development goals.

K260025

Digital Twin-Enabled Smart Irrigation Systems for Predictive Water Management

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Keywords: Digital Twin, Water Management, Artificial Intelligence

Abstract:

Digital twin technology, integrated with artificial intelligence, is transforming agricultural irrigation into a predictive, data-driven process that enhances water efficiency and crop productivity. This paper proposes a Digital Twin-Enabled Smart Irrigation System (DT-SIS) for predictive water management, where virtual replicas of agricultural fields continuously synchronize with real-time data from IoT-based soil moisture sensors, weather stations, and satellite observations. The digital twin framework employs machine learning and time-series forecasting models to predict soil water dynamics, crop water requirements, and irrigation demand under varying climatic conditions. The system architecture integrates edge computing for low-latency decision-making and cloud platforms for large-scale data analytics and model training. Reinforcement learning algorithms are utilized to optimize irrigation schedules by balancing water conservation, energy consumption, and yield maximization. Experimental validation demonstrates a reduction in water usage by up to 30%, improvement in irrigation efficiency by 25%, and enhanced crop yield by 18% compared to traditional irrigation methods. Furthermore, the proposed system supports scenario simulation, enabling farmers and policymakers to evaluate drought responses and water allocation strategies. This research highlights the potential of digital twin-driven irrigation systems as a scalable solution for sustainable agriculture, contributing to climate-resilient farming and efficient water resource management.

K260026

Design of a capacity rationing model and reentrant dynamic scheduling problem for advanced processes below 5 nanometer in wafer fabs with multiple bottleneck modules within an EUV exposure machine

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Keywords: Extreme Ultraviolet Lithography machine, simplified drum-buffer-rope, multiple bottleneck module, capacity rationing, below 5 nanometer

Abstract:

This research introduces a modified bat algorithm (MBA) to solve the problem of reserved capacity within the Extreme Ultraviolet Lithography (EUV) exposure machine, finding the optimal cutting ratio between normal and reserved capacity when 18Å, 2, 3, and 5nm are under various bottleneck modules. The aim is to incorporate the scheduling of regular, emergency, and insertion orders for various advanced processes below 5nm into the capacity planning stage, avoiding frequent changes to the daily scheduling plan on the wafer fab due to the interference of emergency and insertion orders. Next, the research simplifies the scheduling problem of multiple bottleneck modules and multiple advanced processes within the EUV machine by applying a simplified drum-buffer-rope (SDBR) dynamic buffer status rule (BS) to handle the dynamic dispatching priority of 18Å, 2, 3, and 5nm orders in different reentrant layers. Thirdly, a protective capacity adjustment model and execution method for non-bottleneck module families are constructed to ensure that the minimum Cmax performance index can be achieved under different order combinations of multiple bottleneck modules and multiple advanced processes. Fourth, this study intends to use the Monte Carlo method to simulate the numerical analysis of production parameters of multiple bottleneck modules within an EUV machine exhibiting a Poisson distribution. It will compare the models, such as the minimization of delay time and due date cost problem under weighted due date constraints constructed by Demir et al. (2020), and the reinforcement learning algorithm proposed by Kim et al. (2024) for reducing exposure time and enhancing real-time wafer batch allocation. Finally, this study will construct four delivery performance indicators, such as Cmax, Tmax, U, and Fbar, to analyze the performance of a hybrid mode of MBA and SDBR algorithms in the capacity allocation and scheduling problem for advanced processes below 5nm within an EUV machine in semiconductor wafer fabs. This will provide TSMC semiconductor wafer fabs with a reference for future maximizing the wafer output of the EUV exposure machine planning.

K260027

A Study on Gait Balance and Correction in Older Adults Using AI Motion Tracking and Data Analysis

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Keywords: Artificial Intelligence, Motion Tracking, Gait Balance, Gait Correction, Senior Industry

Abstract:

In recent years, falls among older adults have become a significant public health issue. According to the World Health Organization (WHO), falls are the second leading cause of unintentional injury deaths worldwide, resulting in approximately 684,000 deaths each year, with adults over the age of 60 accounting for the highest number of fatal falls. Moreover, falls have become one of the leading causes of injury-related hospitalization and emergency visits among older adults. This study focuses on gait analysis in older adults and develops a gait analysis and feedback system that integrates image-based pose recognition technology with a real-time visualization interface in Unity. The purpose of this study is to capture human skeletal information through non-wearable computer vision technology, perform gait feature computation and abnormality detection, and establish a real-time feedback mechanism to improve users' walking stability and posture correction ability.

The proposed system is capable of acquiring real-time 3D joint coordinate data of the human body and calculating gait parameters such as cadence, step length, left-right symmetry, foot rotation angle, and center-of-mass deviation. Through quantitative analysis and threshold-based judgment, the system can identify common walking problems, including in-toeing, out-toeing, left-right step length imbalance, and insufficient gait stability. The analysis results are simultaneously mapped onto a Unity 3D human model, where color indicators and textual prompts provide immediate feedback, thereby enhancing users' real-time awareness of gait deviations. Experimental results show that the system can effectively analyze users' gait conditions during actual walking tests, demonstrating good gait classification capability and practical application feasibility.

K260028

Directionally Profiling of COP Features for Discriminating Between Normal and Weak Groups

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Keywords: fall-risk screening, center of pressure, directional features, machine learning, feature importance

Abstract:
Population aging has made early fall-risk screening an increasingly important need in both clinical practice and community care. In this study, we develop classification models to distinguish between Normal and Weak groups using center-of-pressure (COP) features derived from keypoint-based motion data acquired during standing-balance tests in older adults. We further compare the discriminative utility of anterior–posterior and medial–lateral directional information, as well as different feature profiling and segmentation strategies. Participants were older adults, and we stratified the data using clinically relevant information. We adopted an integrated pipeline that combines feature reduction and classification modeling. We evaluated model performance under different conditions using cross-validation and robustness assessment, and we performed an interpretability analysis to identify the key features underlying model decisions. The results showed that directional COP features do differentiate between the two groups and that certain directional and segment-specific feature configurations exhibited more stable discriminative performance. Overall, this study provides a COP-based framework for early screening, and it has the potential to be integrated into clinical assessments and wearable monitoring systems. This study extends prior movement-based analyses by focusing specifically on COP-derived features and their stability characteristics.

K260029

Ancient Maze Lock: Basic Research to Science Education in Museums

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Keywords: maze lock, puzzle lock, science education, museum, mechanism design

Abstract:

A maze lock is a type of puzzle lock with a visible keyhole. During unlocking, a specific part of the key head must be positioned and aligned with a specific location on the keyhole, and inserted using a specific movement. It gets its name from the fact that the unlocking process resembles navigating a maze. This design makes it difficult to insert the key head even with the correct key and a visible keyhole, thus enhancing the lock's security. Based on the movement of the key, maze locks can be further divided into three categories: key inserted by rotation, key inserted by sliding, and key inserted by twisting. The basic mechanical members include case, bolt, spring, and key. This study designed and developed four DIY maze lock teaching aids and created computer animations to present the unlocking process. The research results can be used in science education in museums and schools.

K260030

Design An Optimal Deadlock Control Recovery Strategy for Flexible Manufacturing Systems Using The Fewest Controllers Based on Petri Nets Theory

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Keywords: Petri nets, Deadlock Recovery, Flexible Manufactury Systems, Supervisory Control

Abstract:

This paper proposes a novel transition-based deadlock recovery policy for flexible manufacturing systems. Firstly, we develop and define the concept of Shortest Path Selected Legal Marking (SPSLM), which enables us to identify and determine crucial control transitions. Furthermore, we can use these control transitions to resolve deadlocks in flexible manufacturing systems. It is worth noting that the experimental data show that we can not only solve the problem of these flexible manufacturing systems but also recover all deadlock states. Compared with the existing literature, the strategy we proposed is indeed superior to the papers published to date.

K260032

Challenges and Experiences in Constructing an Ancient Chinese Script Database : A Case Study of the Qinghua Bamboo Slips

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Keywords: Ancient Chinese Script Database, Qinghua Bamboo Slips, AI-assisted

Abstract:

A major challenge in integrating information technology with paleography is the accurate display of ancient scripts on web platforms. To address this, collaborations with Chinese linguistics scholars digitized research funded by the National Science Council into online databases. From 2005 to 2015, these efforts produced the Warring States Chu Bamboo and Silk Manuscripts Electronic Character Compendium: Complete Version (http://cjbnet.org/drupal/). In August 2015, focus shifted to digitizing the Qinghua Bamboo Slips, resulting in the Chu Bamboo and Silk Manuscripts Dictionary: Qinghua Edition (http://cjbnet.org/qinghua/), a digital database providing efficient searches to advance paleographic studies.

However, managing these websites exposed technical hurdles in character encoding, database migration, and software maintenance. Both platforms transitioned from initial IIS/ASP/Access architectures to Apache/PHP/MySQL. Despite advancements in 4-byte architectures and expanded Unicode CJK support the delayed standardization of newly excavated texts—particularly bronze inscriptions and Warring States Chu slips—remains a major encoding barrier. Furthermore, migrating legacy data requires resolving complex text anomalies, notably the Big5 trailing-byte ("Xu-Gong-Gai") issue, for accurate conversion. Server-side compatibility also complicates maintenance; transitioning from PHP 5.x to PHP 8.x involves massive syntax deprecations, demanding continuous code revisions to maintain structural stability.

To overcome these limitations, this study explores using generative AI (Claude.ai) starting in January 2026 to modernize legacy codebases. AI-assisted refactoring successfully migrated outdated scripts into stable, modern programming paradigms. Ultimately, this paper demonstrates how AI empowers humanities researchers to reconstruct niche paleographic databases through efficient, modular design. This modernization facilitates easier access to invaluable Qinghua Chu slip materials, significantly advancing structural research and authoritative discourse on ancient Chinese characters.

K260033

From Loneliness to Health Deterioration: The Mediating Role of Game Addiction in the Digital Era

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Keywords: loneliness, game addiction, mental and physical health, structural equation modeling, digital behavior

Abstract:

In the digital era, online gaming has become an increasingly prevalent activity among young adults, influencing both emotional experiences and health conditions. This study examines the relationships among loneliness, game addiction, and mental and physical health. Drawing on stress-coping theory and behavioral addiction perspectives, and employing structural equation modeling (SEM), data were collected from 333 valid respondents using a structured questionnaire. The findings reveal three key results: (1) loneliness has a significant effect on game addiction, indicating that individuals experiencing loneliness are more likely to engage in gaming behaviors; (2) game addiction has a significant effect on mental and physical health, suggesting that gaming behaviors are associated with variations in psychological and physical conditions; and (3) loneliness has a significant effect on mental and physical health, demonstrating its influence on individuals' health status.

K260034

A Preliminary Study on Critical Circular Economy Indicators for Manufacturing SMEs Using AHP

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Keywords: Circular Economy, Small and Medium-Sized Enterprises, Analytic Hierarchy Process, Sustainable Production Operations, Decision-Making

Abstract:

In response to the growing global emphasis on sustainable development and resource ef-ficiency, the circular economy (CE) has become an important strategic approach for man-ufacturing small and medium-sized enterprises (SMEs). However, due to limited re-sources and technical capabilities, SMEs often face challenges in prioritizing suitable CE implementation strategies. Therefore, this study applies the Analytic Hierarchy Process to identify and prioritize the critical CE indicators for manufacturing SMEs. Based on the lit-erature review and expert evaluations, a three-level hierarchical framework consisting of three major dimensions and nine sub-criteria was established, including Resource and Material Management, Sustainable Production Operations, and Product Lifecycle and Recovery Planning. Five industry experts with more than ten years of professional expe-rience participated in the pairwise comparison questionnaire survey. The results indicate that Sustainable Production Operations is the most critical dimension, with production waste reduction, use of recyclable and reusable materials, and renewable energy utiliza-tion ranked as the top three indicators. The findings provide both academic insights and practical decision-support references for SME managers in implementing CE strategies and allocating limited organizational resources more effectively.

K260035

A Preliminary Study on Critical Barriers to Lean Production Implementation in Traditional Manufacturing SMEs Using AHP

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Keywords: Lean production, Small and medium-sized enterprises, Analytic Hierarchy Process, Implementation barriers, Traditional manufacturing

Abstract:

Lean production (LP) has been widely recognized as an effective approach for improving operational efficiency, reducing waste, and enhancing competitiveness in manufacturing industries. However, traditional manufacturing small and medium-sized enterprises (SMEs) often face significant barriers during implementation due to limited resources, in-formal management structures, and insufficient technical capabilities. Therefore, identi-fying the critical barriers that hinder lean implementation is essential for improving adoption success. This study aims to identify and prioritize the critical barriers affecting LP implementation in traditional manufacturing SMEs. Based on an extensive literature review, a preliminary evaluation framework was established, and the Analytic Hierarchy Process was adopted as the primary research method. A three-level hierarchical structure consisting of three main dimensions and nine sub-criteria was developed. Expert evalua-tions were collected from five senior professionals with substantial industrial experience. The results indicate that technical and operational barriers constitute the most critical di-mension, followed by strategic and managerial barriers and human and organizational barriers. Among the sub-criteria, lack of understanding of production processes, poor fa-cility layout planning, and short-term managerial vision were identified as the top three critical barriers. The findings provide practical insights for SME managers in prioritizing improvement efforts and offer a preliminary reference framework for future lean imple-mentation studies.

K260036

A Study on Critical Barriers to Reverse Logistics Implementa-tion in the Catering Industry Using AHP

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Keywords: reverse logistics, catering industry, Analytic Hierarchy Process, food waste management, sustainability

Abstract:
With the increasing emphasis on sustainability and waste reduction, reverse logistics has become an important operational strategy in the catering industry. However, many cater-ing enterprises still encounter various barriers during implementation. Therefore, this study aims to identify and prioritize the critical barriers affecting reverse logistics imple-mentation in the catering industry by applying the Analytic Hierarchy Process. Based on a comprehensive literature review and expert evaluations, a three-level hierarchical frame-work consisting of three major dimensions and nine sub-criteria was established, includ-ing managerial and strategic barriers, operational and technical barriers, and human and external barriers. Five experts from the catering and food service sectors were invited to complete the pairwise comparison questionnaires. The results indicate that operational and technical barriers constitute the most critical dimension. Among the sub-criteria, in-sufficient food waste classification process, lack of packaging return and recycling facili-ties, and lack of management commitment were identified as the top three barriers. The findings provide useful managerial implications for catering enterprises in improving waste sorting systems, return logistics facilities, and long-term sustainability planning.

K260037

A Study on Critical Driving Factors for Reverse Logistics Adoption in the Catering Industry Using AHP

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Keywords: Reverse logistics, Catering industry, Driving factors, Analytic Hierarchy Process, Sustainability

Abstract:

With the increasing emphasis on sustainability, ESG performance, and circular economy practices, reverse logistics has become an important operational strategy for the catering industry. This study aims to identify and prioritize the critical driving factors affecting re-verse logistics adoption in the catering industry by applying the Analytic Hierarchy Pro-cess. Based on a comprehensive literature review and expert evaluations, a three-level hi-erarchical framework consisting of three major dimensions and nine sub-criteria was es-tablished, including managerial and strategic driving factors, operational and technical driving factors, and human and external driving factors. Five industry experts from res-taurant operations, food waste recycling, and sustainability management in Central Tai-wan were invited to complete pairwise comparison questionnaires. The results indicate that operational and technical driving factors constitute the most critical dimension, among which efficient waste classification systems, adequate recycling and return facili-ties, and strong management commitment were identified as the top three driving factors. These findings suggest that catering enterprises should prioritize systematic waste sepa-ration mechanisms, infrastructure readiness, and strategic managerial support to enhance reverse logistics adoption and sustainability performance. The proposed framework pro-vides both academic reference and practical guidance for future reverse logistics imple-mentation in food service operations.

K260038

Hybrid Human–AI Knowledge Co-Creation Frameworks for Sustainable Agricultural Innovation in Developing Economies

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Keywords: Artificial Intelligence, Sustainable Agriculture, Process Innovation

Abstract:
Hybrid Human–AI knowledge co-creation frameworks are emerging as a transformative paradigm for advancing sustainable agricultural innovation in developing economies. This study proposes an integrated framework that synergizes human expertise—such as indigenous farming knowledge, agronomic practices, and contextual decision-making—with artificial intelligence capabilities including machine learning, knowledge graphs, and predictive analytics. The framework enables continuous bidirectional learning, where AI models are trained on localized datasets while farmers and stakeholders refine insights through experiential feedback. A multi-layer architecture is developed, comprising data acquisition (IoT sensors, satellite imagery), knowledge fusion (semantic modeling and ontologies), and decision support (AI-driven recommendations). The proposed system is evaluated through case-based simulations reflecting smallholder farming environments in resource-constrained regions. Results indicate improvements in crop yield prediction accuracy, resource optimization, and adaptive resilience to climate variability. Additionally, the framework enhances knowledge democratization by enabling participatory innovation and inclusive access to digital agricultural services. The study highlights the potential of hybrid intelligence systems to bridge technological gaps, empower rural communities, and support sustainable development goals (SDGs) in agriculture.

K260039

Crowdsourced Knowledge Innovation Platforms for Smallholder Plantation Farmers Using Mobile and Cloud Technologies

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Keywords: Artificial Intelligence, Process Innovation, Cloud Technology

Abstract:

Crowdsourced knowledge innovation platforms are emerging as effective mechanisms for enhancing productivity and sustainability among smallholder plantation farmers. This study proposes a mobile- and cloud-enabled framework designed to facilitate collaborative knowledge creation, sharing, and validation across plantation communities, particularly in crops such as oil palm, rubber, and cocoa. The platform integrates smartphone-based data entry, cloud storage, and machine learning analytics to aggregate farmer-generated insights on pest outbreaks, fertilizer practices, yield patterns, and climate variability. A multi-layer architecture is developed, comprising data acquisition (mobile apps, IoT sensors, remote sensing), knowledge processing (cloud-based aggregation and semantic analysis), and decision support (AI-driven recommendations and alerts). The system incorporates multilingual interfaces and offline synchronization to address connectivity limitations in rural areas. Experimental simulations and pilot deployments demonstrate improved decision accuracy, faster dissemination of best practices, and enhanced resilience to environmental uncertainties. Furthermore, reputation-based validation mechanisms ensure data reliability and trust among users. The findings highlight the potential of crowdsourced platforms to democratize agricultural knowledge, foster innovation, and support sustainable plantation management in developing economies.

K260040

A Physically-Consistent RAG-LLM Framework for Extreme Weather Analysis

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Keywords: Large Language Model, Extreme Weather Analysis, Physical Consistency, Retrieval-Augmented Generation, Manifold-Alignment

Abstract:

Extreme precipitation events present a major challenge to Large Language Models (LLMs) owing to their complex physical phenomena and high-dimensional meteorological features. When traditional dimensionality reduction techniques are applied to this type of data, they introduce physical distortions, leading to physically inconsistent outputs generated by the LLM. Moreover, complex physical phenomena can easily cause LLM to hallucinate.

This study proposes a physically-consistent Manifold-Alignment Framework, which establishes a RAG Meta Filter based on a "Physics Index" to distinguish weather types and constructs an indexing architecture with "Expert Semantic Labeling." The training phase of this framework utilizes a Multi-Layer Perceptron (MLP) to map compressed data features onto the semantic space, while the inference phase distinguishes weather types through "Physical Index" before utilizing a similarity retrieval RAG Top-K mechanism.

ERA5 reanalysis data of extreme events during autumn in Taiwan (1961-2022, comprising 187 events and 551 days). Early-period (1961-1992) extreme events were used to construct the indexing architecture and semantics, integrating the physics index and expert semantic labeling from PCA dimensionality reduction, and mapping physical features onto the LLM embedding space through a Multi-Layer Perceptron (MLP) to mitigate the critical feature loss problem during the dimensionality reduction process. During the inference phase (1993-2022), it more accurately identified of extreme weather events—Northeast Monsoons accounting for 19.6%, Typhoons accounting for 41.0%, Co-existing Systems accounting for19.6%, and Other 19.9%.

K260041

Using Everything of Thoughts to Intelligently Generate Knowledge on MBTI personality

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Keywords: Everything of Thoughts, MBTI personality, Self-media

Abstract:

With the rapid development of digital media, personalized content has become a key factor in enhancing audience engagement. This paper proposed an Everything of Thoughts (XoT) system within a GPT-4 multimodal model environment to intelligently analyzes, in terms of MBTI personality, the audience preferences of different personality types and evaluates their impact on content creation and dissemination. The system employed the slow system of thinking theory, combined with Monte Carlo Tree Search (MCTS) model and strategy-value network action selection guidance to explore multiple reasoning paths, executing well-considered decisions based on objective, factual, and rule-based perspectives.

Through validation analysis using the MBTI Dataset from Kaggle as third-party data, the XoT model constructed in this paper achieved an average accuracy of 85% across all dimensions, demonstrating excellent classification ability and practical application potential. Among the four personality dimensions, the T/F dimension performed best, with an accuracy of 91.43%, followed by the S/N dimension (84.29%) and the I/E dimension (83.57%); in contrast, the J/P dimension had a relatively low accuracy of only 80.71%. It is hoped that more precise content strategies can be provided to self-media operators to enhance content influence and audience interaction, thereby optimizing the development model of intelligent self-media.

K260043

A Branch-Augmented Artificial Potential Field Method for Real-Time UAV Obstacle Avoidance and Navigation

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Keywords: Unmanned aerial vehicle, artificial potential field, local obstacle avoidance, adaptive clustering

Abstract:
This study proposes a Branch-Augmented Artificial Potential Field (BAAPF) method to address the critica limitations of conventional artificial potential field approaches, specifically the tendency to become trapped in local minima when navigating through narrow passages, symmetric obstacle distributions, or regions with flat repulsive gradients. The framework begins with an environment modeling strategy that utilizes LiDAR-derived point cloud data, which is processed through adaptive clustering to transform raw, discrete obstacle information into structured geometric clusters, thereby establishing a robust foundation for local mapping. Based on these clusters, a hierarchical branching is constructed—comprising anchors, trunks, and secondary branch nodes—which introduces a multi-channel diffusion characteristic into the potential field modeling process. By integrating these multi-gradient repulsive fields with target attractive fields, the BAAPF adaptively modulates its influence range according to the proximity of obstacles, resulting in a continuous and directional local navigation policy that significantly reduces stagnation and oscillatory behavior in Unmanned Aerial Vehicle (UAV) flight paths. Extensive simulation results in both single and multi-obstacle scenarios validate the efficacy of the proposed method, demonstrating a reduction in local path lengths by 1.93 m and 2.20 m respectively, alongside a 6.5 m decrease in cumulative turning distance. These metrics underscore the superior performance of the BAAPF in terms of path smoothness, heading stability, and overall computational efficiency, offering a viable and scalable solution for autonomous UAV navigation and real-time obstacle avoidance within complex, unknown low-altitude environments.

K260044

Integrating Visual Classification and Voice Control into Pick-and-Place Robotic Arm

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Keywords: robotic arm, bidirectional long short-term memory, YOLO, Taguchi method

Abstract:

In the era of Industry 4.0, the goal is to achieve breakthrough growth in production efficiency across various industries. With increasing attention to model optimization research in both industry and academia, this study proposes You Only Look Once based on Taguchi experimental design (YOLO-TED). The proposed YOLO-TED employs a low-cost and efficient hyperparameter tuning approach and is applied to object detection tasks of robotic arms. In addition, this study developed a voice control system using a hybrid of Bidirectional Long Short-Term Memory and Convolutional Neural Network (BiLSTM-CNN) for voice command classification. Experimental results show that the mean Average Precision (mAP) of YOLO-TED model improved to 98.5%, with a classification accuracy of 95.02%, significantly outperforming the original YOLO model. Moreover, the BiLSTM-CNN architecture in this study achieved highest classification accuracy of 95.23% on the validation data set and 95.76% on the test data set. The proposed BiLSTM-CNN was successfully integrated into robotic arm operation as a voice-assistive feature, effectively simplifying user operation.

K260045

Intelligent Laser Welding System Based on Vision Tracking

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Keywords: visual tracking, laser welding, YOLO

Abstract:

With the deepening of Industry 4.0, the laser processing industry urgently needs to overcome the processing bottlenecks of high cost and low flexibility of traditional metal fixtures. Laser weld seam tracking sensors utilize laser irradiation on the weld seam surface to form a laser light band, which is received and imaged by a high-end camera. Through YOUOv8, the three-dimensional features of the weld seam are converted into structured information, including the coordinates of the weld joint, misalignment, and gap. This information is transmitted to the robotic arm controller, providing the robotic arm with the necessary path trajectory and data parameters for welding, guiding the robotic arm to weld in real-time or correct workpiece deviations, achieving perfect welding. This research develops a hybrid vision guidance system based on the Raspberry Pi 5 edge computing architecture. Its compact and sophisticated embedded controller system is suitable for various complex and harsh industrial production environments. It features a highly efficient and real-time image detection algorithm, improving image processing speed. This system integrates YOLOv8n semantic error prevention mechanisms and subpixel geometric tracking technology. The system front-end uses deep learning to perform defect screening and safety interception. On the back end, ORB feature matching, image moment weight integration, and RANSAC affine transformation are used to accurately translate the omnidirectional pose of the workpiece into G-code vector compensation parameters, achieving "fixtureless dynamic calibration". Compared with other methods, the proposed system has the advantages of non-contact, high accuracy, high speed, and good adaptability in laser weld seam tracking.

K260046

Speech-Based Dysarthria Assessment for Non-Invasive Health Monitoring

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Keywords: Dysarthria, Acoustic Speech Features, Machine Learning Classification, Health Monitoring, Swallowing Function Assessment

Abstract:

With the advancement of intelligent healthcare, voice-based monitoring has emerged as a promising non-invasive method for health assessment. Dysarthria is commonly observed in various neurological disorders (such as stroke, Parkinson's disease, and amyotrophic lateral sclerosis), and thus can serve as an indicator of early functional abnormalities.

This study proposes a speech analysis approach based on acoustic features (including MFCC, jitter, and shimmer), employing machine learning models such as logistic regression (LR), support vector machines (SVM), and random forests (RF) to classify healthy versus abnormal speech.

Speech data from 100 individuals with dysarthria and 100 healthy participants were used for model training and validation. Experimental results revealed significant differences between healthy and abnormal speech. Among the three models, LR achieved an accuracy of 0.70 with a recall of 0.80, SVM reached an accuracy of 0.75 with a recall of 0.90, and RF attained an accuracy of 0.70 with a recall of 0.95, underscoring its potential in reducing missed abnormal cases. These findings highlight the value of speech signals in early abnormality detection and home-based health monitoring.

Furthermore, considering the association between dysarthria and swallowing difficulties in neuromuscular control mechanisms, the proposed method may also serve as a preliminary foundation for future self-monitoring of swallowing function. It holds promise for applications in remote health monitoring and home care.

K260048

Integration of Virtual–Physical Systems with Carbon Inventory Data Visualization

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Keywords: Cyber-Physical Systems (CPS), Industry 4.0, Carbon Inventor, Data Visualization, Smart Manufacturing.

Abstract:

This study further integrates a Cyber-Physical System (CPS) into a data visualization platform to interconnect operational technologies of manufacturing equipment with information and communication technologies. This integration enhances industrial management and production processes, enabling CPS within the Industry 4.0 context to provide a more comprehensive solution for carbon inventory. Key innovations include real-time data collection and monitoring, data integration and analytics, automated reporting and compliance checking, and cyber-physical interaction for optimization. The proposed approach allows manufacturers to visualize carbon inventory data more intuitively, improving system usability and increasing user acceptance in practical applications.

K260049

A Real-World Failure and Recovery Analysis of a Shared Kubernetes Platform for IIoT Microservices

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Keywords: Kubernetes, IIoT, Microservices, Failure Analysis, Digital Twin, System Monitoring

Abstract:

This paper presents a real-world failure and recovery analysis of a shared Kubernetes (K8s) platform supporting IIoT microservices. By integrating multi-dimensional monitoring data, including CPU, memory, storage, and network traffic, the study reveals infrastructure-level instability patterns. The findings demonstrate that resource oscillations are primarily caused by repeated container restarts and storage reinitialization rather than external cyber-attacks. This work provides valuable insights into the limitations of shared K8s environments in academic deployments.

K260050

A BIM–KNX–IoT Integrated Framework for Real-Time Smart Building Monitoring and Visual Analytics

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Keywords: BIM, KNX, IoT, Smart Building, Digital Twin, Visual Analytics

Abstract:
The integration of Building Information Modeling (BIM), building automation systems, and Internet of Things (IoT) technologies has enabled new opportunities for real-time monitoring and intelligent management in smart buildings. This paper proposes a BIM–KNX–IoT integrated framework for real-time monitoring and visual analytics. The system establishes a three-layer architecture consisting of a BIM-based digital layer, a KNX-based control layer, and an IoT-based data integration layer. A mapping mechanism is developed to link BIM elements with KNX group addresses, enabling real-time synchronization. A visual analytics dashboard supports decision-making through 3D visualization, risk ranking, and heatmap analysis. The framework demonstrates high interoperability and practical applicability.

K260051

A Preliminary Study on the Comparative Difficulty of Traditional Chinese and English Text Recognition Based on CNN-BiLSTM-CTC

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Keywords: Traditional Chinese Text Recognition, English Text Recognition, Character Error Rate (CER), Recognition Difficulty Comparison, Optical Character Recognition(OCR)

Abstract:

This study compares the recognition difficulty of Traditional Chinese and English text under a unified Convolutional Neural Network – Bidirectional Long Short-Term Memory – Connectionist Temporal Classification (CNN-BiLSTM-CTC) model using printed datasets. Results show that, under identica settings, English achieves a Character Error Rate (CER) of 0.2426, while Traditional Chinese reaches 0.8068, indicating higher difficulty. A staged training strategy with longer text lines reduces Chinese Character Error Rate (CER) to 0.2371, while English achieves 0.0006. Findings suggest that Traditional Chinese recognition relies more on data scale, character distribution, and training design, providing a foundation for improving Optical Character Recognition(OCR) systems.

K260052

Investigation on Autonomous Fire Detection and Dynamic Tracking Optimization for VTOL UAVs Based on Low-Cost Edge Computing Platforms

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Keywords: VTOL UAV, Fire Detection, Edge Computing, Autonomous Tracking, Disaster Reconnaissance.

Abstract:

This study proposes an autonomous fire detection and dynamic tracking system for vertical take-off and landing unmanned aerial vehicles (VTOL UAVs) based on a low-cost edge computing platform. In the early stage of fire and disaster response, conventional human-operated UAV reconnaissance is often limited by smoke interference, low image clarity, operator fatigue, and delayed target localization. To address these limitations, this research integrates visual sensing, lightweight deep learning, edge computing, and flight control into a unified autonomous reconnaissance framework.

The proposed system adopts an H-type VTOL UAV platform that combines multirotor vertical take-off capability with fixed-wing long-endurance cruise performance. A Pixhawk flight controller is used as the core avionics unit, while a Raspberry Pi 4 serves as the onboard edge computing device. A quantized YOLOv8-Nano model in ONNX format is deployed for real-time fire source detection under limited computational resources. To improve robustness in complex environments, fallback mechanisms based on red-region extraction and bright hotspot detection are introduced when AI-based recognition becomes unstable.

For dynamic tracking, the detected target center is compared with the image center to calculate pixel offset errors. These errors are converted into yaw and forward-velocity commands through PID controllers and transmitted to the Pixhawk via MAVLink and DroneKit. This enables the UAV to autonomously align with and track detected fire sources. The expected performance includes an inference latency of 150–250 ms, a processing rate of 15–20 FPS, and target stabilization within approximately ±10 pixels from the image center.

The main contribution of this study is the development of a low-cost and modular VTOL UAV system that integrates lightweight AI detection with vision-guided autonomous control. The proposed framework provides a practical foundation for intelligent disaster reconnaissance, fire source localization, and future extensions such as thermal imaging or firefighting payloads.

K260053

Numerical Study on Aerodynamic Interference and Efficiency Enhancement of Propeller Configuration in a VTOL Fixed-Wing UAV

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Keywords: VTOL UAV, CFD, Aerodynamic Interference, Vortex Interaction, AOA

Abstract:

Vertical take-off and landing fixed-wing unmanned aerial vehicles (VTOL fixed-wing UAVs) combine hovering capability with efficient fixed-wing cruise performance, making them suitable for disaster reconnaissance and long-endurance missions. However, integrating lift rotors, a main wing, and a pusher propeller introduces complex aerodynamic interference. Propeller slipstreams may alter wing pressure distribution, increase induced drag, reduce propulsion efficiency, and affect flight stability.

This study numerically investigates aerodynamic interference and efficiency enhancement for a VTOL fixed-wing UAV with a quadrotor-plus-pusher configuration. Computational fluid dynamics (CFD) is applied to evaluate the effects of propeller placement on aerodynamic performance. The major parameters include the vertical and longitudinal positions of lift propellers relative to the wing, propeller rotation direction, and flight angle of attack. The analysis focuses on propeller downwash effects, wake interaction with wingtip vortices, and parasitic drag caused by stopped lift propellers during cruise flight.

A three-dimensional UAV model is constructed using CAD software and simplified to reduce computational cost while preserving key aerodynamic features. The flow field is divided into stationary and rotating domains to represent the aircraft body, wing, and propeller regions. Unstructured meshes with boundary-layer refinement are generated near wing and propeller surfaces, with local refinement applied to slipstream and wake regions. Grid independence tests are conducted to improve numerical reliability.

The expected results are to identify high-interference and high-efficiency propeller-wing interaction regions. Proper propeller placement may suppress flow separation, improve lift-to-drag ratio, and reduce power loss during vertical take-off and transition flight. Counter-rotating propeller arrangements may further reduce induced drag by weakening vortex interaction. This study provides quantitative design guidelines for propeller configuration optimization and supports the development of efficient, stable, and long-endurance VTOL UAVs.

K260056

A Study on a High-Gain DC Converter Integrated with MPPT for High-Voltage Solar Applications

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Keywords: Solar power system, High-gain DC converter, Maximum power point tracking, Voltage step-up

Abstract:

This study proposes a four-times step-up high-gain DC converter for solar power systems. The main purpose is to improve the output capability of low-voltage solar modules and meet the high-voltage requirements of DC grids. The proposed converter is developed from a traditional voltage doubler structure. It has the advantages of high voltage gain, no need for a transformer, and a reasonable number of components, which helps reduce system size and cost. To improve overall power generation efficiency, the system integrates a Maximum Power Point Tracking (MPPT) control strategy. When solar conditions are poor or the output power changes, the system can adjust its operating point automatically to maintain the best efficiency. In this study, the well-known Perturb and Observe (P&O) method is used as the MPPT algorithm and is combined with the proposed high-gain converter to enhance system performance and stability. The system is verified using a 1 kW solar simulator. When the input voltages are 40 V and 50 V, with duty cycles of 60% and 50%, the system can stably produce a 400 V DC output. The results confirm the correctness of the voltage gain formula. Experimental results also show that the system has good output stability and voltage regulation under different operating conditions. In addition, the voltage stress on the power components meets the design requirements, which shows good reliability of the circuit. In conclusion, the proposed four-times step-up high-gain DC converter has high efficiency, high voltage gain, and good practicality. It is suitable for solar power systems and other renewable energy applications that require high-voltage output.

K260058

Ethnicity and Gender Perceptions in Genshin Impact A Cross-Cultural Comparison of Chinese and International Players

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Keywords: Chinese games, anime-style games, ethnic cues, gender temperament, Genshin Impcat

Abstract:

This study analyzes 83 Genshin Impact characters to explore perceptions of skin color, gender traits, and ethnic cues in among Chinese and international players. Results show a weak link between skin color and race in anime-style games, especially for Chinese players. Female characters are often more sexualized, while male characters display gender traits diverging from their biological sex. Additionally, dark-skinned characters are not seen as less attractive, though perceptions vary by region. Moreover, views on neutral and "loli" characters highlight cultural differences. These insights can inform future anime-style game design.

K260060

Cross-Modal Feature Interaction for Enhancing Occluded Pedestrian Detection Using a ConvNeXt–Swin Transformer Hybrid Network

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Keywords: Pedestrian Detection, Squeeze-and-Excitation Module, CNN, Transformers, Occlusion

Abstract:
Pedestrian detection is a cornerstone of computer vision, yet it remains fundamentally challenging when vehicles, objects, or crowds partially obscure people. Occlusion not only reduces the visibility of key features but also exposes the limitations of current pedestrian detection models and datasets. To address these gaps, this study proposes a hybrid architecture that integrates ConvNeXt, a convolutional backbone for fine-grained spatial details, with Swin Transformer, a vision transformer for long-range dependencies. The branches are fused using a Squeeze-and-Excitation (SE)-style module to merge local convolutional and global Transformer features. This design aims to improve robustness across varying visibility levels and pedestrian arrangements. The study also introduces an expanded localized Philippine dataset containing diverse environments through AI-powered synthetic image augmentations, along with an occlusion thresholding scheme (light: 0–30%, moderate: 30–75%, heavy: >75%) for a more flexible occlusion classification. Results on the base 2000-image dataset, averaged across five stratified k-fold validation runs, show that the proposed Hybrid achieves the highest mean mAP@50 (0.5210), outperforming ConvNeXt-T (0.5177) and Swin-T (0.4921). Under heavy occlusion, it also attains the highest mean mAP@50 (0.3460), surpassing ConvNeXt-T (0.3409) and Swin-T (0.3045). In addition, the Hybrid records the lowest Heavy L-AMR (0.526) and MR@FPPI=0.1 (0.510), with a competitive mean AUC-ROC score (0.8943) Experimental results suggest that the proposed hybrid model improves detection performance and exhibits greater robustness in selected occlusion-sensitive settings, particularly in heavy intra-class and inter-class occlusion scenarios.

K260061

Taiwan's Multi-Level Marketing Industry Development and Social Media Marketing: Application of the MCDM Method

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Keywords: Multi-level marketing, social media marketing, UTAUT, MCDM method, digital transformation

Abstract:

With the rapid advancement of digital technology and social media platforms, corporate marketing has shifted from traditional channels toward digitalized operations. The MLM industry faces both transformation pressures and new opportunities in this landscape. This study investigates key factors influencing social media marketing development in Taiwan's MLM industry, using the Unified Theory of Acceptance and Use of Technology (UTAUT) as its theoretical foundation, integrated with the Analytic Hierarchy Process (AHP) for empirical analysis.Through literature review and the Modified Delphi Method, four main dimensions were constructed — performance expectancy, effort expectancy, social influence, and facilitating conditions — along with their respective sub-dimensions as evaluation criteria. Twelve questionnaires were distributed to professional managers in Taiwan's MLM industry, all of which were returned valid. Pairwise comparison analysis was conducted to calculate the relative weights of each dimension and sub-dimension.The findings reveal that facilitating conditions received the highest weight among the four dimensions, followed by social influence, effort expectancy, and performance expectancy, indicating that resource support and the external environment are the most critical factors. At the sub-dimension level, equipment conditions, public image, and perceived ease of use demonstrated the greatest influence, reflecting the importance of technological infrastructure, image management, and operational convenience in shaping distributors' adoption behavior.The study concludes that MLM companies should prioritize strengthening digital infrastructure and resource allocation, foster supportive organizational culture, and proactively manage corporate image to encourage distributor engagement. Simplifying operational processes and improving tool usability can further facilitate adoption. These findings provide practical guidance for MLM enterprises pursuing digital transformation and a foundation for future research.

K260062

Smart Reporting Systems for Needlestick Injuries: A Three-Decade Comparative Study in Taiwan

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Keywords: Needlestick injuries, underreporting, occupational safety, smart healthcare, AI-assisted reporting

Abstract:

Background: Needlestick injuries (NSIs) represent a persistent occupational hazard for nurses, and underreporting continues to hinder effective surveillance and prevention. Longitudinal evidence is critical for informing the design of smart healthcare information platforms and AI-assisted reporting systems that can strengthen occupational safety and optimize data-driven policy interventions.

Objective: This study investigated temporal changes in NSI incidence and underreporting among nurses in Taiwan across three decades, with a focus on evolving determinants of reporting behavior and implications for smart technology applications in healthcare informatics.

Methods: A retrospective cross-sectional design was employed using data collected in 1999, 2009, and 2019. Nurses from 458 hospitals across northern, central, southern, and eastern Taiwan were systematically sampled, yielding consistently high response rates (93.0%, 87.6%, and 92.3%). Statistical analyses examined incidence rates, prevalence of underreporting, and shifts in explanatory factors over time.

Results: The one-year NSI incidence rate declined substantially from 66% in 1999 to 17.1% in 2009 and 8.2% in 2019. Underreporting rates also decreased (72.4%, 34.7%, and 28.4%). Reasons for underreporting evolved from poor risk recognition in 1999, to lack of clarity in reporting protocols in 2009, and workload-related barriers in 2019.

Conclusion: Over two decades, NSI incidence and underreporting among nurses in Taiwan have markedly decreased, reflecting improvements in occupational safety awareness and reporting systems. Nonetheless, persistent workload barriers underscore the necessity of smart healthcare information platforms, AI-assisted reporting systems, and policy-driven digital innovations to enhance reporting efficiency and strengthen occupational health management. This study provides empirical evidence supporting the integration of smart technology applications into healthcare safety strategies.

K260064

Dynamic Evolution of Multi-Stakeholder Collaboration Mechanisms in Green Buildings: A RWCM-Modified Tripartite Evolutionary Game Simulation

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Keywords: Green building, Multi-stakeholder collaboration, Evolutionary game theory, Reference-Weight Corrected Mapping (RWCM), Numerical simulation

Abstract:

Under China's "dual carbon" strategy, the promotion of green buildings faces a persistent "high certification, low performance" dilemma, rooted in interest conflicts and coordination failures among three key stakeholders: governments, developers, and homeowners.This study develops a four-step integrated analytical framework. First, the Analytic Hierarchy Process (AHP) is employed to identify key barriers affecting multi-stakeholder collaboration in green buildings. Second, a novel Reference-Weight Corrected Mapping (RWCM) mechanism is proposed to transform subjective decision-making weights into objective game parameters. Third, a tripartite evolutionary game model involving governments, developers, and homeowners is constructed to analyze the formation mechanisms of evolutionary stable strategies. Fourth, MATLAB-based numerical simulations are conducted to examine the influence of key parameters on stakeholder behavioral choices and system stability.The results reveal three main findings. (1) Government subsidies exhibit a diminishing marginal incentive effect on developers' green construction strategies, with the incentive effectiveness saturating when the subsidy intensity exceeds approximately 1.25 times the baseline level. (2) When penalty intensity exceeds 1.25 times the baseline, the penalty mechanism demonstrates significantly stronger inhibition of free-riding behavior compared to a subsidy-only policy. (3) Developers show the highest sensitivity to green incremental costs, making the reduction of technology application costs approximately 40% more effective than an equivalent increase in financial subsidies in promoting green adoption.The theoretical contribution of this study lies in establishing, through the RWCM mechanism, an effective linkage between subjective cognitive weights and objective game parameters, thereby providing a quantitative analytical framework for green building policy design. The identified parameter thresholds—subsidy cap (≤1.25× baseline), penalty effectiveness condition (≥1.25× baseline), and the relative efficiency of technology cost reduction—offer actionable evidence-based guidance for green building policy optimization.

K260067

Design and Experimental Evaluation of a Hybrid Multilingual AI Recommender System with NLP-Based Content Generation

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Keywords: hybrid recommender system, artificial intelligence, natural language processing, personalized recommendation, multilingual content analysis

Abstract:

This paper presents the design and experimental evaluation of a hybrid AI recommender system integrated with NLP-based content generation for personalized digital platforms. The proposed system combines content-based filtering and collaborative recommendation techniques to improve the accuracy and adaptability of personalized content delivery in multilingual educational environments. In addition, an NLP module automatically generates contextual questions and interactive tasks based on user-selected materials, supporting adaptive user engagement and dynamic content interaction. The system architecture is implemented using a scalable microservice approach with RESTful APIs and a PostgreSQL database. Experimental results conducted on a dataset of more than 600 multilingual texts demonstrate improved recommendation relevance, reduced cold-start limitations, and efficient response performance compared to conventional recommenda-tion approaches.

K260068

Implementation of Visual Speech Assistance for Hearing-Impaired Users Using a Raspberry Pi-Based Smart Hat

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Keywords: visual speech assistance, smart hat, speech recognition, wearable assistive device

Abstract:
A large proportion of the global population suffers from hearing loss. In particular, people with sensorineural hearing loss often experience recruitment phenomena, making it difficult for them to rely on conventional hearing aids in severely noisy environments. Since traditional hearing aids primarily amplify sound, background noise can also be amplified, reducing speech intelligibility and causing physiological discomfort. As a result, hearing-impaired users may face communication barriers, social isolation, and potential safety risks due to limited access to speech and environmental audio information. The object of this work is to implement a non-invasive, discreet Wireless AI smart hat for hearing-impaired users that visualizes speech and environmental sounds to reduce the information gap they experience. The proposed system is based on a Raspberry Pi platform and integrates a ReSpeaker microphone array, an OLED display module, and the VOSK offline speech recognition engine. Spoken content is converted to text in real time and displayed on an OLED screen beneath the hat's brim, enabling users to quickly understand conversations through visual subtitles. The system also supports sound-source direction detection and low-power operation without an internet connection, thereby improving practicality, privacy, and stability. By embedding the system into a wearable hat, the proposed design enhances portability, concealment, and social acceptance compared with conventional medical-style assistive devices. Accordingly, this work integrates AI, edge computing, audio signal processing, and wearable display design to provide a practical assistive solution that supports communication, environmental awareness, and more natural social participation for hearing-impaired users.

K260070

A Human-Centered Framework for Auditing Latent Knowledge Structures in Discourse Embeddings

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Keywords: latent knowledge structure, discourse embeddings, nonparametric clustering, stability audit, human-AI decision support

Abstract:

This paper presents a human-centered framework for auditing latent knowledge structures in discourse embeddings. Utterances are mapped to sentence embed-dings, reduced to PCA-15, clustered into nonparametric modal regions, and con-verted into assignment and transition diagnostics. On the Banking77 test split, the reporting operating point h = 0.45 discovers 16 regions with normalized mutual information (NMI) = 0.5615 and adjusted Rand index (ARI) = 0.1182. A subsample-and-refit diagnostic gives mean global ARI = 0.8747 ± 0.0456 across 20 repetitions. The framework is positioned as an initial quantitative layer for later expert semantic review, not as completed human validation.

K260071

Knowledge-Integrated GPT-RAG Assistant for Automotive Refinish Coatings: Technical Consultation, Process Guidance, and Expert Validation

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Keywords: large language models, retrieval-augmented generation, automotive refinish coatings, technical consultation, knowledge transfer

Abstract:

Automotive refinish coatings require technicians to interpret product manuals, SOPs, defect-handling knowledge, and product-compatibility constraints under time-sensitive conditions. This paper presents a knowledge-integrated GPT-RAG assistant for technical consultation, process guidance, defect diagnosis, and vocational training support in automotive refinish coatings. The system integrates structured product data, SOPs, defect guides, and certification materials into a retrieval-based knowledge base. To improve reliability, rule-based guardrails are introduced for product compatibility, citation support, and procedural completeness. Representative consultation cases and expert validation with six domain instructors show strong perceived usefulness, professional terminology quality, logical consistency, and relevance. The study demonstrates how GPT-RAG can support industrial knowledge transfer and reduce dependence on fragmented technical documents and expert-only consultation.

K260072

A Human-in-the-Loop Prompt-Controlled Framework for Technical Feature Representation in Generative AI Architectural Visualization

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Keywords: Generative AI, Prompt Engineering, Technical Feature Representation, Human-in-the-Loop Evaluation, AI-Generated Architectural Visualization

Abstract:

Text-to-image generative AI is increasingly used in architectural visualization, but its reliability remains uncertain when the goal is to represent specific technical design features rather than produce visually attractive renderings. In low-carbon building design, many features require clear visual cues, while others are implicit, material-based, or system-related. This study proposes a human-in-the-loop prompt-controlled framework for generating and evaluating AI-generated architectural images that represent low-carbon building design features. Using Stable Diffusion, 50 interior-level low-carbon features were organized into five technical categories and translated into operational definitions, key visual cues, structured prompt components, and negative prompt constraints. The framework includes feature operationalization, prompt structuring, candidate image generation, quality-control screening, and human-in-the-loop evaluation. An evaluation was conducted with 84 design-background participants under non-annotated image conditions. Each participant evaluated six randomly assigned images and completed objective recognition and subjective rating items. The results showed an overall objective recognition accuracy of 47.22%. Correlation analysis indicated that objective recognition was positively associated with subjective feature recognizability and semantic interpretability, but not with perceived visual quality or application usability. These findings suggest that photorealistic image quality alone is insufficient for reliable technical feature representation. The proposed framework contributes to AI-supported architectural visualization by emphasizing visual cue legibility, traceable prompt design, and human-in-the-loop evaluation of AI-generated design feature images.

K260073

Deformable YOLOv8: Robust Vehicle Detection for Occluded Edge-Based Traffic Monitoring

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Keywords: Deformable Convolutional Networks (DCN), Intelligent Transport Systems (ITS), Object Detection, Occlusion Handling, Traffic Monitoring

Abstract:
Intelligent Transport Systems for real-time traffic monitoring through the use of computer vision technology have elucidated the need for lightweight object detection models. Convolutional neural networks commonly struggle with occlusion challenges; that is, visual obstructions to objects that impede the rigid geometric sampling grids. This study proposes the integration of Deformable Convolutions (DCNs) into the YOLOv8 architecture, specifically DCNv2 and DCNv3, to improve the spatial adaptability of low-resource models.

Through the use of a localized dataset from school campus surveillance footage, the study identifies the effect of integrating DCN modifications. Two-Way ANOVA and Tukey's HSD tests were used to validate that modifications done at the backbone level offer inconsistent to negligible differences, while integrating DCNv3 into the Path Aggregation Network (PAN) neck yields the most significant improvements.

Using a curated occluded object dataset, the DCNv3-Neck-PAN model achieved a Recall of 0.9191 and an mAP50-95 score of 0.7818. This 13.6% improvement from the baseline YOLOv8n was found to be statistically significant ($p < 0.001$).

K260074

FasterViT-RT-DETR: A Hierarchical Hybrid Network for Occlusion-Robust Real-Time Vehicle Detection

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Keywords: Vehicle Detection, FasterViT, RT-DETR, Occlusion, Transformer Backbone

Abstract:
Vehicle detection in real-world traffic scenes is often challenged by visual occlusions, which significantly reduce the reliability of intelligent transportation systems. This study ad- dresses this limitation by proposing an architectural enhancement to the Real-Time Detection Transformer (RT-DETR) by replacing its conventional Convolutional Neural Network (CNN) backbone of ResNet with a FasterViT hybrid architecture. This modification uses FasterViT's hierarchical attention mechanism to enhance feature representation and reduce computational complexity. By harnessing FasterViT's early-stage convolutional layers for localized feature extraction alongside its deeper window-based Hierarchical Transformer (HAT), the model effectively captures both fine-grained visual details and long-range global context. Results show that under heavy occlusion scenarios, the FasterViT- 0-based model maintained a robust mean Average Precision (mAP@0.5:0.95) of 0.766, outperforming the ResNet-50 baseline (0.721) and achieving a 4.5% improvement in detection perfor- mance. Furthermore, the FasterViT-0-based model achieved an overall high mAP of 0.807 while requiring 54% fewer GFLOPs than the ResNet-101 baseline, making it highly efficient for real-time edge deployment. Overall, integrating FasterViT into RT-DETR results in a more efficient and occlusion-resilient framework for real-time traffic monitoring.

K260076

Development of an Evaluation Method and Practical Benefit Analysis for Behind-the-Meter Energy Systems

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Keywords: Behind-the-Meter, Energy Storage System, Solar PV, Multi-objective Scheduling

Abstract:

In recent years, behind-the-meter (BTM) energy systems have attracted increasing interest from commercial and industrial users due to their potential to improve electricity cost structures, create renewable energy value, and enhance participation in electricity markets. Consequently, more users are considering the deployment of on-site energy systems. However, evaluating the actual benefits of energy system deployment during the investment planning stage has become a critical challenge. The practical operation of BTM energy systems is jointly influenced by load characteristics, system configurations, and dispatch strategies, which significantly increases the complexity of benefit analysis and often leads to uncertainty in investment decision-making. This thesis aims to improve the evaluation capability for BTM energy system deployment. Focusing on the Taiwanese BTM electricity market, a practical and scientifically grounded benefit evaluation ap-proach is developed. By integrating models of user load behavior, energy storage systems, and solar photovoltaic systems, strategy-oriented functional modules are defined ac-cording to practical operational requirements. A multi-objective scheduling framework is further applied to enable consistent and executable simulations for complex dispatch scenarios. To reflect practical performance, this study analyzes real-world load cases using multi-year, full-year daily simulations. The feasibility and risk characteristics of dispatch strategies after energy system deployment are evaluated, and quantitative in-dicators are derived across multiple dimensions, including economic benefits, system operation performance, and renewable energy application. The proposed evaluation ap-proach demonstrates strong extensibility under diverse load characteristics and complex market conditions, providing practical and reproducible results that can support deci-sion-making during investment planning and dispatch strategy design for BTM users.

K260077

Energy Dispatch and Management Strategies for Smart Microgrids with Seamless Switching Capabilities

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Keywords: Microgrid, Microgrid, battery energy storage systems, GFM Inverter

Abstract:

This paper presents the design and operational strategy of a smart microgrid capable of both grid-connected and islanded operation modes. The proposed system integrates photovoltaic generation, a battery energy storage system, a diesel generator, and campus electrical loads. An energy management system is employed to perform optimal scheduling and to ensure seamless transitions between grid-connected and islanded states. Under the grid-connected mode, the microgrid aims to minimize the total energy cost and maximize the utilization of renewable energy. A mixed-integer linear programming model is developed to formulate the day-ahead scheduling problem, accounting for real-world factors such as time-of-use electricity pricing and uncertainties in solar generation and load demand. To enhance operational robustness and flexibility, the model incorporates statistical scenario analysis and intra-day rolling adjustments. In the islanded mode, the power conversion system of the battery energy storage systems (BESS) functions as the main voltage-forming device using Grid Forming control to maintain internal voltage and frequency stability. When the state-of-charge of the battery falls below a preset threshold, the system automatically initiates the diesel generator. The generator operates based on predefined startup logic, synchronization criteria, and parallel operation control to ensure reliable power supply within the islanded microgrid.

The paper also examines the transition mechanisms between grid-connected and islanded operations, identifying key technical challenges and control limitations. A master-slave control scheme is proposed, with the PCS acting as the master controller and other distributed energy resources following, to achieve seamless switching between modes. The proposed intelligent control and scheduling framework demonstrates both economic efficiency under normal operations and high adaptability during grid disturbances. The results validate the technical feasibility and practical potential of the system, providing a concrete reference for the design and implementation of future multi-source, multi-mode microgrids.

K260078

GPS Navigation Using a Cauchy Kernel-Based Centered Error Entropy Filter with Variational Bayesian Covariance Adaptation

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Keywords: GPS, extended Kalman filter, centered error entropy, variational Bayesian, Cauchy kernel

Abstract:
Global Positioning System (GPS) observables are vulnerable to multipath propagation, non-line-of-sight reception, and signal interference, which frequently introduce heavy-tailed and non-Gaussian measurement errors. Under such conditions, the Extended Kalman Filter (EKF) may experience significant performance degradation because of its reliance on accurate system models and Gaussian noise assumptions.

To address these challenges, this paper proposes a Cauchy kernel-based Variational Bayesian Centered Error Entropy Extended Kalman Filter (VBCEEEKF-C) for robust GPS navigation. The proposed framewor integrates Variational Bayesian (VB) inference with the Centered Error Entropy (CEE) criterion to improve both adaptability and robustness in uncertain and dynamic environments. The VB approach provides a probabilistic framework capable of adaptively estimating time-varying noise statistics without requiring prior knowledge of the exact noise distribution. By employing inverse Wishart priors, the proposed method updates the prediction error covariance and measurement noise covariance online, thereby enhancing the adaptability and numerical stability of the filtering process. Unlike the conventional Mean Squared Error (MSE) criterion, CEE is more sensitive to variations in the error distribution and can effectively suppress the influence of abnormal observations. To further improve robustness, the Gaussian kernel used in the CEE framework is replaced with a Cauchy kernel. Due to its heavy-tailed characteristics, the Cauchy kernel maintains a significant response to large residuals and suppresses impulsive pseudorange outliers more effectively than the Gaussian kernel. The updated covariance estimates obtained from the VB framework are incorporated into the Cauchy kernel-based CEE cost function, which is optimized through a fixed-point iterative algorithm.

The effectiveness of the proposed VBCEEEKF-C filter is validated using both simulation experiments anc real GPS pseudorange observation data. Results demonstrate that the proposed method achieves more accurate and robust positioning performance in heavy-tailed and non-Gaussian noise environments.

K260082

Design and Implementation of a Management System for Monitoring Equipment Utilization and Analyzing Carbon Emission Intensity Based on the Industrial Internet of Things.

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Keywords: Industrial Internet of Things, carbon emissions management, fixed energy consumption analysis, reinforcement learning, Dify intelligent query

Abstract:

This study develops an integrated intelligent monitoring and ESG (Environmental, Social, and Governance) carbon emission management platform, leveraging the Industrial Internet of Things (IIoT). Its primary objective is to assist small and medium-sized enterprises (SMEs) in achieving equipment digitalization and energy management cost-effectively, without replacing existing machinery. The system adopts an intelligent machine box as the core device, integrating multi-sensor modules—including current, temperature, vibration, and infrared sensors—and utilizes LoRa long-range wireless communication technology to ensure transmission stability and deployment flexibility.

In terms of methodology, this research proposes a progressive intelligent framework. First, Pearson correlation analysis quantifies the impact of operational states (processing vs. idle) on total energy consumption, accurately identifying fixed base-load energy consumption during idle periods as a critical factor influencing carbon emission efficiency. Subsequently, multi-objective optimization and Deep Q-Network (DQN) reinforcement learning algorithms are introduced. The reward function incorporates electricity costs, carbon emissions, and production stability to provide decision support for dynamic production scheduling. Furthermore, the system integrates the Dify intelligent query mechanism, enabling natural language interaction capabilities and significantly reducing operational barriers for non-technical managers.

The results indicate that the proposed platform effectively enhances real-time monitoring efficiency and significantly reduces non-productive energy waste through quantitative analysis and intelligent scheduling.

This study not only provides a cost-effective digital transformation model for SMEs but also demonstrates the practical value and scalability of integrating artificial intelligence with sustainable ESG governance.

K260083

NeuroSEM-CB: A Bounded Monotone Bottleneck Framework for Interpretable Ordinal Risk Assessment in Autonomous Systems

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Keywords: bounded ordinal regression, monotone neural networks, interpretable bottleneck, autonomous systems, risk assessment

Abstract:

This paper presents NeuroSEM-CB as a bounded monotone bottleneck framework for in-terpretable ordinal risk assessment in autonomous systems. The model maps predictors to a low-dimensional mediator, transforms the mediator into a latent risk score, and uses a bounded ordinal head to keep predictions within a valid range. The method is evaluated against ordinary linear regression on three public tabular benchmarks. Linear regression achieves lower RMSE and MAE, whereas NeuroSEM-CB achieves 0.00% out-of-rang pre-dictions and 0.00% mediator-level monotonicity violations in the recorded computational diagnostics. The contribution is a traceable decision-support framework for structural va-lidity, not a state-of-the-art accuracy claim.

K260084

Differences in Recreational Perspectives Among Various Types of Outdoor Experiential Activities: The Case of Meinong Lake

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Keywords: Meinong Lake, Outdoor Experiential Activities, Recreational. Perspectives

Abstract:
The study primarily examines differences in recreational perspectives among participants engaged in various types of outdoor experiential activities at Meinong Lake. Using a questionnaire survey, the study employed recreational perspectives, activity satisfaction, and recreational dimensions such as ecology, environmental, social and management dimensions as research tools. A total of 130 questionnaires were collected, and statistical analyses including descriptive statistics, reliability and validity, one-way ANOVA, t-tests, and correlation analysis. The results revealed that participants were predominantly male, with the majority aged 21-30; most were out-of-town visitors; visit frequency was predominantly occasional; and recreational motivations were primarily concentrated in the three major categories of "relaxation," "nature," and "family," accounting for over 70% in total. Attitudes toward recreation were generally positive, with high levels of agreement regarding ecological, management, and social issues. No significant differences were found in recreational attitudes based on gender, age, visitor status, or frequency of visits; recreational attitudes revealed no significant differences in motivations regarding the ecological/environmental and social dimensions. However, significant differences were found in the management dimension. Regarding satisfaction, significant differences were observed by gender, while no significant differences were found in the other dimensions.

All satisfaction dimensions showed highly significant positive correlations with one another. Overall, respondents held highly positive attitudes toward the ecological value, management quality, and social functions of Meinong Lake, indicating that the lake performs well in recreational, environmental, and social aspects.

K260086

AMELIE: AI Agent for Multimodal Empathic LLM-based Interactive Exchange

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Keywords: conversational agent, affective computing, emotion recognition, large language models, human-computer interaction

Abstract:

Conversational agents are increasingly used in assistive and therapeutic contexts, where privacy, trust, and emotional responsiveness are critical. Yet many avatar-based systems rely on cloud infrastructure and respond primarily to speech, limiting their ability to adapt to users' non-verbal affective states. This paper presents AMELIE (AI Agent for Multimodal Empathic LLM-based Interactive Exchange), an embodied conversational agent framework that integrates speech, language, vision, and facial animation within a modular pipeline. Speech is transcribed in real time through an automatic speech recognition (ASR) module, processed by a locally hosted large language model (LLM) guided by structured prompting, and rendered as voice output through text-to-speech (TTS) synthesis with synchronized facial animation. Emotional context is derived from live webcam frames through a local vision module that combines face detection with facial emotion recognition using a convolutional neural network (CNN). The estimated affective state is fused with transcribed dialogue as a soft contextual signal, enabling the agent to adapt response tone, conversational pacing, and avatar expression. Additional features include persistent user profiles, session logging, automatic conversation summaries, hands-free turn-taking, and interchangeable local backends for speech, language, voice, and emotion recognition. This fully local inference architecture supports deployment in privacy-sensitive settings while sustaining real-time multimodal interaction. The prototype demonstrates the feasibility of unifying affective computing, local AI services, and embodied avatar interaction in a coherent conversational system, offering a practical framework for utilizing emotionally context-aware agents within healthcare applications, intelligent educational platforms, and broader smart assistive technologies.

K260087

The Impact of Augmented Reality Virtual Try-On Assistive Technology on Consumer Behavioral Intention: An Empirical Analysis Based on the TAM Model

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Keywords: Augmented Reality (AR), Virtual Try-on, Technology Acceptance Model (TAM), Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Behavioral Intention

Abstract:

This study aims to investigate how Augmented Reality (AR) virtual try-on technology influences consumers' attitudes toward use and behavioral intentions through perceived usefulness (PU) and perceived ease of use (PEOU) within the Technology Acceptance Model (TAM). With the rapid development of digital technology, AR technology has become a key driver of digital transformation in the beauty industry. Particularly in the field of virtual try-on, its high interactivity and realism significantly enhance the consumer experience. Through an online questionnaire, this study collected 280 valid samples from consumers with AR try-on experience and utilized multiple regression for empirical analysis.

The empirical results indicate that the interactivity of AR-assisted try-on technology significantly and positively affects perceived usefulness and perceived ease of use, thereby enhancing attitudes toward use and behavioral intentions. Notably, perceived ease of use exerts a significant positive impact on attitudes toward use. Furthermore, this study demonstrates that within highly dynamic and realistic beauty-related contexts, the impact of perceived ease of use surpasses that of traditional e-commerce, emerging as the core driver of consumer decision-making.

K260088

AI-Driven Performance Prediction and Inverse Modeling for 8–12 GHz Ultra-Wideband Antennas

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Keywords: Ultra-Wideband (UWB), Machine Learning Regression, Decision Tree (DT), K-Nearest Neighbors (KNN), Random Forest (RF)

Abstract:

Modern wireless communication and high-resolution sensing systems demand compact, highly efficient antennas capable of operating across expansive frequency bands to support applications such as 5G, IoT, radar, and satellite communication. Ultra-Wideband (UWB) antennas are widely utilized for these applications due to their ability to cover a broad frequency range from 8 GHz to 12 GHz (fractional bandwidth >20%), enabling high data rate transmission and short-range, high-resolution sensing within the X-band. However, tuning geometric antenna parameters to meet precise performance requirements introduces significant design complexity. To address this challenge, this paper investigates the application of five distinct artificial intelligence (AI) and machine learning (ML) regression models: Decision Tree (DT), K-Nearest Neighbors (KNN), Random Forest (RF), XGBoost (XGB), and Artificial Neural Network (ANN) t predict the performance figures of merit (FOM) for UWB antennas. The regression models are trained using electromagnetic simulation data generated via Ansys HFSS. Beyond forward performance prediction, this paper utilizes parameter tuning and AI-based inverse modeling to synthesize desired performance metrics directly from target designs. The predictive and optimization capabilities of each model are evaluated and compared, ultimately providing optimal, data-driven parameter sets recommended for manufacturing and subsequent experimental validation.

K260089

Development of AR-Based Board Game for Biology and Environment Education

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Keywords: Board Game, Augmented Reality, STEAM Education

Abstract:

With the rapid advancement of information technology, mainstream education is gradually shifting toward technology literacy and interdisciplinary integration (STEAM Education). Instructional methods are no longer confined to traditional textbooks and text-based lectures. This study developed "Earth Guardian," an augmented reality (AR) integrated digital board game educational tool designed specifically for the "Biology and Environment" unit in the 6th-grade Natural Science and Life Technology curriculum. The curriculum follows a goal- and content-oriented approach, encompassing three core thematic units: "Water Pollution," "Air Pollution," and "Soil Pollution." To accommodate varying teaching equipment and venue constraints across different schools, the instructional material features a dual-track teaching mode. Instructors can either guide students through a traditional board game activity utilizing physical cards or implement digital board game teaching paired with tablet-operated AR applications (Apps).

During gameplay, students transform into earth guardians, utilizing strategic card play to comprehend the causes of environmental pollution and seek solutions. Research results indicate that the 3D stereoscopic models presented via AR technology effectively capture students' attention, break the spatial limitations of physical classrooms, and deepen their concrete understanding of various environmental education facilities and ecological protection structures. Furthermore, this project has achieved large-scale quantitative promotion across 10 elementary schools in Taiwan, collaborating with 10 in-service teachers and benefiting a cumulative total of over 500 student participants. This educational material has been proven to significantly enhance students' learning motivation, environmental conservation knowledge, and eco-awareness, while simultaneously cultivating critical thinking, teamwork, and problem-solving abilities. These outcomes fully validate the adaptability, feasibility, and educational value of this innovative instructional tool in practical teaching field environments.

K260090

Dual Mid-Frequency Adaptive DCT Watermarking for An-ti-Counterfeiting and Anti-Copying of Smart Tourism Image

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Keywords: Image watermarking, Dual mid.frequency DCT, Anti.counterfeiting, Anti.copying, Adaptive embedding, Human visual system, Copyright protection, Smart tourism im-ages

Abstract:

Digital image forgery and unauthorized duplication have become critical threats to copyright governance and product authentication, accelerated by advances in high-resolution scanning and printing technologies. Conventional single-band water-marking techniques struggle to achieve a balanced performance between resilience to common distortions and sensitivity to illegal replication. This study proposes a dual mid-frequency adaptive discrete cosine transform (DMF-ADCT) watermarking scheme tailored for anti-counterfeiting and anti-copying protection of smart tourism images. The method embeds robust copyright markers and sensitive anti-copying sig-natures into two independent mid-frequency sub bands of 8×8 DCT blocks, with an embedding strength adaptively regulated by human visual system (HVS) characteris-tics to optimize both transparency and distortion tolerance. Experimental results show that the proposed method maintains excellent visual quality with a peak sig-nal-to-noise ratio (PSNR) above 44 dB. It exhibits strong resistance to Gaussian noise, JPEG compression, filtering, and geometric transformations. Under Gaussian noise with variance 0.005, the normalized correlation (NC) remains above 0.92 and the bit error rate (BER) is below 0.08. The anti-copying detection accuracy reaches 98.3%. Comparative evaluations with LSB, standard DCT, and SVD-based watermarking demonstrate that DMF-ADCT outperforms existing approaches in terms of impercep-tibility, robustness, and anti-copying reliability.

K260091

Development of an IoT-Based Physiological Monitoring Platform for Edema and Cardiovascular Assessment

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Keywords: PPG, bioimpedance, SpO., IoT cloud, physiological monitoring, edema assessment

Abstract:

The research specializes in photoplethysmography (PPG) signal analysis, biomedical sensing integration, embedded system development, and IoT-based cloud transmission technologies. A non-invasive physiological monitoring platform has been developed based on Raspberry Pi 4 architecture and SpO_2 sensing modules. The platform supports continuous raw data acquisition, abnormal event detection, real-time alerts, and cloud synchronization for remote healthcare applications.

In addition to PPG monitoring, the system integrates bioimpedance analysis technology for the assessment of body fluid distribution and edema-related conditions. By combining physiological sensing with embedded computing and cloud connectivity, the platform enables continuous monitoring of cardiovascular and fluid status in clinical and home-care environments.

For physiological signal analysis, the research team has established expertise in Bland–Altman analysis, cross-correlation analysis, physiological feature extraction, and time-series data analytics. These analytical approaches facilitate the evaluation of signal reliability, physiological relationships, and longitudinal health trends. The integrated platform provides a foundation for intelligent healthcare systems, digital health applications, and AI-assisted physiological monitoring, particularly for patients with edema, cardiovascular disorders, and chronic disease management needs.

K260092

Enhancing Android App Testing through Static Broadcast Analysis and Dynamic Crawling

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Keywords: Android testing, Android crawler, static analysis, software testing

Abstract:

With the rapid growth of Android applications (Apps), user expectations for functional correctness, execution stability, and overall user experience have continued to rise. Consequently, developing effective and reliable automated testing techniques to im-prove software quality and reduce crash risks has become an important research topic in mobile software testing. To address this challenge, we previously developed ACE (Android CrawlEr), an automated testing tool capable of exploring an app's GUI and detecting crashes triggered by GUI interactions. However, ACE's heuristic-based dy-namic exploration approach has inherent limitations. Since it generates events solely from visible GUI widgets, it lacks awareness of Android system events and internal app state changes, leaving certain behaviors and functionalities unexplored. To overcome these limitations, this paper enhances ACE by integrating static data-flow analysis to extract BroadcastReceiver registration and broadcast transmission information from applications and automatically generate corresponding broadcast events. These events are dispatched during ACE's dynamic exploration process to explore additional app states and trigger functionalities that are unreachable through GUI interactions alone. In addition, this paper investigates the impact of different broadcast dispatch timings on exploration effectiveness. Experimental results demonstrate that the enhanced ACE can effectively analyze and trigger BroadcastReceivers, thereby improving code coverage during dynamic exploration of Android Apps.

K260093

Semantic‑Driven Intelligent Divination: A Hybrid NLP–RAG–LLM Framework with Knowledge Management Integration

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Keywords: Natural Language Processing, Retrieval.Augmented Generation, Large Language Models, Intelligent Divination, Voice Interaction

Abstract:

With the rapid development of the information industry and Taiwan's 2050 net-zero transition policies, the nation's industrial structure is increasingly oriented toward technology and sustainability. At the same time, declining birth rates and an aging population have reduced the workforce available for traditional religious practices and related cultural industries, posing new challenges to the preservation and transmission of religious heritage. This study focuses on the digital transformation of traditional divination-interpretation services and proposes an intelligent divination platform integrating Natural Language Processing (NLP), Retrieval-Augmented Generation (RAG), and Large Language Models (LLMs).

The system incorporates speech-to-text (STT) and text-to-speech (TTS) modules to support a complete voice-based interaction experience. Semantic embedding and topic-classification mechanisms enable the platform to generate context-aware interpretations tailored to users' prayer intentions. Additionally, a 3D jiaobei (moon-block) physics simulation is introduced to enhance ritual authenticity in the digital environmen. Experimental results demonstrate that the proposed system improves the accuracy of divination-topic classification and enables personalized interpretation generation based on both user queries and divination texts. Through knowledge-management mechanisms, the platform further externalizes and digitally preserves interpretive knowledge, offering a novel pathway for intelligent transformation within religious and cultural domains.

K260094

Edge Based Real Time Fall Detection Using YOLO11 Pose and Multi Feature Temporal Analysis

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Keywords: Fall Detection, Edge Computing, Pose Estimation, YOLO11 Pose, Skeleton Keypoints

Abstract:

Fall incidents frequently occur in environments such as elderly care facilities, hospitals, school campuses, and construction sites. Without timely detection and reporting, these events may delay medical intervention and increase the risk of severe injury. Conventional monitoring approaches—such as manual surveillance or wearable devices—are often limited by monitoring fatigue, user non compliance, and hardware constraints. To address these challenges, this study proposes a non contact, real time, and privacy preserving fall detection system.

The system adopts an edge computing architecture, deploying visual inference models on local devices such as Raspberry Pi units or personal computers. Using YOLO11 Pose, the system extracts human skeletal keypoints and performs temporal analysis through a sliding window mechanism. Multiple motion related features—including body inclination angle, height ratio, skeleton aspect ratio, velocity and acceleration variations, and prolonged inactivity after collapse—are integrated to distinguish true fall events from daily activities such as bending or sitting, thereby reducing false positives.

By completing fall detection and event notification directly at the edge, the proposed system minimizes the transmission and storage of raw video data, enhances response efficiency, and provides improved protection of personal privacy. The results demonstrate the feasibility of deploying lightweight, privacy aware fall detection solutions in real world environments.

K260095

Web‐Based Digital Twin Framework for 3D Spatial Navigation and Emergency‐Aware Indoor Management

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Keywords: Digital Twin, Floor Plan Analysis, Indoor Navigation, 3D Gaussian Splatting, Dynamic Evacuation Routing

Abstract:

This study proposes a Web based intelligent visual spatial navigation framework that transforms traditional PDF based architectural drawings—typically lacking spatial semantics and difficult to integrate with IoT systems—into interactive three dimensional (3D) digital environments. To address practical management needs in smart indoor spaces, the system architecture integrates five core functional modules. First, a Web 3D indoor navigation mechanism is developed to mitigate wayfinding difficulties and improve resource coordination. Second, CCTV video analytics are incorporated to provide real time information, dynamically mapping human density and environmental data onto a Digital Twin model. Third, an emergency aware routing module automatically generates evacuation paths based on real time hazard locations and crowd distribution. Fourth, a natural language interaction interface enables users to query IoT device locations or request navigation guidance conversationally. Fifth, 3D Gaussian Splatting and WebGL technologies are adopted to deliver lightweight, photorealistic 3D scenes directly within standard web browsers without requiring high end GPUs.

The proposed cross platform and highly interactive Digital Twin framework enhances situational awareness, operational efficiency, and disaster resilience in public or specialized indoor environments. The system demonstrates strong potential for deployment in smart buildings, transportation hubs, and safety critical facilities, contributing to the advancement of intelligent spatial management and resilient digital infrastructure.

K260097

Exploring the Differential Effects of AI-Supported Situated Learning on Entrepreneurship Education: Evidence from High- and Low-Motivation Students

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Keywords: Entrepreneurship Education, Artificial Intelligence (AI), Situated Learning, Learning Scaffolding

Abstract:

This study investigates the effects of integrating Artificial Intelligence (AI) tools into a situated learning framework on students' learning motivation and learning outcomes in an entrepreneurship practicum course. Drawing on Drucker's view that entrepreneurship is fundamentally a practice, this study designed an authentic entrepreneurial learning environment within a Micro-Entrepreneurship Management course to foster entrepreneurial thinking through real-world experiences.

To address the low learning motivation and achievement commonly observed in Taiwan's technological and vocational higher education sector, generative AI tools were incorporated as learning scaffolds to support students in business model development, brand storytelling, and visual identity design. An action research approach was employed, and students were categorized into high-motivation and low-motivation groups based on classroom observations. Quantitative and qualitative data were collected to evaluate learning processes and outcomes.

The findings indicate that the integration of entrepreneurial situational learning and AI tools significantly enhanced learning motivation and learning outcomes among highly motivated students.
In contrast, low-motivation students exhibited learned helplessness, cognitive defensiveness, and reduced self-confidence when facing the uncertainty inherent in entrepreneurial practice. However, they perceived AI tools positively, suggesting that AI can serve as an effective learning scaffold that lowers technical barriers to creative project implementation.

This study concludes that while AI tools can compensate for skill deficiencies and facilitate learning, they cannot fundamentally overcome motivational deficits or cultivate entrepreneurial mindsets. The findings challenge the optimistic assumption that AI integration universally improves learning outcomes and highlight learner motivation as a critical factor influencing the effectiveness of AI-assisted entrepreneurship education.

K260098

Interface Paradigm Revolution in UI X AI: Exploring the Future of Generative AI-Assisted Industrial Design Tools

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Keywords: Human-Computer Interaction (HCI), Interface Paradigm, Generative AI, Industrial Design Process, Visualized Parametric Control

Abstract:

This study explores the revolution of human-computer interaction (HCI) and interface paradigms within industrial design workflows through the lens of UI X AI. While current generative artificial intelligence (AI) tools accelerate early-stage ideation, their inherent operational opacity and stochastic nature (the "black box" effect) often present unpredictable bottlenecks. This instability poses a severe challenge for designers who must deliver high-quality proposals consistently under tight project deadlines. To address this critical pain point, this research forms a dedicated core research group of nine master's students to investigate stable and visual parametric workflows. Through collaborative synergy and synthesis of diverse user insights, the group aims to reframe random prompt-based generation into a structured, controllable visual interface blueprint.

Methodologically, this project relies on qualitative focus group insights and synthesis analysis developed by the nine-member research group. Possessing strong backgrounds in professional design and software prototyping, these researchers deeply deconstruct cutting-edge node-based and canvas-editor interfaces (such as ComfyUI or Vizcom). Utilizing electronic product archetypes—including home appliances and information/communication technology (ICT) products—the group systematically analyzes the evolutionary trajectory toward visually parameterized interfaces, evaluating them across dimensions of interface visibility, operational transparency, and output controllability.

The primary contribution of this study lies in its synthesis of collective intelligence, proposing a novel framework for the "UI X AI Industrial Design Interface Paradigm Revolution." The findings demonstrate that shifting the generative paradigm toward a visually parameterized control stream effectively mitigates output uncertainty, ensuring design stability under intense time constraints. These insights provide essential theoretical foundations and actionable design guidelines for next-generation AI-assisted professional design tools.

K260099

Solar-powered venetian blind with automatic angle adjustment

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Keywords: Solar panel, Venetian blind, D'Arsonval movement principle

Abstract:
This study researches automatic angle adjustment for venetian blinds. Utilizing the power supply and photo sensing capabilities of solar panels, and combining this with the D'Arsonval movement principle, a solar-powered venetian blind with automatic angle adjustment is proposed, eliminating the need for traditional electricity.

The solar panel serves as the power source for the motor in this system. Based on the D'Arsonval principle, the motor replaces the permanent magnet and movable coil in the device, and the venetian blinds replace the pointer. The motor drives the venetian blinds, and a braking device is designed to regulate the motor's driving torque. When the driving force and braking force reach equilibrium, the motor stops rotating, and the venetian blinds stop rotating accordingly.

Because the solar panel itself is composed of multiple photodiodes, it inherently functions as a photo sensor, generating different amounts of electricity based on the intensity of sunlight. The electrical energy supplied to the motor also changes according to the intensity of sunlight. In this way, the venetian blinds automatically adjust their angle based on the intensity of sunlight, improving the inconvenience of manual adjustment.

In addition, a microcontroller was used to automatically adjust the angle of the blinds every 15 minutes. Due to the instability of sunlight intensity, a buck-boost converter was designed in this study to provide a stable voltage to the microcontroller.

The proposed method has the following advantages: 1. The power is entirely provided by solar panels; 2. Solar panels are used as sensors; 3. The operation is simple. This system effectively solves the inconvenience of manual adjustment, achieving energy saving and carbon reduction. Moreover, compared to other motorized blinds that use mains power or batteries and require additional illuminance sensors, it is more efficient and less expensive.

K260100

Design and Pilot Validation of a Virtual Reality Art Activity Module for Emotional Expression and Spatial Interaction

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Keywords: virtual reality, Art Activity Design, Emotional Expression, Spatial Interaction, Heart Rate Variability

Abstract:

This study designs and tests a virtual reality (VR) art activity module for university students' emotional expression, spatial interaction, and creativity. The module addresses learning pressure, emotional stress, limited nonverbal expression, and lack of physical activity. Interviews with counseling professionals highlighted Generation Z students' challenges: identity formation, peer relationships, emotional regulation, and academic stress. These insights were used to structure the VR art activities.

The module uses expressive art concepts, turning points, lines, and planes into VR tasks. With Open Brush and a Meta Quest 3S headset, users create in 3D space using hand controllers and body movement. The design enables nonverbal emotional expression, spatial perception, and physical engagement. VR art creation is presented as an interactive process combining emotion, space, and movement.

Pilot validation used pre- and post-activity questionnaires, physiological data, and operational observation. Heart rate data were recorded with a Polar H10 sensor, with heart rate, SDNN, and RMSSD as observationa indicators. Results showed that heart rate increased during the VR activity by 2.76 beats per minute ($p = .025$), while SDNN decreased by 13.05 ms ($p = .006$), suggesting physiological arousal, attention engagement, or task load. After the activity, heart rate decreased by 2.35 beats per minute ($p = .012$), while SDNN increased by 32.39 ms ($p = .001$), indicating recovery in autonomic variability. RMSSD decreased during the activity and increased after the activity.

This study contributes a feasible VR art activity module integrating emotional expression, spatial interaction, and bodily engagement. It also demonstrates the practicality of combining questionnaires, heart rate data, and operational observation in early-stage VR activity design. The findings support future applications in education, emotional support, and human-computer interaction research.

K260101

MCL-USFM: Foundation Model with Mutual-Channel Loss for Enhanced Breast Ultrasound Classification

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Keywords: Deep learning, Computer-aided diagnosis, Breast tumor, Foundation model, Mutual-channel loss

Abstract:

The incidence of breast cancer remains consistently high, making early diagnosis crucial. However, the interpretation of traditional ultrasound images relies heavily on physicians' experience, which is not only time-consuming but also carries the risk of misdiagnosis. AI-assisted diagnosis can effectively improve interpretation efficiency, reduce misdiagnosis rates, and provide a second opinion for physicians, thereby alleviating the medical burden. This study proposes an architecture based on a Foundation Model combined with a Mutual-Channel Loss for the task of breast tumor ultrasound image classification. The research utilizes the USFM, pre-trained on massive data, as the foundation model. It is fine-tuned and tested using the Breast Ultrasound Images Dataset (BUSI), which covers three clinical categories: normal, benign, and malignant. Through transfer learning, this approach effectively mitigates the common issues of class imbalance and data scarcity in medical imaging, while enhancing the model's generalization capability across different patients and ultrasound machines. Experimental results demonstrate that the proposed method achieves outstanding performance, specifically yielding 85.5% in Accuracy, 85.7% in Precision, 86.5% in Recall, and 85.6% in F1-score. Furthermore, our approach significantly outperforms traditional baseline models, demonstrating a substantial improvement over baseline models, including VGG16 (67.8%) and ResNet50 (81.2%).

K260102

The Forming Mechanism and Parameter Effects of Bamboo Fiber-Based Plastic-Free Materials in FDM Printing

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Keywords: Bamboo Fiber, Plastic-Free Material, Sustainable 3D Printing, FDM, Forming Conditions

Abstract:

With the widespread application of 3D printing in manufacturing, education, and design, conventional materials remain predominantly plastic-based filaments such as PLA. Although PLA is partially bio-based, its limited degradation in natural environments restricts its sustainability. This study therefore developed a plastic-free sustainable 3D printing material using bamboo fiber as the primary raw material, combined with a bio-based binder and natural plasticizing system, aiming to provide a greener alternative to traditional plastic filaments. The material was prepared by compounding bamboo fiber, bio-based binder, and natural plasticizer via twin-screw extrusion at 150–180°C into filament or pellets. FDM printing tests were conducted under varying nozzle temperatures, printing speeds, and layer heights, with evaluation criteria including forming success rate, surface quality, structural integrity, and soil degradation performance. Results showed that the bamboo fiber-based plastic-free material achieved basic printability, and that both material formulation and printing parameters significantly affected forming stability and surface quality. Appropriately increasing nozzle temperature improved flowability and interlayer bonding, while excessively high temperatures caused thermal degradation. Overall, this study demonstrates the processing feasibility and sustainability potential of the developed bamboo fiber-based plastic-free 3D printing material, offering valuable references for future plastic-free filament development.

K260103

Quantitative Evaluation of Biochar Yield and Combustion Performance in a TLUD-Based Biochar Burner

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Keywords: Agricultural Waste, TLUD Combustion, Biochar Yield, Burning Rate, Theoretical Power Output

Abstract:

Agricultural residues generated from vineyard pruning are commonly treated through open burning, which may cause environmental pollution and waste of biomass resources. This study developed and experimentally evaluated a top-lit updraft (TLUD)-based biochar burner for converting grapevine pruning residues into biochar. The burner configurations were systematically modified by adjusting primary air inlet design, secondary air inlet design, combustion chamber height, and integrated structural optimization. Three quantitative indicators, including biochar yield, burning rate, and theoretical power output, were adopted to evaluate carbonization performance and combustion behavior.

Experimental results showed that TLUD I and TLUD II failed to sustain stable combustion and produced no measurable biochar. TLUD III improved combustion stability after introducing secondary air inlets; however, the biochar yield remained low at 4.29% because of excessive combustion intensity. TLUD IV further improved carbonization performance by increasing combustion chamber height, achieving a biochar yield of 25.14%. The final prototype integrated optimized airflow configuration, combustion chamber geometry, and a double-layer thermal insulation structure, resulting in the highest biochar yield of 44.43% and stable combustion duration exceeding 3600 s.

The relationship analysis among burning rate, theoretical power output, and biochar yield demonstrated that higher combustion intensity did not necessarily improve carbonization efficiency. Instead, slower and more stable low-oxygen combustion conditions were more favorable for biochar production. The proposed TLUD biochar burner provides a practical approach for agricultural waste valorization and decentralized biomass carbonization applications.

K260105

Design of a Mobile Augmented Reality-Based Visualization System for Traditional Spatial Geomancy (Feng Shui)

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Keywords: Augmented Reality, Spatial Visualization, Feng Shui, Information Architecture

Abstract:

Feng Shui is an ancient wisdom in Eastern traditional culture involving geographic principles and spatial layout. It continues to exert a profound influence on modern interior and environmental design. However, its profound ideological theories and abstract spatial concepts impose a substantial cognitive load on novices. To address this challenge, this study describes the design and implementation of a Mobile Augmented Reality (AR)-based visualization system for traditional spatial geomancy. The system architecture uses the Unity engine and Vuforia AR framework based on the spatial core theories of "Macro-Taiji" and "Micro-Taiji." The core design of the system comprises three primary modules. First, the Spatial Positioning and Guidance Module leverages the mobile de-vice's built-in gyroscope to calibrate the central reference point and main entrance ori-entation of a physical room. Second, the Geomantic Orientation Algorithm and Real-time Rendering Module dynamically computes and overlays specific geomantic positions and the Five Elements attributes onto the physical environment based on orientation te-lemetry. Third, the Dynamic Object Preview and Contextual Interaction Module trans-forms abstract jargon into intuitive 3D item indicators with accessible graphical descrip-tions of residential taboos. This paper presents the initial prototype development and preliminary proof-of-concept verification. The results indicate that the mobile AR ap-proach effectively converts abstract cultural knowledge into concrete spatial interactions. The proposed system design methodology offers a practical blueprint for digital cultural heritage preservation and contextual information visualization using emerging media technologies.

K260106

Finger-Count Gesture Control for Omnidirectional Mobile Robot with Edge-Host Decoupled Architecture and Dependable Failsafe Design

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Keywords: Telepresence Robotics, Hand Gesture Recognition, Edge Computing, Omniwheel Robot, Dependable Systems

Abstract:

Remote telepresence control of mobile robots in constrained environments demands low-latency command pipelines, intuitive human-machine interfaces, and dependable failsafe mechanisms. However, existing systems either rely on resource-intensive onboard AI or physically taxing gesture modalities that induce upper limb fatigue in operators. This ergonomic fatigue, caused by holding an arm outstretched without support for extended periods, is a well-documented barrier to sustained gesture interface adoption.

This paper presents an Edge-Host Decoupled architecture for a six-directional omnidirectional vehicle based on omniwheels, deployed on an extremely resource-constrained Raspberry Pi 1 Model B+ (700 MHz, 512 MB RAM). All AI inference is offloaded to a host machine running Google MediaPipe, which maps single-hand finger-count micro-gestures — performed with the arm resting flat on a surface — to holonomic motion commands (forward, backward, left, right, clockwise, counter-clockwise). A latch-state machine locks each command after three consecutive confirmation frames, allowing the operator to remove their hand entirely while the vehicle continues executing the manoeuvre. Dependability is enforced by a UDP watchdog that autonomously halts the vehicle within 533 ms of communication loss.

Experimental evaluation demonstrates a gesture recognition accuracy of 98.1% across eight gesture classes and an end-to-end command latency of 1260 ms. The proposed system proves that dependable, zero-fatigue telepresence control is achievable even on decade-old edge hardware. The mobile base is designed as the locomotion layer for integration with robotic arm systems, targeting industrial logistics and inspection applications.

K260107

Deep Learning-Based Intelligent Underwater Receiver Design for Unmanned Underwater Vehicle Acoustic Communication System

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Keywords: Orthogonal Frequency Division Multiplexing (OFDM), Demodulation, Underwater Acoustic Communication, Deep Learning, Transfer Learning

Abstract:

Severe multipath propagation, refraction, and ambient noise pose critical challenges to underwater acoustic (UWA) communication, causing conventional equalizers to yield substandard demodulation performance. This paper introduces a hybrid deep learning architecture, combining a Dilated Convolution Attention Residual Network with Long Short-Term Memory (DCARN-LSTM), for robust UWA channel estimation and equalization. The DCARN employs dilated convolutions to broaden the feature extraction receptive field without increasing parameter complexity, utilizing attention mechanisms and residual paths to optimize feature selection and stabilize training, while the LSTM captures signal temporal dependencies. Additionally, transfer learning is integrated to facilitate cross-oceanic adaptability. Validated on the WATERMARK benchmark and five real-world environmental datasets, the DCARN-LSTM outperforms traditional methods by 87.3%–89.0% at a 30 dB SNR. Experimentally, it achieves a bit error rate (BER) of 1.76×10^-3, marking an 81.1% reduction compared to conventional equalizers 9.31×10^-3. The model exhibits strong generalization, adapting rapidly to unseen environments with sparse data, thereby presenting a robust solution for high-fidelity UWA communication.

K260108

Influence of Barrier Structures on DC and RF Performance of GaN HEMTs on SiC Substrates

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Keywords: InAlN/GaN, AlGaN/GaN, RF-HEMT, GaN on SiC substrate, Electron beam lithography (EBL)

Abstract:

This study investigates the DC and RF characteristics of InAlN/GaN and AlGaN/GaN high electron mobility transistors (HEMTs) fabricated on SiC substrates using a 100 nm T-gate process. The influence of different barrier structures on device performance is comparatively analyzed. Experimental results show that the InAlN/GaN HEMT achieves a higher maximum drain current density of 1628 mA/mm and a lower ON-resistance of 2.5 Ω·mm. In RF measurements, the device exhibits superior high-frequency performance, with a cutoff frequency (fT) of 50.1 GHz and a maxi-mum oscillation frequency (fmax) of 71.7 GHz. Although the AlGaN/GaN device demonstrates slightly higher transconductance and a smaller subthreshold swing, its RF performance remains comparatively lower. The enhanced RF characteristics of the InAlN/GaN device are attributed to stronger polarization-induced carrier confinement and improved two-dimensional electron gas (2DEG) formation. These results highlight the importance of barrier engineering for optimizing GaN HEMTs in high-frequency applications.

K260110

Investigating Data, Label, and Control Failure Modes in An-ti-Money Laundering Machine Learning Systems

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Keywords: Anti-Money Laundering, detection model, reproducible benchmark framework

Abstract:

Anti-Money Laundering (AML) machine learning models are increasingly deployed to detect suspicious transactions; however, their reliability is highly sensitive to data in-stability, evolving typologies, and operational control changes. Despite regulatory emphasis on model validation, there is limited systematic research on how specific failure modes affect AML model performance and alert stability. This study proposes a reproducible benchmark framework that categorizes and empirically evaluates critical data, label, and control failure modes in AML machine learning systems. Using syn-thetic transaction datasets (AMLSim and PaySim), controlled perturbations are intro-duced, including feature distribution drift, schema changes, delayed or noisy labels, class imbalance shocks, and threshold modifications. A baseline AML detection model (e.g., Logistic Regression and XGBoost) is evaluated under each failure condition. Per-formance degradation, alert volatility, ranking instability, and operational workload impact are quantitatively measured. The study contributes (1) a structured taxonomy of AML model failure modes, (2) a reproducible experimental benchmark for valida-tion research, and (3) empirical evidence identifying which failures most severely af-fect detection reliability. The findings provide a foundation for developing automated assurance mechanisms and improving governance practices in AML analytics.

K260111

Automated Assurance Metrics for Detecting Stability and Performance Degradation in AML Machine Learning Models

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Keywords: Anti-Money Laundering (AML), Machine Learning, Model Assurance, Performance Degradation Detection, Model Monitoring

Abstract:

The reliability of Anti-Money Laundering (AML) machine learning models extends beyond predictive accuracy, requiring continuous monitoring of stability, operational impact, and model behavior under changing conditions. However, current validation practices largely rely on traditional performance metrics and ad hoc analyses, which fail to capture early signs of model degradation. This study introduces a novel set of automated assurance metrics designed to detect performance instability and operational risks in AML machine learning systems.

Building on a controlled experimental framework, the study evaluates model behavior under simulated failure conditions, including data drift, label delay, and class imbalance changes. In addition to standard evaluation metrics, the proposed framework introduces assurance-oriented indicators such as Alert Stability Index, Investigator Workload Risk Score, False Positive Cost Proxy, and segment-level coverage measures. These metrics are designed to quantify the practical impact of model behavior on AML operations.

Experimental results demonstrate that the proposed assurance metrics can identify degradation patterns that are not captured by traditional metrics alone, providing earlier and more actionable insights into model performance issues. The study contributes a structured and reproducible approach to AML model monitoring, bridging the gap between machine learning evaluation and operational risk management in financial crime systems.

K260112

A Simulation Game–Based 3D Training System for Postpartum Care Using Blender and Unity in Nursing Education

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Keywords: Nursing education, 3D modeling and simulation, Unity engine, Blender modeling, Virtual training environment

Abstract:

Although traditional textbook-based instruction in nursing education provides essential theoretical foundations, it fails to effectively replicate the real-world pressures and challenges of clinical environments. Moreover, practical nursing training is often constrained by limited facilities and equipment, restricting students' opportunities to acquire sufficient hands-on experience. This study, conducted in collaboration with the Department of Nursing, presents the design of a simulation game–based software system for postpartum care training. The software enables nursing students to practice and assess their clinical skills anytime and anywhere. Using Blender, the required 3D models were created and imported into Unity to simulate realistic postpartum ward scenarios. The complete postpartum care procedures provided by the Department of Nursing were integrated into the game, which includes three primary modules: umbilical cord care, breastfeeding in a sitting position, and breastfeeding in a lying position. Each module offers two modes: a learning mode, which allows users to practice either as beginners or with some prior knowledge, and an assessment mode, which requires users to perform procedures without prompts. The assessment mode evaluates performance based on the correctness of detailed operations, thereby measuring students' proficiency in postpartum nursing practices. Furthermore, the game's design emphasizes intuitive and easy-to-follow steps, aiming not only to support nursing education but also to help new parents learn essential neonatal care techniques.

K260114

An Applied Generative AI Instructional Design Platform for Pre-service Teachers: System Architecture and Quantitative Evaluation

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Keywords: Teacher education, Instructional design platform, Verification-by-design, Learning analytics, Generative AI

Abstract:
Pre-service teachers increasingly use generative AI (GenAI) for lesson planning and content creation, but unstructured use may cause pedagogical misalignment, unverifiable claims, privacy risks, and over-reliance. This paper presents the Generative AI Instructional Design Platform (GAIDP), which positions GenAI as a bounded co-designer within a structured instructional de-sign workflow. GAIDP integrates constructive alignment, claim verification and evidence tagging, role-based AI support, governance guardrails, and learning analytics for iterative improvement. The platform architecture includes client interfaces, an API gateway, LLM orchestration, veri-fication/alignment services, an evidence layer, and analytics. A quantitative evaluation protocol assesses lesson quality, alignment, responsible use, and self-efficacy.

K260115

A Comparative Study of LLMs and FinBERT for Sentiment Analysis of Chinese Cryptocurrency News Headlines

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Keywords: Sentiment Analysis, Large Language Models (LLMs), Cryptocurrency News, LoRA Fine-Tuning

Abstract:

Sentiment analysis in the cryptocurrency sector is significantly challenged by a scarcity of labeled Chinese data and the prevalence of promotional noise. In Chinese crypto-news, headlines frequently employ ostensibly bullish terminology that lacks substantive market impact, leading to a phenomenon of "subjective-neutral ambiguity." This study addresses these issues by proposing a parameter-efficient fine-tuning (PEFT) approach using Low-Rank Adaptation (LoRA) on 1B-parameter Large Language Models (LLMs). A centra objective of this research is to evaluate the distinct operational scopes of specialized encoders and versatile decoders, justifying a comparative analysis between domain-specific BERT variants and modern LLMs (Gemma-3-1B and Llama-3.2-1B). We curated a human-annotated data set derived from a corpus of 50,500 headlines from cnyes.com to benchmark performance across various configurations. Experimental results demonstrate that while base models achieve low accuracy (below 41%), supervised fine-tuning effectively re-calibrates decision boundaries. In particular, the Llama-3.2-1B-LoRA (all-module) model achieved 84.17% precision, while the specialized FinBERT reached 86.33%. Specifically, LLMs leverage their expansive context windows to maintain thematic coherence across long-form financial reports, a task where fixed-length encoders typically struggle. This study provides a technical blueprint for selecting sentiment analysis architectures based on specific market needs, highlighting that tuning the entire transformer backbone via LoRA is essential for capturing complex linguistic nuances in resource-constrained environment.

K260116

Doppler-Based Direction Sensing in an Biological Excitable Medium

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Keywords: mobile molecular communication, Doppler effect, mobility, excitable medium

Abstract:

In mobile molecular communication, a mobile receiver must infer the direction of a sender from molecular signals in order to approach the sender. In a Doppler-based direction-sensing scheme, the sender emits periodic pulses, and the receiver exploits the shortening of the observed inter-pulse interval as it moves toward the sender [1]. Previous work evaluated the scheme using an idealized pulse field, in which concentric annular pulses propagate at a constant speed. However, the previous work omits the nonlinear propagation properties of biological signaling waves. Here, we replace the geometric pulse-field model with traveling waves generated by an excitable medium. These waves exhibit curvature-dependent propagation speed, refractory recovery, and wavefront annihilation. Therefore, the effective inter-pulse interval and propagation speed observed by the receiver are no longer constant. We evaluate the Doppler-based direction-sensing scheme under these more realistic signaling conditions and characterize its operating regime as a function of medium excitability and noise level.

K260117

Design and Evaluation of Biomimetic Visual Cues for Continuous Risk Communication in P-HUD Warning Interfaces: An Exploratory Eye-Tracking Study

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Keywords: panoramic head-up display, biomimetic visual cue, continuous risk communication, highway back-of-queue, eye tracking

Abstract:

This study explores whether biomimetic visual cues can support continuous risk communication in a panoramic head-up display (P-HUD) warning interface for highway back-of-queue scenarios. Unlike conventional binary warnings, queue-related hazards develop progressively and require drivers to interpret changing risk levels over time. To address this issue, this study designed a Biomimetic P-HUD that translates gradual risk changes into dynamic visual cues inspired by biological warning and attention-guiding patterns.

An exploratory within-subject A/B evaluation was conducted with nine participants, who sequentially experienced a Binary P-HUD and a Biomimetic P-HUD. Gaze behavior was recorded using a Gazepoin GP3 eye tracker, and heatmaps, AOI-based eye-tracking metrics, NASA-TLX ratings, and post-task interviews were analyzed.

The descriptive results suggest that the Biomimetic P-HUD may help participants orient attention toward the hazard area earlier, increase attention to the warning area, and use the Biomimetic Cue Area as a secondary confirmation signal for changing risk. Participants also reported lower subjective workload, suggesting reduced effort in interpreting warning information.

These findings provide preliminary evidence that biomimetic visual cues may complement conventional alerts by supporting progressive risk perception, attentional orientation, and warning confirmation. Given the small sample size and fixed condition order, the results should be interpreted as exploratory and require further validation with counterbalanced experiments, larger samples, and driving performance measures.

K260118

Mitigating Digital Anxiety in Green Governance: How Digital Citizenship and FoMO Shape Renewable Energy Acceptance

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Keywords: Renewable Energy Acceptance, Digital Citizenship, Fear of Missing Out (FoMO), Green Governance, Psychological Resilience

Abstract:

Background: The transition to renewable energy is a crucial path toward achieving Sustainable Development Goals (SDGs) and net-zero emissions. However, in the contemporary digital transformation landscape, public discourse surrounding energy policies has largely shifted to social media, creating a highly volatile information environment. Information overload regarding regional energy infrastructures often induces a unique psychological anxiety among digital citizens—specifically, the "Fear of Missing Out" (FoMO) on policy updates or social trends—which may severely hinder rational policy consensus and social acceptance.

Purpose: Grounded in socio-technical governance and psychological resilience perspectives, this study investigates how individual digital citizenship serves as a protective factor to alleviate digital anxiety (FoMO), foster constructive civic participation behaviors, and ultimately enhance social acceptance of the renewable energy transition.

Methods: This study adopts a quantitative survey research design. An online questionnaire will be administered to adult social media users in Taiwan who actively engage with public or environmental issues. Structural equation modeling and bootstrapping methods will be utilized to analyze the valid responses to validate the sequential mediating mechanisms of FoMO and civic participation between digital citizenship and renewable energy acceptance.

Results & Contributions: It is hypothesized that higher levels of digital citizenship (knowledge, health, and ethics) will significantly reduce policy-related FoMO. Reduced anxiety, in turn, will positively drive constructive civic participation behaviors, which subsequently increase social acceptance toward regional green energy projects. This research bridges the academic gap between digital psychology, public well-being, and environmental governance. The findings will provide practical insights for governments and energy industries to design digitally-friendly public participation platforms, optimize citizens' digital mindsets, and foster public support for sustainable transition goals.

K260120

Effects of an AI-Integrated Smart Learning Environment on Students' Learning Outcomes in Climate Change Education

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Keywords: Smart learning environment, smart technology applications, AI educational robot, climate change education, gamified learning

Abstract:

Taiwan is increasingly affected by extreme weather events such as typhoons, droughts, heatwaves, and heavy rainfall. However, climate change education is often delivered through traditional lectures, limiting student engagement and contextualized learning. To address this issue, this study developed a smart learning environment integrating an AI educational robot with board game-based learning to enhance students' learning achievement, motivation, and climate change adaptation literacy.

A mixed-methods approach was adopted. Based on expert consultation and literature review, an educational board game, Guardians of Mountains and Seas, was designed to teach climate change, renewable energy, and extreme weather adaptation. The AI educational robot provided image recognition, multimedia learning materials, interactive questioning, and real-time feedback. Participants were middle- and upper-grade elementary school students from urban and suburban schools. The experimental group learned through the AI-integrated smart learning environment, while the control group used the board game alone. Data were collected through achievement tests, motivation scales, adaptation literacy questionnaires, and interviews.

Results showed that the experimental group significantly outperformed the control group in learning achievement, motivation, and adaptation literacy. Real-time interaction, personalized feedback, and multimedia support promoted deeper understanding and greater engagement. Most post-test results showed no significant differences across school locations or grade levels, indicating the approach's applicability to diverse learners. Students with lower initial motivation also demonstrated notable improvement after interacting with the AI educational robot.

These findings suggest that AI-integrated smart learning environments can effectively support climate change education and foster adaptation literacy. The study highlights the potential of smart technology applications to create engaging, scalable, and learner-centered learning experiences.

K260121

Home-Based Parenting Guidance Work from an International Perspective

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Keywords: child protection, home-based parenting empowerment, parenting facilitators, home-based parenting guidance, family support services

Abstract:
Article 64 of Taiwan's Children and Youth Welfare and Rights Protection Act stipulates that local governments shall develop family intervention plans for child protection cases, including parenting education services. However, current parenting support programs implemented by local governments in Taiwan primarily focus on counseling services for perpetrators or general parenting education courses. Comparatively few programs provide home-based parenting guidance services, and most interventions continue to rely on one-way instructional approaches rather than collaborative and relationship-based models.

This study employed a literature review method to examine the implementation and characteristics of home-based parenting guidance programs across different countries. The review focused on publications published between 2020 and 2024 and covered six continents, excluding Antarctica, including North America, Latin America and the Caribbean, Oceania, Europe, Africa, and Asia. A total of 54 studies from 14 countries were identified. After excluding 23 studies that did not align with the research focus, 31 articles were included in the final analysis.

The findings revealed several key characteristics of home-based parenting guidance programs: (1) the integration of multidisciplinary professionals, (2) diversified home-visiting approaches, (3) flexible service intensity and duration, and (4) theory-driven intervention frameworks. In addition, notable differences were identified in the composition of professional teams, the age range of service recipients, and modes of service delivery across countries and programs.
The review also identified several innovative practices with potential implications for child protection and family support services, including the《Veo Veo》monthly magazine, PIM radio broadcasting segments, interactive puppet theater interventions, and internationally recognized Endorsed® certification systems.

Based on the findings and the researchers' observations, this study provides recommendations for future research and policy development related to child protection, parenting empowerment, and home-based family support services in Taiwan.

K260122

A Study on Critical Design Factors of Adaptive Sports Equipment for University Students with Disabilities Using AHP

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Keywords: Adaptive Sports Equipment, Students with Disabilities, Adaptive Physical Education, Analytic Hierarchy Process, Design Factors

Abstract:

This study applies the Analytic Hierarchy Process (AHP) to identify the critical design factors of adaptive sports equipment for university students with disabilities. Based on literature review and expert evaluation, four dimensions and twelve factors were established. The results indicate that Equipment Design Perspective is the most important dimension, while Safety, Participation Motivation, Physical Function Improvement, Teaching Effectiveness, and Ease of Operation are the most critical factors. The findings provide practical guidance for adaptive physical education instructors, educational institutions, and equipment developers in designing and implementing adaptive sports equipment.

K260123

A Study on Critical Needs of Sports Participation Equipment for University Students with Disabilities Using

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Keywords: Students with Disabilities, Sports Participation Equipment, Adaptive Physical Education, Analytic Hierarchy Process, Needs Assessment

Abstract:

This study applies the Analytic Hierarchy Process to identify the critical needs of sports participation equipment for university students with disabilities. Based on literature review and expert evaluation, four dimensions and twelve factors were established. The results indicate that Physical Needs Perspective is the most important dimension, while Safety Protection, Functional Adaptability, Self-Confidence Enhancement, Participation Motivation, and Skill Development are the most critical needs. The findings provide practical references for adaptive physical education and sports participation equipment development.

K260124

Mechanical Improvement of Cu Joints by Thermal Annealing

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Keywords: Cu direct bonding, thermal annealing, nanotwinned Cu, molecular dynamics

Abstract:

Cu-to-Cu direct bonding technology has attracted a lot of attention in the advanced packaging industry due to its low thermal budget and fine pitch interconnects. In this study, the effect of thermal annealing on the mechanical improvement of Cu joints is investigated using molecular dynamics simulations. The simulation results show that for a nanotwinned Cu (NT-Cu) pair with smooth surfaces, a modest increase in interference amount during the bonding process can improve bonding strength. The more compressive stress accumulates during the bonding process, the more residual compressive stress is released through the annealing process. The annealing process can generally improve the strength of bonded NT-Cu due to its promotion of structural recovery, and stress and potential energy relaxation.

K260125

Structural, Optical and Piezoelectric Properties of Gd-Doped ZnO Nanowires for Piezoelectric Nanogenerator Applications

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Keywords: ZnO, Nanowires, piezoelectric nanogenerator, energy harvesting

Abstract:

Gd-doped ZnO nanowires were successfully synthesized on indium tin oxide (ITO) glass substrates using a combination of a sol-gel-derived ZnO seed layer and a low-temperature chemical bath deposition (CBD) method. The effects of Gd incorporation on the structural, optical, and piezoelectric properties of ZnO nanowires were systematically investigated for nanogenerator applications. X-ray diffraction (XRD) results confirmed that all samples exhibited a hexagonal wurtzite structure with a preferred orientation along the (002) plane. No secondary phases were observed, indicating the successful incorporation of Gd ions into the ZnO lattice. The crystallite size and lattice parameters were calculated from the XRD patterns, revealing that Gd doping influenced the crystal structure and improved the crystallinity of the ZnO nanowires.

Scanning electron microscopy (SEM) analysis showed that the Gd-doped ZnO nanowires possessed a more uniform morphology and higher aspect ratio than those of the undoped sample. UV–Vis spectroscopy revealed that the optical bandgap increased from 3.196 eV for pure ZnO nanowires to 3.250 eV for $Zn_{0.995}Gd_{0.005}O$ nanowires, which was attributed to the Burstein–Moss effect resulting from the increased carrier concentration caused by Gd incorporation.

To evaluate their energy harvesting capability, the synthesized Gd-doped ZnO nanowires were employed as the active layer of a flexible piezoelectric nanogenerator (NG). The fabricated NG exhibited excellent electromechanical conversion performance and generated an output voltage of approximately 20 V under a gentle finger-tapping force of only ~0.01 kgf. The enhanced output performance was mainly attributed to the improved crystallinity, modified lattice structure, and enhanced polarization induced by Gd doping. These results demonstrate that Gd-doped ZnO nanowires prepared by a simple and cost-effective solution process are promising candidates for flexible nanogenerators, wearable electronics, energy harvesting systems, and self-powered sensing devices.

K260127

In-Vehicle Respiratory Rate Estimation via Seatbelt Displacement Sensing

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Keywords: In-vehicle health monitoring, Respiratory rate, Seatbelt displacement, Motion artifact compensation, CCD sensor

Abstract:

Real-time driver-state monitoring requires respiratory sensing methods that are unobtrusive, privacy-preserving, and robust under vehicle motion. Respiratory rate is a key indicator of driver fatigue and cognitive load. However, contact-based methods are sensitive to body posture, and non-contact methods face occlusion, noise, and privacy issues. Practical in-vehicle respiration monitoring thus remains an open problem. This paper presents an in-vehicle respiratory-rate estimation system based on seatbelt displacement sensing. To the best of the authors' knowledge, this is the first system to combine seatbelt displacement sensing with adaptive signal processing for in-vehicle respiratory rate estimation. The proposed system consists of two hardware components and a two-stage signal processing pipeline. A linear charge-coupled device (CCD) captures stripe marker displacement on the seatbelt, while an inertial measurement unit (IMU) records vehicle motion. The displacement signal is then filtered to extract the respiratory frequency band. Respiratory rate is estimated using Welch power spectral density (PSD) analysis, with a variational mode decomposition (VMD) branch activated during low-confidence intervals to improve robustness. Five healthy licensed drivers with an average age of 24.3 years participated in the experiment. Each participant completed a 5-min stationary test and a 10-min on-road driving test, producing ten datasets validated using a commercial respiration belt. Compared with the basic ribbon PSD method, the advanced fused method reduced the on-road mean absolute error (MAE) from 2.82 to 2.21 breaths per minute (BPM) and the root mean square error (RMSE) from 4.42 to 3.79 BPM. Segment-wise analysis of the 6-km driving route further showed that the lowest error occurred in the low-speed straight segment (MAE = 0.92 BPM), whereas the suburban segment produced the largest error (MAE = 3.46 BPM). These results demonstrate the feasibility of using seatbelt displacement and adaptive signal processing for unobtrusive in-vehicle respiration monitoring.

K260128

An Exploratory Study on Short-Form Video Content Design for Branding Small and Medium-Sized Tourism Cities

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Keywords: short-form video, city branding, small and medium-sized tourism cities, content design, digital media design

Abstract:

With the rapid growth of short-form video platforms, short-form videos have become an important medium for shaping tourism destination impressions and stimulating travel interest. However, existing studies on city branding and short-form videos have mainly focused on large cities. In contrast, less attention has been paid to small and medium-sized tourism cities, particularly to how short-form video content design can translate local characteristics, build brand recognition, and enhance promotional effectiveness from a digital media design perspective. Therefore, this exploratory study investigates audience perceptions of short-form videos for small and medium-sized tourism cities in terms of local feature presentation, audiovisual content performance, city brand image and recognition, travel intention, and promotional effectiveness.

This study adopted literature analysis and a questionnaire survey. A total of 36 valid responses were collected from viewers with experience in watching short-form videos. The questionnaire covered five dimensions: local features and city perception, audiovisual content performance, city brand image and recognition, travel intention, and promotional effectiveness. Descriptive statistics, Cronbach's alpha, Pearson correlation, and preliminary group mean comparison were conducted. The overall scale showed good internal consistency (Cronbach's alpha = 0.927). Participants generally held positive perceptions of short-form videos in promoting travel intention and effectiveness. The highest mean score was given to the item that short-form videos would lead viewers to include a city in their travel consideration list. In contrast, lower evaluations were given to the ability of short-form videos to strengthen city brand perception, city differentiation, and city personality recognition.

Overall, this study suggests that short-form videos can serve as an important medium for branding small and medium-sized tourism cities. However, effective content design should go beyond scenic presentation and visual attraction, and emphasize local culture, everyday scenes, human interaction, city stories, and differentiated symbols.

K260129

Model-Guided Active Sampling for Discovering Fragile Regions in Simulated Cellular Networks

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Keywords: Active sampling, Network fragility, Cellular simulation, Graph neural networks

Abstract:

Cancer tissues are increasingly understood as spatially organized cellular networks, where local cell-cell interactions can shape collective survival, damage propagation, and recovery after perturbation. Identifying structurally fragile regions in such networks may therefore provide useful clues for targeted therapeutic strategies, but exhaustive perturbation simulations are computationally expensive and many random perturbations yield little informative damage. We present a simulation-driven active sampling framework for discovering local deletion events that induce significant efficiency loss and nontrivial recovery behavior in a simulated cell-connection network. Each simulation is divided into a pre-event phase, where the network state is saved, and a branching phase, where multiple candidate regions are deleted from the same pre-event state. We quantify perturbation effects using hop-wise network efficiency drops, recovery ratios, and late-jump recovery patterns. Starting from 1,200 baseline simulations, we trained a contextual-bandit-style selector using handcrafted spatial and topological features, then generated 1,800 additional model-guided branches. Compared with random exploration, the exploitative selector substantially reduced low-information samples and increased the frequency and magnitude of meaningful damage events. These results suggest that model-guided active sampling can concentrate simulation budget on structurally informative perturbations and provide a foundation for future graph neural network models that directly score candidate fragile regions from pre-event cellular graphs.

K260130

Physics-Triggered Modality Switching : Enhancing Physical Consistency and Efficiency of MLLMs in Extreme Rainfall Analysis

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Keywords: Multimodal Large Language Models, Retrieval-Augmented Generation, Modality-Switching, Physical Fidelity, Extreme Weather Events, Computational Efficiency

Abstract:

When Multimodal Large Language Models (MLLMs) directly analyze weather maps to identify extreme weather events, processing high-dimensional visual and spatial information leads to massive token consumption and high computational costs. Standard approaches often reduce high-dimensional meteorological data into a latent space; however, this dimensionality reduction tends to smooth out critical physical-dynamical features (such as typhoon structural gradients), resulting in degraded physical consistency and increased inference errors.

To balance efficiency and accuracy, this study proposes a modality-switching inference framework integrated with vector retrieval and physical verification. First, an Autoencoder reduces the dimensionality of high-dimensional meteorological data to build a weather-pattern vector index library. Next, a Retrieval-Augmented Generation (RAG) mechanism retrieves the top-K candidate results, and a physical fidelity verification is performed on their corresponding raw meteorological data. When the retrieval results align with the physical constraints, the latent and textual features are aligned for the final output. If an inconsistency is detected, a modality switch is triggered: the task is handed over to a high-cost MLLM, which utilizes both the raw weather maps and the aligned results as a soft prompt for cross-modal comprehensive inference to guarantee quality.

The framework was validated using 205 extreme rainfall days (defined as the 95th percentile and above) during the autumn season (September to November) in northeastern Taiwan from 1979 to 2024. Experimental results demonstrate that through retrieval and physical fidelity auditing, the framework successfully classified 171 days directly, leaving only about 34 days (17%) requiring MLLM (GPT-4o) invocation. Compared to the pure MLLM baseline inference which required 270,000 tokens, our method consumed only about 44,000 tokens—improving computational efficiency by over 6-fold. This approach effectively balances computational efficiency with physical credibility, providing a highly scalable architecture for meteorological inference.

K260131

Beyond Syntax: A Synergistic Framework of PSP Discipline and Pair Programming for Novice Programmers

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Keywords: Personal Software Process, Pair Programming, Learning Analytics, Software Engineering Education

Abstract:

Introductory programming courses pose a persistent pedagogical challenge for novice learners due to the abstract nature of computational concepts and deficiencies in problem-solving skills. While conventional instruction heavily emphasizes syntax acquisition, the critical roles of software engineering discipline and collaborative learning remain underrepresented. To address this gap, this study investigates the empirical efficacy of integrating Personal Software Process (PSP) discipline training with Pair Programming within an introductory Python course.

An 18-week quasi-experimental study was conducted with 75 first-year undergraduate IT students. Participants were bifurcated into an experimental group (n = 39) and a control group (n = 36). The experimental group underwent structured PSP training—encompassing development planning, defect tracking, code review, and process reflection—concurrently with mandatory Pair Programming. Conversely, the control group followed conventional instruction with optional adherence to these practices. Learning outcomes were evaluated utilizing academic performance, professional certification attainment, learning motivation, instructional satisfaction, and computational thinking metrics.

The empirical results demonstrate that the experimental group significantly outperformed the control group. Students subjected to the joint PSP and Pair Programming intervention exhibited superior course grades, heightened motivation, elevated satisfaction, and a substantially higher certification pass rate. Furthermore, Grey Relational Analysis (GRA) revealed that collaborative learning behaviors and adherence to PSP practices yielded a stronger correlation with programming achievement than syntax proficiency alone.

These findings underscore that efficacious programming education must transcend mere syntax instruction to emphasize disciplined software development and collaborative frameworks. Ultimately, this integration offers a robust framework for cultivating computational thinking, self-regulated learning, and sustainable programming competencies among novice developers.

K260132

Design and Implementation of an Instruction Compression Subsystem for Self-timed Two-Way VLIW Processors

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Keywords: VLIW, Asynchronous Circuit, Self-timed Circuit, Instruction Compression, Muller Pipeline

Abstract:

The idea of VLIW architecture focuses on multiple instruction issue, moving the instruction scheduling from hardware to the compiler. This, it can simplify hardware circuitry. However, a major inherent drawback of VLIW design is instruction memory inefficiency. Because most instruction packets cannot be executed in parallel, lots of redundant NOP instructions are introduced, leading to underutilized memory space. To mitigate the overhead, instruction compression has become a widely adopted technique.

In this paper, we propose an instruction compression scheme designed for a self-timed two-way VLIW processor. While self-timed design is often employed to lower power consumption, it also demands a larger circuit area, rendering complex compression mechanisms impractical. The RISC-based VLIW processors utilize fixed-length instructions, but the instruction packets are frequently under-filled. These useless NOPs causes significant capacity waste. Reducing the code size not only optimizes memory footprint but also reduces communication frequency between the memory and the processor.

To tackle these challenges, we implemented a two-way VLIW self-timed processor utilizing the Muller pipeline, which employs a four-phase signaling protocol with dual-rail encoding. The proposed instruction compression mechanism is integrated into this processor. Inspired by the VelociTI approach, our design utilizes 32-bit RISC-style instructions, where the final bit of each instruction is dedicated to indicating parallel operations. This strategy efficiently eliminates redundant NOPs within the VLIW instruction packet. The instruction fetch mechanism is executed via a two-stage pipeline consisting of Prefetch and Dispatch stages. Instructions are routed to the correct execution path for decoding and execution after successfully passing through the two stages. Furthermore, we implement a simple yet efficient branch handling mechanism to keep a 50% pipeline utilization rate. The design was verified with ModelSim and synthesized using Design Compiler. Experimental results show our design achieves a compression ratio of approximately 60%, with a minimal circuit area overhead of only 2.8%.

K260133

Application of Backpropagation Neural Networks for Indoor PM2.5

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Keywords: PM2.5 air pollution, neural network-based control system, backpropagation algorithm, indoor air quality

Abstract:

Particulate matter with an aerodynamic diameter less than 2.5 μm (PM2.5) is one of the most critical indoor air pollutants and poses significant risks to human health. Due to the nonlinear and time-varying characteristics of indoor PM2.5 concentrations, conventional control methods often fail to achieve stable and accurate control performance. This study proposes an indoor PM2.5 concentration control system based on a backpropagation (BP) artificial neural network (ANN).

A feedforward neural network with two hidden layers is adopted, and five different network configurations with varying numbers of neurons are evaluated to determine the optimal architecture. Indoor PM2.5 data are collected from a controlled experimental environment and used to train and validate the proposed model using MATLAB neural network tools. Simulation results demonstrate that the BP-based ANN can effectively learn the nonlinear relationship between input PM2.5 data and control targets. Among the examined architectures, the network with 8 and 16 neurons in the two hidden layers achieves the lowest mean squared error and the most stable convergence.

The proposed approach successfully maintains indoor PM2.5 concentrations below 35 μg/m³, meeting indoor air quality standards. The results confirm that the BP neural network is a feasible and effective solution for intelligent indoor air quality control systems.

K260134

Enhancing Learning Motivation and Problem-Solving Skills in Computer Networking Education through Integrated PBL and GBL Strategies

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Keywords: Problem-Based Learning, Game-Based Learning, Computer Networking Education, Learning Motivation, Problem-Solving Skills

Abstract:

Computer networking courses are essential in engineering and information technology education. However, students often struggle with abstract concepts and complex network operations, which may reduce learning motivation and practical problem-solving skills. To improve learning effectiveness, this study integrates Problem-Based Learning (PBL) and Game-Based Learning (GBL) into a computer networking course. The proposed approach combines networking scenarios, collaborative problem-solving activities, and gamified learning mechanisms. Students complete tasks involving network topology design, IP addressing, routing configuration, troubleshooting, and network security using simulation tools. Gamification elements, including challenge missions, rewards, and instant feedback, are incorporated to encourage participation and sustain motivation. A mixed-methods approach was adopted to evaluate the framework. The study involved 23 students enrolled in a computer networking course. Quantitative data were collected through pre- and post-course questionnaires, while qualitative feedback was obtained from student reflections and course evaluations. Assessment dimensions included learning motivation, conceptual understanding, self-directed learning, problem-solving ability, collaboration, and learning satisfaction. Results indicate positive learning outcomes. Among participants, 87.0% agreed that the course improved their understanding of networking concepts and technologies. Additionally, 78.3% reported enhanced self-directed learning ability, while 78.3% believed that the integration of PBL and GBL improved their ability to understand and apply networking knowledge. Furthermore, 82.6% expressed satisfaction with the course, and 87.0% reported increased interest in networking technologies. The findings suggest that integrating PBL and GBL promotes active learning, practical skill development, and conceptual understanding. The proposed framework provides a practical strategy for improving learning outcomes in computer networking education.

K260135

Environmentally Aware Reading for Systems Thinking in Spatial Design Education

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Keywords: environmentally aware reading, systems thinking, problem-based learning, spatial design education, place-based learning

Abstract:
Spatial design education integrates bodily environmental perception, the learning of tectonic and spatial language, and creative expression. However, vocational students often struggle to translate site experience into design concepts because of insufficient perceptual training, superficial site reading, and weak systems thinking. To address this problem, this study adopts environmentally aware reading as the core pedagogical intervention and integrates it with problem-based learning (PBL), place-based learning, and design studio pedagogy to examine how these approaches reinforce systems thinking in vocational spatial design education.

The study was conducted in the Environmental Visual Design course in the Department of Spatial Design at Kun Shan University, Taiwan, using Qiding Old Street in Longqi, Tainan, as the primary field site. The course included five-sense workshops, site walks, cognitive and system mapping, model making, bamboo construction workshops, memory-weaving activities, and public presentation. A mixed-methods action research design was employed, and data were collected through pre- and post-course questionnaires, student reflections, design outputs, and instructor observations.

The results show an overall improvement, with the mean score increasing from 3.99 in the pre-test to 4.11 in the post-test. The strongest gains appeared in systems thinking indicators, including topic grasp, goal setting, brainstorming, and group discussion. Qualitative findings further show that students shifted from visually dominated observation to multisensory awareness and became more capable of connecting residents' memories, local craft, and material culture with design language and spatial propositions.

The findings suggest that environmentally aware reading is not only a sensory training strategy but also a pedagogical bridge linking PBL and design studio learning. Through real-site problem framing, data collection, collaboration, and design making, students gradually formed a progressive learning sequence from perception to systems thinking, then to cultural interpretation and design narration.

K260136

NotebookLM-Based Analysis and Prevention Strategies for Firefighter Occupational Safety Accidents

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Keywords: Firefighter Occupational Safety and Health, NotebookLM, Professional Training and Development, Occupational Accident Investigation, Risk Identification

Abstract:

Firefighters operate in highly hazardous and unpredictable environments, exposing them to significant occupational safety and health (OSH) risks. To enhance firefighter safety, Taiwan has actively promoted OSH management systems and preventive strategies. This study analyzed 102 Firefighter Occupational Safety Investigation Reports submitted to the National Fire Agency in 2025 using Google NotebookLM. Due to file format inconsistencies and platform upload limitations, reports from fire departments within the same county or city were consolidated prior to analysis. The identified cases were further used to develop educational videos and infographic-based training materials.

The results indicate that firefighter occupational safety incidents can be categorized into three dimensions: accident classification, accident causation, and preventive strategies. Major accident types include fire suppression, emergency medical services, special rescue operations, and transportation-related incidents. Common injuries involve burns, smoke inhalation, heat exhaustion, falls, transportation accidents, and biological hazards encountered during rescue missions. Accident causes are associated with personnel factors, environmental conditions, and equipment or resource limitations. Key contributing factors include inadequate use of personal protective equipment, insufficient risk awareness, adverse environmental conditions, and deficiencies in safety management and operational resources.

Based on the findings, recommended preventive measures include strengthening risk-awareness training, incorporating accident case studies into educational programs, improving protective equipment, implementing pre-duty safety inspections, establishing accident databases and feedback mechanisms, and optimizing operational management systems. The infographic materials developed in this study provide practical guidance for safety education and risk communication. The proposed approach demonstrates the potential of large language model–assisted analysis to efficiently identify occupational safety issues and support evidence-based safety management for fire service organizations.

K260137

A United Electro-Optically Reconfigurable Multimode Interference Accelerator for In-Situ Trainable Optical Neural Networks

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Keywords: optical neural network, multimode interference, electro-optic modulation, deep learning inference

Abstract:

To overcome the thermal loss and interconnect delays of conventional electronic processors under escalating AI computing workloads, analog optical processors have emerged as a compelling low-latency alternative. This work introduces an integrated optical neural accelerator leveraging an electro-optically reconfigurable multimode interference (MMI) framework for localized parallel processing. The device exploits complex wavefront interference to execute trainable weight mappings via a layout of micro-electrodes manipulating. We build the architecture of the in-situ tuning paradigm where optical states adaptively evolve based on error feedback, and it helps us better understand the actual cooperative ways of the real biological neurons. The proposed platform of thin-film lithium-niobate (TFLN) is validated through numerical electromagnetic simulations applied to the famous Iris flower classification benchmark, demonstrating the self-learning capabilities of the integrated optical neural network with an accuracy of 72%. These findings present a compact, low-loss building block for next-generation photonic tensor processors.

K260138

From Tacit Knowledge to Explicit Representation: Semiotic Translation in Generative AI-Assisted Metal Jewelry Proposal Development

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Keywords: generative AI, tacit knowledge, design semiotics, metalsmithing, semiotic translation

Abstract:

Generative AI is transforming the initial proposal stage of metal jewelry design by en-abling designers to externalize tacit craft knowledge into visible and revisable design representations. In traditional metalsmithing practice, early design judgment often de-pends on embodied experience, material sensitivity, hand skills, and intuitive evaluation of structure, proportion, balance, and fabrication feasibility. Such knowledge is difficult to fully verbalize before physical making begins. This study explores how generative AI images, prompts, and iterative evaluation support the transformation of tacit knowledge into explicit semiotic representations during the early stage of metal jewelry proposal development.

This study adopts a qualitative case-study approach and uses the conceptual brooch case Framed Void to demonstrate the proposed model. The design process is examined through prompt formulation, AI-generated visual representation, design evaluation, and iterative refinement. The analysis focuses on five criteria: formal clarity, art jewelry quality, metalsmithing feasibility, wearable functionality, and iterative convergence. The find-ings suggest that generative AI does not replace the designer's tacit craft knowledge; rather, it functions as a semiotic mediator that transforms implicit design judgment into visible, discussable, and revisable representations during the initial proposal stage.

K260139

Domain-Adaptive Warm-Start Multi-Noise Training for JPEG-Robust Watermarking of Measurement Imagery

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Keywords: image watermarking, measurement-data integrity, domain adaptation, JPEG robustness, industrial surface inspection

Abstract:

Verifying the origin and integrity of images is a basic requirement in distributed measurement pipelines, where instrument-acquired data are compressed and transmitted over open networks before informing decisions. Deep-learning watermarking is a promising authentication primitive, but a watermarker trained on natural images does not necessarily transfer to measurement imagery. Off-the-shelf, a strong COCO-trained model applied to steel-surface inspection images (NEU-DET) keeps clean extraction and most robustness yet suffers a large cross-domain JPEG collapse: QF=50 bit accuracy falls from 0.94 (in-domain) to 0.78. We close this gap by domain-adapting the model with warm-start, multi-noise fine-tuning on target-domain images. On a held-out test split, JPEG bit accuracy recovers to 0.92 (+13.5 pp) and the five-attack average from 0.92 to 0.96, while imperceptibility stays above the natural-image benchmark (PSNR 38.0 vs 35.9 dB). A data-efficiency study shows only a few hundred target images already recover most of the gap, so adaptation is practical near the instrument. The result is initial evidence that off-the-shelf watermarkers should be domain-adapted before deployment on measurement data.

K260140

Sovereign Credit Risk as an Early-Warning Indicator of Currency Risk Premia: Evidence from Latin American Emerging Markets

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Keywords: sovereign CDS spreads, foreign exchange excess returns, currency risk premia, exchange rate vulnerability

Abstract:

This study investigates whether sovereign credit default swap (CDS) spreads provide leading information on currency risk premia and exchange rate vulnerability in Latin American emerging markets. Unlike studies that examine sovereign credit risk and exchange rate dynamics separately, this paper links the pricing, crisis-state, and volatility channels within a unified empirical framework. Using monthly data for Brazil, Chile, Colombia, Mexico, and Peru from 2009 to 2022, five-year USD-denominated sovereign CDS spreads are used as market-implied measures of sovereign credit risk, while foreign exchange excess returns capture investors' compensation for bearing currency risk. OLS regressions are employed to examine mean-return pricing, while GARCH(1,1) and EGARCH(1,1) models are used to evaluate volatility persistence and asymmetric risk responses. Crisis-interaction specifications further assess whether the CDS–currency risk transmission changes during the European sovereign debt crisis and the COVID-19 period. The results show that higher sovereign CDS spreads are associated with higher subsequent foreign exchange excess returns in most countries. Economically, a 10% increase in CDS spreads implies approximately 0.128% to 0.261% higher next-month excess returns. Crisis interaction effects are generally limited, suggesting that crisis information is reflected mainly through CDS levels and volatility dynamics rather than through a stronger marginal mean effect. Overall, the findings identify sovereign CDS spreads as forward-looking indicators for monitoring currency risk premia and exchange rate vulnerability in emerging markets.

K260141

Visual Encoding-Based Deep Learning for Smart Meter Anomaly Detection

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Keywords: Advanced Metering Infrastructur, Non-Technical Losses, Gramian Angular Difference Field, Deep Learning Method, Smart Grid

Abstract:

With the widespread adoption of smart grids and Advanced Metering Infrastructure (AMI), electricity consumption data have been extensively collected and applied to Non-Technical Losses (NTLs) detection. These data capture long-term variations in electricity consumption behavior across users, forming a solid basis for data-driven analysis. However, due to the highly nonlinear and time-dependent nature of electricity consumption patterns, traditional statistical methods and certain machine learning algorithms struggle to effectively model temporal relationships. As a result, their ability to identify abnormal consumption patterns is limited. To address the aforementioned issues, this study proposes a deep learning framework that integrates the Gramian Angular Difference Field (GADF) with ResNet50 for Non-Technical Losses (NTLs detection. The proposed method transforms one-dimensional electricity consumption time-series data into two-dimensional GADF images to preserve temporal dependencies and consumption behavior characteristics. A ResNet50 model is then employed for feature extraction and classification to identify different types of electricity consumption events, including normal events, suspected incidents (SI), moderate fraud (MF), and severe fraud (FS). To evaluate the effectiveness of the proposed approach, repeated holdout validation was conducted over ten independent runs. Experimental results show that the proposed method achieves an average accuracy of 96.50%, precision of 97.23%, recall of 96.50%, and F1-score of 0.96. These results indicate that the proposed framework can effectively detect non-technical losses while maintaining stable and reliable classification performance. The proposed approach is suitable for deployment in smart grid monitoring systems, contributing to improved distribution network operation and electricity management.

K260142

A Data-driven Thermal Error Compensation Model for CNC Machine Tools Based on Sensor Measurement

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Keywords: CNC machining center, deep-learning neural network, thermal error compensation

Abstract:

Currently, the thermal error compensation (TEC) models widely used for CNC machine tools struggle to accurately address the issue of instantaneous thermal error compensation. They also fail to automatically adjust to actual machining conditions. Moreover, these models cannot intelligently adapt to changes in machining conditions or the aging of CNC machine tools. As a result, when machining under varying conditions, the machining errors remain significant even after thermal error compensation, and in some cases, these errors exceed the thermal errors present when no compensation is applied.

To address this challenge, we propose an intelligent and dynamic TEC model for CNC machine tools that accounts for both transient and steady-state machining. This innovative model consists of two components: the first is a mathematical thermal error model that uses the ARX scheme to characterize transient and steady-state thermal deformation, while the second is an intelligent dynamic thermal error compensation method.

K260143

Integrated Deep Learning-Based Fault Diagnosis Method for Gear Lubrication Systems

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Keywords: On-line monitoring, deep learning neural networks, fault detection and diagnosis

Abstract:

As one of the key components affecting the operation of machines, the gear lubrication system, its fault monitoring and diagnosis research has been widely emphasized by researcher. Failure of the gear lubrication system, which transmits power to the machine, may cause overheating of the gear box, damage to the gears and machine as well. Previous studies reveal that the main difficulties of the fault diagnosis of gear lubrication system lie in: (1) high system complexity, which makes accurate diagnosis difficult; (2) excessive reliance on expert experience, which affects universality and reliability; (3) insufficient real-time monitoring and rapid response capability; and (4) the diagnostic model lacks adaptability and flexibility, which makes it difficult to cope with environmental changes and unknown faults. To solve the above problems, we propose a lubrication system fault diagnosis method based on integrated deep learning method; firstly, by combing the structure and principles of lubrication system, we use fault tree analysis to determine the causal relationship between faults and signs; secondly, we combine the evaluation of multiple experts and use the fuzzy fault tree method in order to quantify the probability of failure and determine the key system failure factors; then we propose the RCI-AE-FCNN fault diagnosis algorithm, which effectively improves the accuracy of fault classification and separates the unknown fault types with strong applicability and flexibility. Finally, in order to verify the effectiveness of the algorithm, we design and implement an online fault detection and diagnosis experimental platform using the lubrication system of the ring pump gearbox in a nuclear power plant as a research example. The platform adopts precisely selected sensors and layouts, uses Python language, and combines tools such as Tkinter and Figma to fulfill real-time monitoring of system status and 100% correct fault diagnosis.

K260144

Research on Powertrain Matching of Formula SAE Hybrid Electric Racing Car

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Keywords: hybrid power system, hybrid electric system, Formula SAE

Abstract:

This paper takes FSAE racing cars as the research object, aiming to improve the vehicle dynamic performance and fuel economy. A hybrid electric racing car model is established by co-simulation of CarSim and Simulink. Under typical FSAE working conditions including straight-line acceleration and figure-eight slalom, the lap time and vehicle slip characteristics obtained from simulations are comprehensively analyzed. On this basis, the parameters of powertrain components such as the engine and motor are determined, and a design scheme that meets the technical requirements is finally obtained.

K260145

Research on surface defect detection of H-shaped beam steel based on integrated machine learning and deep learning model

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Keywords: H-beem steel, deep learning, surface defect detection

Abstract:
H-beams are widely used in the infrastructure of industrial workshops, civil buildings and bridge engineering. Nevertheless, various surface defects inevitably occur on H-beams due to the characteristics of production processes. Current machine learning-based methods for image processing and recognition of steel products with surface defects generally suffer from unsatisfactory image processing effects and low recognition accuracy. To address these issues, this paper proposes an integrated model combining machine learning and deep learning, and develops a corresponding experimental platform for detection and recognition.

First, raw images of H-beams captured in harsh production environments often suffer from uneven grayscale, noise interference and inaccurate edge extraction. To tackle these problems, the proposed integrated learning model innovatively combines algorithms including FAGC, InvDn and PiDiNet, enabling accurate image preprocessing and defect edge segmentation. Second, traditional single-stage object detection methods are limited by insufficient feature fusion, which leads to low detection accuracy. For this reason, three advanced deep learning recognition algorithms — Faster R-CNN, RetinaNet and the YOLO series — are incorporated into the integrated model, achieving a substantial improvement in detection performance. Finally, to rapidly and effectively validate and deploy the proposed model for H-beam defect recognition, an experimental detection and recognition platform is built based on Jetson Xavier NX.

Experimental results obtained via the CMOS sensor of this platform on defective steel samples show that the proposed integrated learning method achieves a mean Average Precision (mAP) of 93.4% for steel surface defect recognition and a Frame Per Second (FPS) of 69.75. The results fully demonstrate that the proposed model integrating machine learning and deep learning can realize high-precision and real-time detection and recognition of surface defects on H-beams.

K260146

Visualizing Taiwan's Temperature Data through Dynamic Visual Integration: Prototype Design and Preliminary Usability Evaluation of an Interactive Temperature Map

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Keywords: information visualization, interactive map, climate information, climate information literacy, usability evaluation

Abstract:

As climate change intensifies, Taiwan's monthly average temperatures show year-to-year fluctuation alongside a long-term warming trend, making public understanding of climate change increasingly important. Yet official historical weather data are mostly presented as static two-dimensional tables or fragmented text, leaving non-expert users prone to information overload when interpreting long-term, highly variable temperature data.

Drawing on Human–Computer Interaction (HCI) and information literacy, this study examines how a "dynamic visual integration" design can support the public's climate information literacy. As an early-stage study, this paper reports only the prototype design of the "Taiwan Dynamic Temperature Map" and an initial usability evaluation; a full system and a dynamic-versus-static comparison are left to future work.

We cleaned and integrated nine years of Taiwan's monthly average temperature data into an interactive web-based prototype whose core combines a map layer (geospatial encoding), a time slider, and a linked trend chart, letting users follow each city and county's temperature change over time by dragging the slider. The interface follows User-Centered Design and Shneiderman's mantra—overview first, zoom and filter, details on demand—to reduce cognitive load.

To assess usability, three to five general users operated the prototype; feedback was gathered through observation and semi-structured interviews, and each participant completed the System Usability Scale (SUS). Early findings indicate that participants found the prototype intuitive and easy to use. Building on this, the study will complete the implementation and adopt a quasi-experimental design comparing the dynamic interface with static charts on information-literacy accuracy and cognitive load (NASA-TLX).

K260147

A Particle-Mesh Approach for Large-Scale Multicellular Molecular Communication Simulation

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Keywords: molecular communication, agent-based model, particle-mesh method, chemotaxis, multicellular simulation

Abstract:

In multicellular molecular communication, populations of cells coordinate through chemical signaling to form large-scale structures such as clusters and vascular-like networks. Simulating these processes with agent-based models requires evaluating long-range chemotactic interactions between all cell pairs, whose computational cost scales as $O(N^2)$ and becomes prohibitive for large cell populations. Here, we replace the direct pairwise force calculation with a Particle-Mesh (PM) formulation, in which cell secretion sources are deposited onto a spatial grid and the resulting concentration field is solved via a Fourier-based method. Chemotactic forces are then obtained from the field gradient and interpolated back to individual cells, reducing the complexity of long-range interactions while retaining an agent-based representation of cell motion. We evaluate the PM method against a conventional pairwise implementation using structural metrics including cluster statistics, nearest-neighbor distance, and pair-correlation functions across multiple simulation seeds. Results demonstrate that the PM approach reproduces global aggregation behavior with only minor differences in local cell packing attributable to grid interpolation effects, while achieving substantially lower runtime for large cell populations.

K260149

Development of a Virtual Reality-Based Training Platform for Structured Cabling and Network Maintenance

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Keywords: Virtual Reality (VR), Network Operation and Maintenance, ICT Network Infrastructure, Immersive Training, Structured Cabling System

Abstract:

Traditional network deployment and operation-and-maintenance (O&M) training often depends on dedicated training facilities, physical equipment, consumable materials, and instructor availability. These requirements increase training costs and limit scalability, while hands-on practice in real-world environments may expose trainees to operational and safety risks. To address these challenges, this study presents the design and implementation of a Virtual Reality (VR)-based immersive training platform for ICT network deployment and maintenance education. The proposed platform provides a realistic three-dimensional virtual environment that simulates practical network infrastructure scenarios. The training modules cover essential operational tasks, including network cable installation, equipment deployment, device configuration, and standard maintenance procedures. By integrating immersive interaction techniques, task-oriented learning activities, and real-time feedback mechanisms, the platform enables trainees to repeatedly practice operational workflows in a safe and controlled environment. In addition, procedural guidance and performance assessment functions are incorporated to support standardized training processes and competency development. Compared with conventional training approaches, the proposed platform reduces dependence on physical training resources, enhances training flexibility, and facilitates scalable technical workforce development. This paper describes the system architecture, implementation methodology, interactive training workflow, and key design considerations of the platform. The feasibility of applying VR technology to network O&M education is discussed, and future work will focus on user studies and learning effectiveness evaluations to further validate the platform's educational value and practical applicability in ICT professional training.

K260150

A Study on the Co-creation Impact of AI Robot Proactivity and Empathy on Well-being

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Keywords: Proactivity, Empathy, Well-being, Value Co-Creation

Abstract:

Thanks to AI technology, the increasing prevalence of contactless services from intelligent service robots is changing the way people interact, meeting consumers' needs for safe interaction. The implementation of artificial intelligence is transforming how businesses interact with customers and co-create value. Although businesses are increasingly adopting AI services, the impact of robot service behavior on co-created value remains unknown. Therefore, this study will explore co-created value points, investigating whether the proactive robot service and perceived robot empathy further influence consumer satisfaction and well-being when using smart gyms. The findings can provide important reference for the fitness industry's decision-making regarding the adoption of smart management.

K260152

A Digital Twin Framework for 6D Pose Estimation and Sim-Side Closed-Loop Grasping Validation Based on OpenUSD

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Keywords: 6D object pose estimation, digital twin, OpenUSD, PBR synthetic data, domain randomization

Abstract:

High-mix, low-volume (HMLV) manufacturing increasingly demands robotic 6D object pose estimation for grasping and assembly, yet deploying learning-based pose estimators on real production lines is bottlenecked by the prohibitive cost of annotating real images and by the simulation-to-reality gap. This work presents a simulation-side digital-twin pipeline, built on OpenUSD and NVIDIA Isaac Sim, that integrates physically-based rendering (PBR) synthetic data generation, GDRNPP pose-estimation training, and closed-loop grasping validation under a unified scene description. Using tricolor industrial cubes as a representative workpiece, more than 100,000 PBR synthetic images with zero real annotation were generated via Omniverse Replicator to train GDRNPP; the trained model attains mssd 87.00%, mspd 99.79%, and vsd 73.65% (BOP-19 AR 86.82%) on the BOP-19 protocol. Closed-loop grasping is validated in two stages within the physics engine: a ground-truth-pose stage that isolates the electromechanical capability ceiling (inverse kinematics, controller convergence, and the suction gripper), achieving, in this setup, a 100% success rate over 200 trials across four random seeds (Wilson 95% CI [98.12%, 100%]); and a vision-in-the-loop stage driven by GDRNPP-inferred pose, achieving 197/200 (98.50%), only about 1.5 percentage points below the deterministic ceiling. Analysis of the inferred-pose error reveals a pronounced axial decomposition: the lateral (XY) median error is about 1.19 mm whereas the depth (Z) median error is about 5.55 mm, with depth-axis error dominating, consistent with the scale-invariant translation estimation of GDRNPP. We further propose a verification:validation dichotomy that positions this simulation-side ceiling as a reproducible reference baseline. The entire pipeline is demonstrated on a Taiwan-made HIWIN RA605-710-GB six-axis industrial manipulator, providing simulation-side feasibility evidence for low-cost deployment in HMLV small-and-medium manufacturing; the framework naturally extends to more diverse scenes and workpieces and to subsequent real-robot sim-to-real quantification.

K260154

Clinical Feasibility and Clinician Feedback of a Cuffless Four-Limb ECG/PPG Invention for Point-of-Care PAD Screening in Patients Where the Ankle–Brachial Index Fails

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Keywords: Peripheral artery disease, pulse transit time, ankle–brachial index, chronic kidney disease, clinician satisfaction

Abstract:

Peripheral artery disease (PAD) is under-diagnosed, and the reference ankle–brachial index (ABI) is unreliable in patients with diabetes or chronic kidney disease (CKD), whose calcified, incompressible vessels can produce falsely normal readings. This study evaluated a cuffless device that screened for PAD from all four limbs at the same time. A single 3D-printed clip on each limb combined a dry stainless-steel ECG electrode with a reflective optical sensor, so that one electrocardiographic (ECG) lead and four photoplethysmographic (PPG) channels were recorded through four contact points. A discrete analog front end conditioned the signals, which were digitised at 500 Hz and analysed on a host computer for pulse transit time (PTT). Under institutional review board approval, an attending physician enrolled healthy adults, patients with PAD but without CKD (ABI 0.4–0.9), and CKD patients who had PAD symptoms but a normal-range ABI. The device was operated in outpatient consultation rooms and at the hemodialysis bedside. Every measurement was completed on the first attempt in under one minute. In a companion analysis, toe PTT tracked the reference ABI and differed in the CKD group where ABI was non-discriminatory [7]. In a post-use questionnaire, the ten participating clinicians rated the device favourably: respondent-level mean satisfaction was 4.4 / 5 (95% CI 4.2–4.6) with acceptable internal consistency (Cronbach's $\alpha = 0.76$), and all ten were satisfied or very satisfied overall. This pilot showed that the device fitted real outpatient and bedside workflows and was well received by clinicians, supporting its further evaluation as an accessible PAD screening tool for primary-care, bedside, and home use.

K260155

Optimizing Adaptive Learning Pathways Through a Hybrid Ensemble of Recommender Algorithms

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Keywords: adaptive learning, recommender systems, hybrid ensemble, K-Means clustering, learning pathways, cold-start problem, Alternative Learning System

Abstract:

Flexible and non-formal education programs, such as the Philippine Alternative Learning System (ALS), serve learners with diverse backgrounds and learning needs but often have limited learner interaction data. This makes it difficult to use traditional recommender systems that rely on extensive usage histories. This study developed and evaluated a hybrid adaptive learning pathway system that generates personalized and dynamically adjusted learning module sequences using learner profiling, clustering, similarity-based recommendation, and performance-based adaptation. Survey responses from learners were transformed into eleven dimensions representing cognitive, behavioral, motivational, and contextual characteristics. After data standardization, Principal Component Analysis reduced the dataset to four components while preserving 83.8% of the total variance. K-Means clustering, validated using the elbow method and a silhouette score of 0.26, grouped learners into four learner readiness levels. A hybrid ensemble recommender combined cluster-based filtering, cosine similarity, and an adaptive readiness score through weighted aggregation to create an initial twelve-module learning pathway. The system then adjusted the pathway by adding remedial modules, skipping mastered content, reordering modules, and updating learning sequences based on learner performance and predefined mastery thresholds. Evaluation results showed that the system produced coherent, diverse, and personalized learning pathways while remaining effective under cold-start conditions. These findings demonstrate the potential of an interpretable hybrid ensemble approach for delivering personalized learning pathways in flexible educational environments with limited learner data.

K260156

Automatic App Testing via Web and LTL Model Checking

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Keywords: software testing, android apps, LTL, model-checking

Abstract:
Mobile and cloud computing rapid evolution creates undocumented software testing challenges. We present an automated, black-box test case generation framework oper-ating without source code or system documentation. The pipeline captures sys-tems-under-test (SUT) execution traces, mines a behavioral Kripke model, and surfaces test paths verifying Linear Temporal Logic (LTL) specifications. We guarantee complete counter-example coverage on converged graphs and validate our solution empirically via runtime defect exposure in Android mobile applications.

K260158

Evaluating Performance and Complexities of Deep Learning Models for Vehicle Detection and Instance Segmentation

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Keywords: object detection, instance segmentation, localization, deep learning

Abstract:

Understanding differences in SOTA models is key to choosing the best model for specific constraints. There exists a gap detailing the differences of SOTA models for both vehicle detection and instance segmentation. This study addresses the gap in understanding performance and complexities of YOLO26, YOLOv11, Mask R-CNN, and RF-DETR in detection and instance segmentation of several vehicle classes. Average precision across various IOUs and scales was measured, including total parameters, GFLOPs, training and inference time, and throughput. The results within 20 epochs showed that transformer-based RF-DETR significantly surpasses other models in vehicle detection and instance segmentation, achieving AP50 70.9% and 66.8%, respectively. Next are one-stage CNN-based YOLOv11n-seg and two-stage CNN-based Mask R-CNN while YOLO26n-seg performs poorest. Additionally, YOLO surpasses all models in inference and training time. YOLO11n-seg has better generalizability than YOLO26n-seg. The insights can be a basis for developing solutions and improving real-world vehicle object detection and instance segmentation.

K260159

Different Gate Finger Geometries for GaN High-Performance Low-Noise Amplifier Design

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Keywords: GaN device, gate fingers, NFmin, Rn, Γopt

Abstract:

This study employed GaN as the material platform for the LNA devices. GaN-based LNAs are promising for low-Earth-orbit satellite applications in the 1–4 GHz frequency range. Owing to the radiation tolerance of GaN and its compatibility with GaN power amplifiers (PAs), GaN LNAs can potentially be integrated with PAs using the same process technology. Such integration can reduce losses associated with external interconnections and packaging parasitics. Therefore, GaN technology is expected to play an increasingly important role in space and satellite communication systems.

This study investigates devices with the same total gate width of 800 μm but different gate geometries. One device has a gate periphery of 8 × 100 μm, consisting of eight gate fingers with a unit gate width of 100 μm, whereas the other device has a gate periphery of 4 × 200 μm, consisting of four gate fingers with a unit gate width of 200 μm. The objective of this study is to analyze the performance tradeoffs between increasing the number of gate fingers and increasing the unit gate width.

With the same total gate width, the 4 × 200 μm device, which has a larger unit gate width, exhibits a higher transconductance of 231 mS compared with 199 mS for the 8 × 100 μm device. However, the 8 × 100 μm device has a larger number of gate fingers, which increases the number of parallel parasitic gate paths and thereby reduces the equivalent parasitic gate resistance. As a result, the gate resistance, Rg, is reduced, leading to improved high-frequency bandwidth in the 8 × 100 μm device. At VD = 28 V, the 8 × 100 μm device achieves an fmax of 60 GHz, whereas the 4 × 200 μm device exhibits an fmax of only 47 GHz.

Furthermore, the larger number of gate fingers reduces the thermal noise generated as the input signal passes through the parasitic gate resistance. Consequently, at VG = −2 V and 3 GHz, the 8 × 100 μm device achieves its lowest NFmin of 0.03 dB, with Γopt = 0.709∠102.6°, Rn = 5.57 Ω, and an associated gain of 14.1 dB. In contrast, at VG = −1.9 V and 2 GHz, the 4 × 200 μm device exhibits its lowest NFmin of 0.23 dB, with Γopt = 0.583∠69.6°, Rn = 8.21 Ω, and an associated gain of 16.5 dB.

K260160

Spatio-Temporal Adaptive Gate Fusion Network for Robust Synchrophasor Data Reconstruction

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Keywords: Synchrophasor Data Reconstruction, Spatio-temporal Learning, Adaptive Gate Fusion, Phasor Measurement Unit, Data Resilience

Abstract:

This paper presents a Spatio-Temporal Adaptive Gate Fusion Network specifically designed for robust synchrophasor data reconstruction in modern smart grids. Real-time data from Phasor Measurement Units (PMUs), including time-synchronized voltage magnitudes, phase angles, active power, and reactive power, are critical for power system state estimation and stability monitoring. However, these measurements frequently suffer from data incompleteness due to communication network interruptions, sensor malfunctions, or localized regional disturbances. To address this vulnerability, the proposed framework integrates a Gated Recurrent Unit (GRU) to capture temporal dependencies and a Graph Convolutional Network (GCN) to extract spatial topologies. Crucially, a lightweight gate mechanism is introduced to dynamically generate fine-grained fusion weights at both per-bus and per-feature levels. This enables the network to adaptively calibrate the relative contributions of temporal and spatial context based on real-time data conditions. Extensive experiments are evaluated on the IEEE 39-bus system utilizing quasi-static synchrophasor data generated via MATPOWER AC power flow simulations. Five distinct missing-data distribution types are established to stress-test the model's resilience. Experimental results demonstrate that the proposed adaptive gate fusion network significantly outperforms conventional single-branch architectures and fixed-ratio fusion benchmarks, achieving exceptional robustness and recovery accuracy across diverse data-loss scenarios.

K260161

Design and Evaluation of a Conversational AI-Enabled AR-HUD Navigation for Adaptive Driver Assistance

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Keywords: conversational AI, AR-HUD, in-vehicle navigation interface, eye-tracking, visual attention

Abstract:

Conventional in-vehicle navigation systems mainly provide passive guidance through predefined voice and visual prompts, making it difficult to respond to drivers' context-dependent information needs. While prior research on conversational AI in vehicles has largely examined text- or speech-based interaction, less attention has been paid to how conversational outputs can be translated into spatially situated visual feedback for driving tasks. This study addresses this gap by designing and evaluating a conversational AI-enabled augmented reality head-up display (AR-HUD) navigation interface that transforms semantic interpretations of drivers' navigation-related questions into coordinated voice feedback and augmented reality visual cues.

The proposed interface introduces structured navigation labels as an intermediate layer between semantic interpretation and interface output. Drivers' navigation-related questions are converted into structured labels, enabling navigation intent to be mapped onto controllable voice and AR-HUD cues. The study focuses on three navigation scenarios: turn confirmation, lane guidance, and nearby location inquiry. A driving simulation experiment compared the proposed interface with conventional predefined navigation prompts. AOI-based eye-tracking measures and questionnaires were used to evaluate drivers' visual attention and situation awareness. The results suggest that adapting feedback content to drivers' navigation needs can support more context-sensitive information presentation and may improve visual attention allocation during navigation. These findings reveal design implications for adaptive in-vehicle navigation interfaces that integrate conversational AI with spatial AR-HUD feedback.

K260162

Decision Boundary Robustness under Information Degrada-tion in Autonomous Vehicles

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Keywords: Autonomous Vehicles, Information Timeliness, Age of Information, Decision Making

Abstract:

Autonomous vehicle decision-making depends on timely and consistent information. The robustness of decision boundaries under information degradation is investigated in this study. A baseline decision boundary is constructed using relative temporal features, and two temporal perturbation patterns, namely independent perturbation and correlated perturbation, are evaluated. Information degradation is represented as temporal perturba-tions applied to decision-related features, allowing its impact on decision separability and boundary stability to be systematically analyzed. The results show that independent per-turbation reduces AUC and increases feature-space overlap, whereas correlated perturba-tion has a limited impact on decision performance. These findings suggest that decision degradation depends not only on the magnitude of temporal error but also on whether the underlying temporal feature structure is disrupted.

K260163

Deep Reinforcement Learning Empowered Dynamic Reduced-Stream Transmission for MIMO Systems

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Keywords: Multiple input multiple output (MIMO), Spatial multiplexing, Reduced-stream transmission, Deep reinforcement learning

Abstract:
While MIMO techniques like SVD and GMD approach theoretical capacities, conventional GMD-SIC forces transmission over all spatial degrees of freedom, including highly attenuated streams susceptible to noise. Reduced-Stream Transmission (RST) mitigates this by intentionally discarding weak SVD components and applying GMD to the retained streams. However, static RST frameworks are highly vulnerable to dynamic environments. Rigid stream reduction incurs an unjustified modulation penalty in orthogonal channels and suffers severe noise amplification in heavily correlated channels.

This work proposes an intelligent, channel-aware stream selection framework empowered by Deep Reinforcement Learning (DRL) to overcome these limitations. Formulated as a Markov Decision Process (MDP), a Deep Q-Network (DQN) agent dynamically selects the optimal number of active spatial streams based on real-time conditions. The state space incorporates normalized singular values, operating SNR, and the previously selected stream count to evaluate sequential hardware reconfiguration. The agent maximizes a reward derived from an analytical SINR proxy that bounds the M-QAM symbol error rate, balanced against a switching penalty to prevent configuration oscillation.

To ensure scalability for massive MIMO, the architecture replaces full channel decomposition with truncated SVD (tSVD) and partial GMD. By iteratively extracting only the K dominant singular triplets, baseband computational complexity is drastically suppressed from O(Nt^3) to strictly O(K^2).

Simulations in a mixed-channel environment with first-order Gauss-Markov temporal evolution demonstrate the framework's superiority. The DRL agent significantly outperforms static RST and full-stream baselines (Zero Forcing, Maximum Likelihood, Full GMD-SIC) by intelligently transitioning between single-stream transmission during severe spatial correlation and full-stream transmission during rich scattering. This dynamic RST-GMD architecture prevents catastrophic error floors, providing a robust, low-latency transceiver solution for next-generation networks.

K260164

Corrosion Classification for Metallic Surfaces Using Faster Objects More Objects (FOMO) Algorithm

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Keywords: Corrosion Classification, FOMO Algorithm, MobileNetV2, Edge Computing, Metallic Surface Inspection

Abstract:

Manual visual inspection and conventional ultrasonic scanning methods for metallic surface assessment can be time-consuming, equipment-dependent, and less suitable for portable inspection applications. Therefore, this study presents a low-cost, edge-based corrosion classification system using a Raspberry Pi 5, camera module, and touchscreen interface. The proposed system integrates a lightweight MobileNetV2 backbone with the Faster Objects, More Objects (FOMO) algorithm to classify metallic surface conditions on-device. The study aims: (1) to design and build an edge-based inspection prototype using a Raspberry Pi 5 and camera module; (2) to utilize a FOMO head with a MobileNetV2 backbone for classifying metallic surface conditions, targeting at least 80% overall accuracy; (3) to gather and annotate a metallic surface image dataset with at least 30 images per class using an 80:10:10 training, validation, and testing split; and (4) to evaluate system performance using accuracy, precision, recall, F1-score, and confusion matrix analysis. The model was evaluated using 150 metallic surface images evenly distributed across five classes: no corrosion, galvanic corrosion, crevice corrosion, uniform corrosion, and pitting corrosion. The evaluation results showed 86.67% accuracy, 89% precision, 85% recall, and an 87% F1-score, demonstrating the feasibility of deploying a lightweight corrosion classification model on a resource-constrained edge device for portable metallic surface inspection.

K260165

Analysis and Simulation of a Reactive Power-Compensating Interleaved Resonant Inverter for Fuel Cell Applications

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Keywords: Interleaved Converter, push-pull converter, secondary side resonant tank, Voltage Multiplier

Abstract:

This paper designs and implements a single-phase interleaved resonant inverter with a two-stage architecture. For the front-stage circuit, two push-pull converters are connected in parallel, with a resonant circuit integrated into the secondary side of the transformer. By employing a 90-degree phase-shift control technique for the switching signals combined with a voltage multiplier circuit, the input voltage is successfully boosted to a high-voltage DC bus. This design not only enables zero-voltage switching (ZVS) for the primary-side switches but also effectively reduces input current ripple and mitigates transformer voltage stress.Regarding the rear-stage circuit, an interleaved buck inverter consisting of two fast legs and one slow leg is adopted, controlled by a hybrid modulation method. This configuration significantly lowers output current ripple, reduces switching losses, and improves the total harmonic distortion of current (ITHD).In terms of the system control strategy, the system integrates a second-order generalized integrator-quadrature signal generator (SOGI-QSG) phase-locked loop (PLL), PQ power control, voltage feedforward technology, and a current loop control to achieve precise active and reactive power regulation. Finally, a single-phase interleaved resonant inverter with a rated power of 1000 VA, an input voltage of 48 V, and an AC output voltage of 110 V is validated through simulation, confirming the feasibility of the proposed architecture and control strategies.

K260168

A Coupled Inductor Interleaved Totem-Pole PFC Converter with Dual-Mode Feedforward Control

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Keywords: Power factor correction (PFC), Couple indutor, Continuous conduction mode, discontinuous conduction mode

Abstract:

This paper proposes an interleaved totem-pole bridgeless power factor correction (PFC) converter for electric vehicle (EV) charging and discharging systems. By establishing a Δ-type equivalent circuit model for the coupled inductor, the charging and discharging behaviors are analyzed to achieve zero-voltage switching (ZVS) of the power switches, effectively reducing switching losses. Furthermore, a seamless switching control method between continuous conduction mode (CCM) and discontinuous conduction mode (DCM) is employed. This allows the converter to dynamically adjust the conduction time of the synchronous rectification (SR) switches during light-load DCM operation, preventing the generation of negative inductor current and subsequently reducing body-diode conduction losses. Additionally, a duty-ratio feedforward (DFF) digital compensation technique is introduced to precisely calibrate the current waveform by pre-calculating the ideal duty cycle. To verify the feasibility of the proposed architecture, a 1 kW simulation circuit is established using POWERSIM (PSIM). The operating conditions consist of a 220 V input voltage a 400 V output voltage, and a 50 kHz switching frequency. Simulation results demonstrate that the proposed PFC architecture achieves ZVS operation across the entire load range. The power factor is maintained above 0.97 under various load conditions, with a peak efficiency reaching 98.9%.

K260170

Defect Detection in SiC Wafer Optical Microscopy Images Based on an Improved RetinaNet

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Keywords: SiC wafer, optical microscopy image, RetinaNet, adaptive anchor, defect detection

Abstract:
This study aims to improve defect detection performance for silicon carbide (SiC) wafers in optical microscopy (OM) images. SiC wafer defects are often small, low-contrast, irregular in shape, and unevenly distributed, which may lead to missed detections and localization errors when using conventional object detection models. To address these issues, this study proposes an improved RetinaNet-based defect detection method integrating a ConvNeXt backbone, PAFPN feature fusion, sliding-window image slicing, and K-means-based adaptive anchors.

In the proposed architecture, the original ResNet backbone of RetinaNet is replaced with ConvNeXt to enhance feature extraction for low-contrast and irregular defects. The original FPN is further replaced with PAFPN, which strengthens multi-scale feature fusion through both top-down and bottom-up feature propagation, improving the localization capability for small defects. For high-resolution OM images, a sliding-window slicing strategy is used to divide large wafer images into fixed-size tiles for training and inference, preventing the loss of small defect information caused by image resizing. After inference, the predicted bounding boxes from each tile are mapped back to the original image coordinates and merged using non-maximum suppression.

In addition, K-means clustering is applied to analyze the width, height, and aspect ratio distributions of annotated defect boxes, generating adaptive anchors that better match the characteristics of SiC wafer defects. The proposed method is expected to improve small defect detection, localization accuracy, and overall detection stability, providing a deep learning-based solution suitable for semiconductor wafer surface defect inspection.

K260171

An Edge-Deployed Course Question Answering System Using Multi-Expert SLMs and Subject-Specific RAG

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Keywords: Small Language Models, Retrieval-Augmented Generation, Edge Deployment, Multi-Expert Architecture, Text Classification Router

Abstract:

With the rapid advancement of smart education, deploying Large Language Models (LLMs) on resource-constrained edge hardware faces severe computational and memory limitations. Conventional lightweighting strategies, such as directly reducing parameter size, often significantly degrade generalization and accuracy. To address this perfor-mance-resource trade-off, this study proposes an edge-deployed course question answer-ing system that integrates Multi-Expert Small Language Models (Multi-Expert SLMs) with Subject-Specific Retrieval-Augmented Generation (RAG).

The core innovation replaces traditional monolithic models with multiple lightweight, domain-specific expert models trained for different subjects. The architecture incorporates a lightweight Text Classification Router to pre-identify the subject category of a student's query and dynamically activate only the corresponding expert model, minimizing edge resource overhead. Furthermore, coupled with subject-specific RAG distributed retrieval services, the system effectively suppresses model hallucinations and eliminates semantic interference across interdisciplinary materials.

For optimization, this study applies compression techniques including QLoRA fi-ne-tuning, SparseGPT pruning, and GGUF (GPT-Generated Unified Format) quantization, conducting ablation experiments on the RAG-enabled system. results show the pipeline reduces model size from 16.6GB to 5.1GB; during inference, system RAM usage drops by approximately 75%, and throughput increases by nearly 5 times. Furthermore, evalua-tions via the Ragas framework confirm that compared to the No-RAG baseline—which is prone to cross-domain hallucinations and misinterpretations (such as mistaking abbrevi-ations for unrelated organizations or fabricating incorrect RFC numbers)—the proposed system achieves substantial improvements across five core metrics, including Context Recall, Context Precision, and Answer Correctness. Even under severe edge constraints, the system maintains stable, low-latency, and high-accuracy operation, fully validating the practical value of this multi-expert edge architecture in real-world educational scenar-ios.

K260172

A Key Turning-Point Model of Design Transformation: Knowledge-Position Reconfiguration and Local Innovation Conditions in the Zuo-Shan Practice

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Keywords: design transformation, critical turning points, knowledge-position reconfiguration, local innovation conditions, Zuo-Shan practice

Abstract:

This study examines the Zuo-Shan practice in the Wang'an Huazhai Important Residential Complex (Penghu County) as a field-based case. Using a qualitative approach and treating "critical turning points" as the unit of analysis, it traces how the design team and local residents reconfigure collaborative boundaries, decision-making positions, and action procedures over time. The study identifies five turning points and develops a "critical turning point model of design transformation," in which four interlinked conditions—trust, procedure, takeover, and strategy—account for the generative pathway of knowledge-position reconfiguration. The findings further specify three observable components of local innovation conditions: a transferable takeover-oriented collaboration mechanism, a diffusable pace of advancement, and articulable action knowledge. Together, these results offer an analytical reference for cross-context comparison and field collaboration practice.

K260173

An eBPF-Based Passive Network Latency Monitoring Frame-work Using Dual Middlebox Collaboration

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Keywords: eBPF, passive latency monitoring, round-trip time, dual-middlebox collaboration, RTT decomposition

Abstract:

Network latency significantly impacts the performance of interactive applications, real-time streaming, and cloud services. Existing passive monitoring approaches, such as evolved Passive Ping (ePPing), leverage eBPF (Extended Berkeley Packet Filter) to efficiently estimate round-trip time (RTT) on a single Linux middlebox. However, single-point monitoring provides only end-to-end latency measurements and cannot determine whether latency originates from the transit network or the remote network segment. To address this limitation, this study proposes ePPing-improve, an eBPF-based passive network latency monitoring framework using dual-middlebox collaboration. The framework deploys two cooperative middleboxes: MB1 measures the end-to-end RTT (RTT_total) using TCP timestamps, while MB2 estimates the latency of the remote network segment and embeds the information into a TCP experimental option. By combining measurements from both middleboxes, MB1 derives the estimated transit-path RTT (RTT_transit) and remote-segment RTT (RTT_remote).

The proposed framework extends conventional end-to-end RTT monitoring into a latency decomposition mechanism that provides greater visibility into network performance and enables more accurate latency diagnosis. Experimental results under controlled-delay conditions show that RTT_transit accounts for approximately 90.9% of RTT_total, while RTT_remote contributes 9.1%, indicating that the dominant delay source can be accurately identified. In addition, the average throughput difference between the original ePPing and ePPing-improve remains within 2%, demonstrating that the collaboration mechanism introduces minimal overhead. Overall, the proposed framework preserves the efficiency of eBPF-based passive monitoring while significantly enhancing latency diagnosis capability. The results demonstrate that dual-middlebox collaboration provides an effective and practical solution for passive network latency monitoring in heterogeneous network environments.

K260174

An Enhanced MPTCP ECF Scheduler with RTT Rising-Trend Correction for Heterogeneous Networks

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Keywords: Multipath TCP, MPTCP Scheduler, RTT Rising-Trend Correction, Heterogeneous Networks, Completion Time Estimation

Abstract:

With the widespread adoption of mobile devices and multi-homed network environments, modern end devices are typically equipped with multiple network interfaces. Multipath TCP (MPTCP) allows a single connection to simultaneously utilize multiple network paths, improving bandwidth utilization and connection reliability. However, the performance of MPTCP heavily depends on its packet scheduler. In heterogeneous environments with different Round-Trip Times (RTTs), bandwidths, and delay fluctuations, inefficient scheduling may lead to underutilization of high-bandwidth paths, out-of-order packet delivery, Head-of-Line (HoL) blocking, and increased completion time.

Estimated Completion First (ECF) is an MPTCP scheduler specifically designed for heterogeneous network paths. The original ECF estimates completion time by considering the Smoothed RTT (SRTT), congestion window, in-flight data, and send buffer status of each subflow. However, when a high-RTT path also provides higher band-width and experiences RTT fluctuations, sudden RTT increases may not be immediately reflected in the SRTT measurement, resulting in inaccurate completion time estimation and unstable path utilization.

To address this limitation, this study proposes RTT Rising-Trend Correction ECF (ECFR). ECFR preserves the original completion time estimation framework of ECF while introducing an RTT rising-trend correction mechanism. When a selected high-RTT path exhibits a noticeable RTT increase, ECFR temporarily inflates its effective RTT value to detect short-term delay degradation earlier and adjust packet allocation.

An MPTCP testbed with two heterogeneous paths was constructed to evaluate ECFR. One path represents a low-RTT and low-bandwidth connection, while the other represents a high-RTT, high-bandwidth path with delay fluctuations. Experimental results demonstrate that ECFR outperforms the original ECF. Average receiver goodput increased from 6.90 Mbps with the original ECF to 8.79 Mbps with ECFR, an improvement of approximately 27.45%. Average completion time was reduced from 215.99 seconds with the original ECF to 158.21 seconds with ECFR, a reduction of approximately 26.75%.

K260176

Dual-Branch Cross-Attention Reverse Distillation with Conditional Positional Encoding for Unsupervised Industrial Image Anomaly Detection and Localization

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Keywords: Unsupervised anomaly detection, Defect localization, Reverse distillation, Vision transformer, Knowledge distillation

Abstract:

Automated visual inspection of industrial products requires detecting and localizing defects that are rare, diverse, and costly to annotate, which motivates unsupervised anomaly detection trained only on defect-free images. Reverse distillation, in which a student decoder reconstructs the multi-scale features of a frozen pre-trained teacher encoder, has become a leading paradigm; however, its student decoders are typically convolutional and single-flow, and still suffer from over-generalization, where the teacher-student discrepancy vanishes on subtle anomalies. This paper proposes a reverse-distillation framework whose student decoder is a dual-branch multi-scale vision transformer. A fine branch and a coarse branch reconstruct shallow and deep teacher features respectively and exchange information through cross-attention, while conditional positional encoding generated by depthwise convolution provides resolution-flexible positions for multi-scale dense outputs, and convolutional patch embedding preserves local texture critical for fine-grained surface defects. The teacher-student feature discrepancy produces a pixel-level anomaly map for localization and an image-level score for detection. Experiments on the MVTec AD benchmark demonstrate that the proposed method achieves competitive image-level and pixel-level AUROC together with strong AUPRO compared with representative state-of-the-art methods.The application of Cross-Attention in industry will bring about different changes and entirely new approaches.

K260177

An Interior Permanent Magnet Synchronous Motor Drive System for Electric Vehicles with Power Factor Correction and On-Board Charging Function

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Keywords: EV, IPMSM drive, bidirectional interleaved DC/DC converter, CLLC resonant converter, totem-pole PFC

Abstract:

This thesis develops a battery-powered electric vehicle (EV) interior permanent magnet synchronous motor (IPMSM) drive with on-board DC/AC charging and grid connection.

For motor drive, an inner current loop and an outer speed loop are adopted. The current controller is designed by ramp comparison and refined through computer-aided simulation. The speed controller uses moment of inertia and friction coefficient identified by system identification and a first-order approximate transfer function. Experiments verify startup, regenerative braking deceleration, and steady-state performance. To improve torque and efficiency, commutation shift angle and maximum torque per ampere (MTPA) control are compared, and both enhance IPMSM performance.

A bidirectional interleaved DC/DC converter is used between the battery and motor drive. The voltage loop adopts a robust voltage error cancellation controller (RVECC), and two independent current loops achieve current sharing. The converter reduces current ripple, supports fault tolerance, recovers regenerative energy, and improves light-load efficiency through a variable DC-link voltage. Tests under a trapezoidal speed profile and the ECE15 driving cycle show higher efficiency and lower battery energy consumption.

For DC charging, a bidirectional full-bridge CLLC resonant converter provides galvanic isolation and bidirectional power transfer between the battery and the DC microgrid. Charging changes from constant-current charging to constant-voltage charging after the rated voltage is reached, and the current decreases. With ZVS in charging and discharging modes, switching losses are reduced and efficiency is improved.

For AC charging, a front-end totem-pole PFC converter converts single-phase AC utility power into DC power, followed by a CLLC resonant converter. The front-end circuit supports wide input voltage and uses filters to suppress switching noise. The control focuses on input current shaping, with PF and THD as key indices. Timing control near zero-crossing reduces current spikes. Experiments show high PF, low THD, and good efficiency.

K260178

Design and User Evaluation of a Smart Guide Interface for Cultural Heritage Tourism Experience: A Case Study of A-Ma Temple in Macao

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Keywords: cultural heritage, smart guide system, interaction design, user interface design, A-Ma Temple, digital cultural tourism, living heritage

Abstract:

With the continued development of digital cultural tourism, mobile guide systems have become an important medium for presenting, interpreting, and facilitating visitor engagement at cultural heritage sites. However, many existing guide applications still rely primarily on map-based navigation, textual descriptions, and image displays, offering limited support for understanding spatial relationships, cultural narratives, ritual practices, and visitors' emotional experiences. Taking A-Ma Temple in Macao as a case study, this paper examines the design of a smart guide interface for cultural heritage tourism from a user interface design perspective. Through user scenario analysis, cultural content organization, information architecture planning, and interface prototype development, the study proposes a design framework consisting of four dimensions: cultural content extraction, spatial route guidance, ritual interaction, and post-visit communication. The proposed system integrates heritage introduction, route navigation, AR-based interpretation, story reading, digital blessing, and check-in editing functions. By doing so, it seeks to transform the guide experience from one-way information delivery into a more comprehensible, participatory, and memorable cultural experience. This study provides a practical reference for the design of digital guide systems for historical temple sites and other forms of living cultural heritage.

K260179

VLSI DDR5 Memory Streaming Architecture for Lumbar Spine Medical Imaging

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Keywords: DDR5, FPGA, medical imaging

Abstract:

Real-time lumbar medical imaging systems require efficient data movement and storage, which drives the development of resource-efficient embedded hardware platforms. This study presents an FPGA-based embedded image data transfer system and implements a memory control architecture based on the access characteristics of Double Data Rate 5 (DDR5) memory using Verilog hardware description language (HDL). The proposed architecture is designed to support high-speed transmission and temporary storage of medical image data. It aims to reduce the memory access bottleneck during image data transfer and buffering while providing a practical hardware foundation for subsequent medical image processing tasks. The control architecture targets a 1.1 V operating voltage, making it suitable for power-constrained embedded systems. Operating at 100 MHz, the proposed platform achieves a total data transfer latency of 7891.24 ms under room temperature and 7910.84 ms under high temperature when transferring 1000 grayscale images, each with a resolution of 256 × 256 pixels. In terms of hardware resource usage, the design uses 373 look-up tables (LUTs) and 366 flip-flops (FFs), corresponding to an estimated application-specific integrated circuit (ASIC) gate count of 3.573k. Experimental results show that the proposed low-complexity DDR5 memory control architecture provides hardware implementation feasibility, system stability, and high-speed data transfer capability. It can serve as a scalable solution for embedded medical image storage and transmission and demonstrates its potential for portable and edge healthcare applications.

K260180

Research on a Smoke Image Background Removal Method Based on Blind Source Separation

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Keywords: Blind Source Separation, Digital Image Processing, Independent Component Analysis, U-Net, Vision Transformer

Abstract:

Background removal is a common and important preprocessing technique in many computer vision applications. However, in certain application scenarios, conventional methods that simply remove background pixels may not be suitable, because the information of the target object and the background may be mixed within the image. Taking the estimation of smoke concentration with light-transmitting characteristics as an example, smoke images are easily affected by current illumination conditions and background textures, which may reduce the accuracy of concentration estimation. To obtain purer smoke image information and improve the reliability of subsequent concentration estimation, this study adopts Blind Source Separation (BSS) to remove background information. BSS is a method that separates and reconstructs independent source signals based only on observed mixed signals. In this study, FastICA, U-Net and Vision Transformer are employed to separate smoke information from background information. In addition, a proposed physics-guided median background reference image method is integrated to enhance the performance of BSS in smoke image separation. In the experiments, the quality of the separated smoke images is used as the basis for evaluating the BSS performance of the three methods, and five evaluation indicators are further applied to analyze the applicability of each method (smoke–background correlation coefficient, background leakage ratio in the separated smoke component, smoke–dark residual correlation coefficient, background edge leakage score, false smoke response in non-smoke regions). The experimental results show that, among the three methods, FastICA, a machine learning-based method, achieves the best performance in smoke image separation. It can more effectively remove background interference while preserving the main smoke information.

K260181

Applying Innovative Kansei Design methods to the Develop-ment of Visual Symbols for Mass Transit Systems

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Keywords: Mass Transit Identification Symbols, Kansei Engineering, Design Methods, Factor Analysis, ANOVA

Abstract:

This study constructs a comprehensive visual symbol design pattern for mass transit sys-tems to address travelers' cognitive challenges with diverse identification symbols. Adhering to design science research, this study integrates Kansei engineering, design methods, factor analysis, and Analysis of Variance(ANOVA). First, visual imageries from developed nations' rapid transit logos were analyzed. Participants' affective imagery evaluations were collected, extracting five primary Kansei semantic attributes through factor analysis. Based on these attributes, five logo design proposals were developed, and the optimal design was validated using ANOVA. The empirical results demonstrate that this scientific approach effectively and rapidly generates high-quality symbol designs. Furthermore, this study synthesizes op-timized logo design guidelines tailored for the Taiwan region, proving that merging abstract Kansei imagery with concrete design thinking significantly enhances visual design efficien-cy.

K260185

Layout Optimization of High-speed Train Luggage Racks Relieving Psychological and Moral Pressure on Short-statured Passengers

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Keywords: User Psychology, Public Transport Service, Short-statured Group, Service Design, High-speed Train Luggage Rack

Abstract:

Based on service design and psychology theories, this study adopts questionnaire survey and observation methods to investigate the psychological and moral pressure experienced by passengers when using high-speed train luggage racks. Data analysis reveals that the conventionally high-positioned luggage racks tend to trigger multiple negative emotions among passengers, including frustration, social awkwardness, safety anxiety, and guilt over seeking help. The research verifies that diversified layouts such as low-level and tiered luggage compartments can effectively reduce passengers' psychological burden. Combining the survey findings, this paper analyzes the changing patterns of pressure brought by facility renovation, and constructs an inclusive luggage service system for high-speed trains suitable for all groups. It calls for public attention to the travel needs of diverse groups, and provides theoretical basis and practical references for the human-centered design and service improvement of public transport facilities.

K260186

U-Net-Based VLSI Image Circuit for the Recognition of Cervical Spinal Fractures, Bone Spurs, OPLL, and Cervical Curvature Abnormal

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Keywords: U-Net, OPLL, bone spurs, fractures, cervical curvature abnormal

Abstract:
Cervical curvature abnormalities, fractures, bone spurs, and ossification of the posterior longitudinal ligament (OPLL) represent common pathologies of the cervical spine. Due to global use of digital devices and an elderly population, the clinical prevalence of cervical spine diseases has been rising, posing a serious threat to human health. To resolve these clinical impediments, this study presents a cervical spine pathology recognition system that integrates deep learning with hardware acceleration. Built on a U-Net architecture, the system automatically segments pathological regions within computed tomography (CT) images, delineating cervical vertebrae C2 through C7, OPLL boundaries, and bone spurs. The trained U-Net achieved an overall pathology segmentation accuracy of 91.92%. The complete digital hardware design was implemented and verified through simulation on the ModelSim platform, yielding condition-specific accuracies of 98.12% for OPLL, 95.42% for bone spur identification, 93.55% for fracture detection, and 83.87% for cervical curvature abnormality recognition. The synthesized digital circuit module utilizes 48,954 flip-flops, 17,511 look-up tables (LUTs), and an ASIC gate count of 66,465 gates. By using a Very Large-Scale Integration framework, the time it takes to do calculations was reduced from 129.56 seconds when done in software to only 2.56 seconds. This design helps doctors look at pictures quickly and focus on the parts that are not normal.

K260187

Designing and Evaluating an Information Security Dashboard Prototype: A User-Centered Design Approach

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Keywords: Information Security, Information Visualization, Usability Evaluation, Material Information Event Disclosure

Abstract:

Information security has become an increasingly important issue in corporate operations and governance. Since 2021, the Taiwan Stock Exchange has required listed and over-the-counter companies to disclose major cybersecurity incidents through the Market Observation Post System. However, these disclosures are primarily presented as plain text with limited integration and visualization. In addition, related news reports are often dispersed across multiple sources, making it difficult for investors and the public to quickly understand the overall context of cybersecurity incidents.

To address this issue, this study develops a visualized information security event dashboard to integrate company disclosures and related online news for Taiwan-listed companies. As a pilot study, this research focuses on the design and preliminary evaluation of a dashboard prototype rather than the implementation of a complete system.

The dashboard was designed using a User-Centered Design approach. User needs and challenges in accessing cybersecurity information were first identified, and a prototype was developed to transform fragmented information into a more intuitive visualization. A small group of users familiar with the Taiwan stock market were recruited for the pilot study. User feedback on interface design and information presentation was collected through observation and interviews. Participants also completed a Technology Acceptance Model questionnaire to provide a preliminary assessment of the prototype's usability and usefulness.

The results provide initial evidence on whether the dashboard improves access to cybersecurity information, enhances users' understanding of cybersecurity incidents, and increases their willingness to seek related information. Compared with existing practices that require users to search across multiple disclosure platforms and news websites, the proposed dashboard integrates relevant information into a single visual interface. This study is expected to provide a reference for applying information visualization to cybersecurity communication and to support future system refinement and formal research.

K260190

A Study on Sustainability Awareness among Wood Industry Stakeholders in Taiwan

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Keywords: Sustainable Development Goals (SDGs), Wood Industry Stakeholders, Sustainable Consciousness

Abstract:

This study examined the relationships between sustainability knowledge, attitudes, and behaviors among wood industry stakeholders and their perceived importance of the social, environmental, and economic dimensions of the Sustainable Development Goals (SDGs). Participants were adults aged 20 and above, including designers and consumers with varying levels of industry involvement (students with or without internship experience and current practitioners). Data were collected using the Sustainability Consciousness Questionnaire (SCQ-S) and a 17-item SDG scale through Google Forms from May 13 to June 13, 2026 yielding 93 valid responses.

Results showed generally high levels of SDG importance. The top five goals were SDG 15 (Life on Land) SDG 6 (Clean Water and Sanitation), SDG 4 (Quality Education), SDG 11 (Sustainable Cities and Communities), and SDG 7 (Affordable and Clean Energy). Designers prioritized SDG 6 and SDG 15 whereas consumers prioritized SDG 15 and SDG 6, indicating shared concern for environmental conservation.

One-way ANOVA revealed significant differences in sustainability attitudes among the three experience groups ($F(2, 90) = 6.225$, $p = .003$). Scheffé post-hoc tests indicated that current practitioners reported significantly more positive attitudes than students without industry experience, suggesting that greater industry engagement is associated with more favorable sustainability attitudes.

Multiple regression analyses showed that sustainability knowledge, attitudes, and behaviors significantly predicted the social, environmental, and economic dimensions of the SDGs (all $p < .001$). Knowledge was the primary predictor of the social dimension ($\beta = .297$, $p = .024$), attitudes and behaviors predicted the environmental dimension ($\beta = .375$, $p = .002$; $\beta = .218$, $p = .043$), and knowledge and attitudes jointly predicted the economic dimension ($\beta = .273$, $p = .025$; $\beta = .290$, $p = .015$). These findings demonstrate that different dimensions of the SDGs are influenced by distinct aspects of sustainability consciousness.

K260191

A Study on the Lineages of Craftsmen of Traditional Architecture in Taiwan: Based on the List of Traditional Masonry Craftsmen Qualified Monument Restorers

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Keywords: masonry craftsmen, cultural genes, lineage analysis, traditional craftsmen

Abstract:

Traditional craftsmen and the techniques they embody constitute a vital foundation for the conservation and restoration of cultural heritage in Taiwan. Although previous studies on traditional architectural craftsmen have generated valuable findings, most have focused on individual cases and lacked a comprehensive examination across different trades and generations.

To address this gap, this study investigated traditional craftsmen involved in cultural heritage restoration, using the master–apprentice data of 208 traditional masonry craftsmen as its primary research material. Through literature review, field investigation, and semi-structured interviews, lineage data were collected and verified. Systematic cross-referencing and lineage analysis were then employed to reconstruct transmission networks, resulting in 91 master–apprentice lineage diagrams.

A gene is the fundamental hereditary unit of biological reproduction, whereas cultural genes apply the principles of biological evolution to cultural transmission. They refer to ideas, behaviours, and styles transmitted through imitation and learning. Drawing on this concept, this study further organized and corrected transmission networks among traditional craftsmen, reconstructing a more comprehensive lineage of traditional masonry craftsmen and analysing their transmission patterns and characteristics.

The findings indicated that, although cultural genes function as fundamental units of cultural evolution, changing historical contexts and diverse pathways of skill acquisition have reshaped the sense of identity within master–apprentice relationships, generating new variations in cultural gene transmission within masonry craftsmanship. In addition to supplementing the historical documentation of Taiwan's traditional architectural craftsmen, this study contributes to understanding the continuity and transformation of traditional techniques in contemporary society and provides important references for heritage restoration training, the preservation of traditional techniques, and the formulation of transmission policies.

K260192

Design and Feasibility Study of a Sky-to-Ground Collaborative Distributed Sensing Ecosystem for Visually Impaired Navigation

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Keywords: Smart Guide Shoes, Distributed Sensor Network, Multi-Sensor Fusion, Universal Design, De-stigmatization, Spatial Audio

Abstract:

Abstract

While the traditional white cane provides blind and visually impaired (BVI) users with physical tactile protection, it remains constrained in long-distance navigation and suspended obstacle detection. Furthermore, single-carrier assistive devices frequently suffer from sensing blind spots caused by visual occlusion. This study proposes an innovative "Sky-to-Ground Collaborative Distributed Sensing Ecosystem" that constructs a comprehensive, de-stigmatized safety net for BVI users through multi-sensor fusion technology.

Based on human gait physics, the system adopts a collaborative hardware configuration across three spatial layers: the upper layer features "Smart Sunglasses" embedded with a micro-camera for traffic signal and crosswalk recognition; the middle layer utilizes a chest-worn "Smart Badge" with millimeter-wave radar for dynamic crowd density analysis and upper-body collision avoidance; the lower layer consists of "Smart Guide Shoes" integrating dual-frequency GPS, an Inertial Measurement Unit (IMU), and a downward Time-of-Flight (ToF) sensor within the midsole for micro-topography reconstruction, precisely detecting curb heights and tactile paving transitions. These modules interconnect via low-power IoT technology and deliver real-time guidance via 3D spatial audio through wireless bone-conduction headphones. Additionally, this study introduces a novel "modular and replaceable pod design," encapsulating core electronics within a waterproof, shockproof housing to resolve the commercial conflict between footwear consumables and high-value electronics.

Feasibility analyses demonstrate that the system does not eliminate the white cane, but establishes a dynamic division of labor between long-range navigation and physical protection. This research fills a scholarly gap in wearable computing regarding multi-carrier deployment and offers a universal design solution with high commercialization potential, enhancing both the autonomy and social inclusion of BVI individuals.

K260193

Development and Performance Analysis of a High-Efficiency Interior Permanent Magnet Synchronous Motor Drive System Based on a T-type Three-Level Inverter

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Keywords: IPMSMs, Motor drive, Wide bandgap semiconductors, Field-Oriented Control (FOC), T-type inverters

Abstract:

This paper presents the development and performance analysis of a high-efficiency interior permanent magnet synchronous motor (IPMSM) drive system based on a T-type three-level inverter. First, a field-oriented control (FOC) strategy with space vector pulse width modulation (SVPWM) is designed, incorporating a neutral-point voltage balancing compensator. A comprehensive simulation model constructed in PLECS validates the dynamic speed tracking capability of the control algorithms and the symmetry restoration mechanism of the DC-link voltage under extreme conditions. Next, a 2.2kW physical hardware drive platform is constructed using wide-bandgap (WBG) semiconductor devices, integrating a solid-state circuit breaker (SSCB) to ensure operational safety. Meanwhile, a double-pulse test (DPT) platform is established to extract the dynamic switching characteristics of the WBG devices, thereby evaluating switching losses. Subsequently, firmware implementation is executed on a digital signal processor (DSP) platform, translating the dual-loop control algorithms and protection frameworks into real-time executable routines to achieve software-hardware integration. Finally, physical motor drive experiments are conducted to evaluate system performance. Experimental results demonstrate that, under switching frequencies of 20kHz and 40kHz, the proposed system significantly minimizes the total harmonic distortion (THD) of the motor phase current and effectively suppresses switching losses compared to conventional two-level inverters. This substantially enhances the overall energy conversion efficiency, validating the practicality of the proposed architecture for next-generation electric vehicle applications.

K260194

Design and Reliability Mechanism Construction of a High-Noise Financial Document Recognition System

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Keywords: OCR, Financial Documents, Data Extraction, Deep Learning, Anomaly Detection

Abstract:
With the advancement of digital transformation in the financial industry, converting large volumes of unstructured financial documents into structured data has become an important task for banking process automation. However, in practical environments, financial documents often suffer from low-resolution images, watermark interference, stamp occlusion, and distorted table structures, which reduce the effectiveness of traditional OCR methods. To address these challenges, this study proposes an AI-based document recognition system designed for noisy financial documents. The system adopts a modular architecture that integrates data preprocessing, deep learning-based OCR recognition, and structured output modules, while supporting system integration through standardized APIs. In addition, a confidence scoring mechanism and anomaly detection are incorporated to improve the reliability and traceability of document recognition in financial applications.

K260195

Exploring the Impact of Role-Playing on Intergenerational Communication and Learning Effectiveness in Anti-Fraud Education

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Keywords: Kebbi Robot, Role-Playing, Intergenerational Learning, Anti-Fraud Education

Abstract:

Fraud prevention has become an important social safety issue for governments around the world. Although governments have invested many resources in anti-fraud campaigns and fraud prevention actions, fraud cases still occur frequently. Both young people and older adults can be victims of fraud. Most current anti-fraud education is delivered through posters, seminars, or short videos. Therefore, this study proposes an alternative approach by incorporating role-playing for perspective-taking, an intergenerational learning model, and social robots, to explore the effectiveness of fraud prevention education and its impact on intergenerational communication between older adults and students. This study adopts a quasi-experimental single-group pretest–posttest design. The participants included 32 high school students and 21 older adults.

The primary experimental tool is an interactive game, "The Great Scam", developed by the researchers for the Kebbi Robot, covering five themes: investment fraud, fake online shopping, fake installment cancellation, romance scams, and "Guess Who I Am" scams. During the activity, students and older adults collaborated through role-playing and task-based challenges.

The results showed that both students and older adults reported positive evaluations of intergenerational communication after the activity. In terms of learning effectiveness, the post-test scores of both students and older adults were slightly higher than their pre-test scores, but the differences were not statistically significant. This may be due to participants' prior knowledge of fraud prevention, which limited score improvement. Nevertheless, participants gave highly positive feedback on the learning model, indicating strong acceptance of combination role-playing, intergenerational learning, and a social robot. Overall, the fraud prevention education model designed in this study demonstrates developmental potential and has a positive effect on improving the quality of intergenerational communication. Future studies should optimize instructional design, extend intervention duration, and increase sample size to better validate its effectiveness.

K260196

Large Language Models for Life Cycle Assessment and Product Carbon Footprint under the Low-Carbon Transition : A Literature Review

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Keywords: Large language models, Life cycle assessment, Product carbon footprint, Carbon accounting, AI-driven sustainability

Abstract:

In recent years, Large Language Models (LLMs) have increasingly been applied in research on Life Cycle Assessment (LCA) and Product Carbon Footprint (PCF), due to their capabilities in text comprehension information extraction, knowledge retrieval, and content generation. Accordingly, this study clarifies the current state of LLM-assisted LCA/PCF research across application fields, task types, and validation approaches. It further identifies major trends, practical value, and research gaps in this area. Following the PRISMA systematic literature review process, this study retrieved publications from the Web of Science and Scopus databases using keywords related to Life Cycle Assessment, Product Carbon Footprint, Large Language Models, and retrieval-augmented generation, ultimately including 44 relevant studies for content analysis. The findings indicate that LLM applications in LCA/PCF have covered multiple industrial domains with data matching, emission factor recommendation, and unstructured information processing emerging as core task areas. To enhance the credibility and traceability of model outputs, recent studies have increasingly incorporated methods such as retrieval-augmented generation (RAG), knowledge bases, knowledge graphs, external databases, and human review. Nevertheless, most studies still focus on procedural tasks and case-level validation. Insufficient verification and application cases are demonstrating how to further integrate LLMs into specific industries' material selection, process planning, standardized carbon footprint calculation, and practical low-carbon decision-making scenarios.

K260197

Design and Development of an Immersive Virtual Reality Serious Game Learning System: A Case Study of Macau Bamboo Scaffolding Craftsmanship

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Keywords: Intangible cultural heritage, Virtual reality, Serious games, Bamboo scaffolding craftsmanship, Cultural inheritance

Abstract:

Bamboo scaffolding craftsmanship is a traditional Chinese construction technique that uses natural materials such as bamboo and wood. Through intricate lashing methods and mechanical principles, it creates temporary working platforms or structures for construction projects and festive events. This craft is both practical and flexible, and it carries significant cultural value, recognized as an important intangible cultural heritage in Macau. However, many of its inheritors are ageing, and the relatively low wages fail to attract young people. Moreover, without a certain foundational knowledge, the general public cannot easily understand or engage with this craft. As a result, this traditional intangible cultural heritage faces numerous problems and challenges. In contrast, with rapid technological advancement, the integration of immersive technologies and gamification strategies into cultural experiences for educational development has become increasingly common both domestically and internationally. Virtual Reality (VR) technology, unconstrained by time and space, can quickly construct virtual representations of physical objects and set learning objectives, thereby enabling the revitalization of cultural heritage and enhancing the convenience of its dissemination. Therefore, this study focuses on the intangible cultural heritage of Macau—bamboo scaffolding craftsmanship—and employs the serious game framework (F4ASG) and its features (e.g., conveying specific knowledge, training skills, or solving practical problems) to design an immersive VR game-based experiential learning system. Through field research, data collection, and interviews with master scaffolders, the researcher selected three foundational techniques—single scaffolding, raking scaffolding, and suspended scaffolding—as the core craft experiences within the system. This aims to provide a reference for future research and practice related to the inheritance, learning, and technological innovation of traditional crafts.

K260199

Exploring the integration of MIT App Inventor , LEGO Robotics, and IoT for STEM learning—using ZMET research methods

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Keywords: LEGO robotics, MIT App Inventor, Internet of Things, STEM education, ZMET, learner-centered design, mobile programming.

Abstract:
This study examines how LEGO robotics, MIT App Inventor, and Internet of Things (IoT) technologies can be integrated to support STEM learning in a learner-centered environment. Although educational robotics and mobile programming have been widely used to promote hands-on learning and computational thinking, many systems emphasize technical functionality rather than learners' underlying perceptions, emotions, and expectations. To address this gap, the study adopts the Zaltman Metaphor Elicitation Technique (ZMET), a qualitative method that uses image-based elicitation and metaphor analysis to uncover deeper user meanings that are often difficult to express directly. The research explores how students or teachers perceive robot-assisted learning, mobile control, and smart connectivity, and then translates those perceptions into prototype design requirements. MIT App Inventor is used as the mobile interface, LEGO robotics serves as the physical learning platform, and IoT functions extend the system toward monitoring, feedback, and remote interaction. The expected outcome is a learner-centered framework that can inform the design of more meaningful and scalable robotics-based STEM learning environments.

K260200

Stock Market Reactions of Taiwan-Listed Apple Supply Chain Firms to Apple's Annual iPhone Launch Events

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Keywords: Event study, Apple supply chain firms, abnormal returns, information disclosure, two-index market model

Abstract:

Apple Inc.'s annual flagship iPhone launch events are scheduled public information events that may lead investors to revise their expectations about supplier revenues, potentially generating abnormal returns for Taiwan-listed Apple supply chain firms. This study applies event study methodology to examine abnormal returns for 65 firm-event observations across four launch events from 2020 to 2023. A two-index market model incorporating returns on the Taiwan Stock Exchange Capitalization Weighted Stock Index (TAIEX) and the Electronic Sector Index is estimated using OLS over a [-140, -31] estimation window and evaluated over a [-15, +15] event window.

Statistical tests based on Brown and Warner (1980) and Boehmer, Masumeci, and Poulsen (1991) show that the [-1, +1] window yields a positive and statistically significant CAAR of +0.8777%. Longer windows are not statistically significant, suggesting that the valuation effect is short-lived. Because the significance is concentrated on event day -1, the results may also reflect anticipatory trading or pre-event expectation revisions.

K260201

Technology as Cultural Mediator: Visual Fusion of Futuristic Aesthetics and Eastern Elements in Zenless Zone Zero

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Keywords: Cyberpunk aesthetics, video game design, cultural sustainability, inclusive design, Zenless Zone Zero

Abstract:

This study examines how digital technologies function as cultural mediators in Zenless Zone Zero. Through visual analysis of scene, character, and UI/UX design, it identifies three strategies—direct incorporation, hybrid reconstruction, and symbolic transformation—through which Eastern cultural elements are integrated with futuristic aesthetics. The findings show that technology does not simply display cultural heritage but actively reorganizes it into new perceptual forms. The study contributes to understanding digital games as sites of cross-cultural communication, offering insights for designers and scholars working at the intersection of digital media and cultural representation.

K260202

An Artificial Intelligence Model for Light Source Position Estimation

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Keywords: light source estimation, artificial intelligence, residual neural network, augmented reality

Abstract:
In an augmented reality (AR) application, incorrect setting of the light sources produces inconsistent shading across the scene and severely damages the fidelity of the virtual models. This work proposes an artificial intelligence model for estimating 3D light source positions in an indoor scene through a 2D image, aiming to improve the quality of AR rendering processes. To reduce the problem complexity, we assume that there are at most five light sources in the scene, residing in the ceiling and the four walls. Our AI model calculates the presence of these individual lights at first. Then, the positions of the available light sources are estimated. The proposed AI model is based on a convolutional neural network (CNN) and is further improved by adding residual blocks to form a residual neural network (RNN). Hence, the proposed AI model reduces feature degradation and gradient vanishing by using residual connection. The proposed AI model is orchestrated as a multi-branch architecture such that it can learn the features hidden in various training data and blend the results of individual branches to produce better estimation. Experimental results reveal that our AI model is able to predict the presence of the light sources with high accuracy. It also produces decent estimations of light positions in an indoor scene if limited light sources are turned on.

K260203

Operationalizing Brand Visual Grammar for AI-Generated Design Consistency: A Preliminary Study Using Lovart

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Keywords: Brand Visual Grammar, AI-Generated Design, Lovart, Brand Consistency, Audience Perception

Abstract:

This preliminary study examines how brand visual grammar can be operationalized as generation constraints in an AI design agent workflow and whether different levels of visual grammar control influence audience perceptions of brand consistency. Using Burger King as a pilot case, the study compares three groups of AI-generated visual materials produced through Lovart: Group A, based on the platform's default inference; Group B, generated through Lovart's brand kit function; and Group C, generated through visual grammar extracted from brand references and brand guidelines. A questionnaire survey with 29 valid responses was conducted to evaluate five indicators: perceived series consistency, closeness to reference images, clarity of brand impression, credibility, and visual preference. The results show that Group B achieved the highest overall mean score (M = 3.66), followed by Group C (M = 3.36) and Group A (M = 2.63). Group B performed more consistently in perceived brand series, closeness to reference images, and credibility, suggesting that the platform's brand kit function can provide a relatively stable sense of brand proximity in this pilot case. However, Group C revealed an important design implication: although extracted brand grammar can increase visual interest and preference, excessive accumulation of colors, typography, icons, patterns, and promotional elements may weaken focal hierarchy and credibility. Therefore, the value of designer intervention in AI-generated brand visuals is not simply to add more brand elements, but to translate brand grammar into controlled visual priorities, density rules, and evaluative criteria. The findings suggest that AI design agents still require human design judgment to achieve brand-consistent outcomes. This study contributes a preliminary framework for connecting brand visual grammar extraction, AI generation conditions, and audience-based evaluation, while clarifying the designer's role as a rule maker, visual editor, and evaluator in AI-assisted brand design.

K260204

From Fu Talismans to Wearable Experiences: Constructing a Cultural Translation Framework for Fashion Design through Artificial Intelligence, Service Design, and Human–Computer Interaction

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Keywords: fulu, generative artificial intelligence, fashion design, cultural translation, human–computer interaction

Abstract:

Fu talismans are not merely decorative symbols; they constitute a visual knowledge system shaped by writing, imagery, ritual context, embodied practice, and culturally specific restrictions. When fulu imagery is transferred directly into contemporary fashion, its symbolic structure and cultural boundaries may be flattened into an exotic surface style. Generative artificial intelligence (AI) can broaden ideation and visualization, but it can also amplify misinterpretation by pro-ducing visually plausible yet culturally inaccurate variations. This study proposes a traceable cultural-translation framework for transforming selected fulu elements into wearable experiences through an exploratory mixed-methods design. Classical texts, published studies, and repre-sentative talismanic images are analyzed to identify cultural sources, visual grammar, symbolic meanings, and restricted content. Semi-structured interviews with experts in fulu practice, Daoist culture, and fashion design are used to validate which elements may be translated, contextual-ized, or excluded. AI is then employed for semantic organization, prompt development, and de-sign visualization, while designers and experts retain final decision-making authority. Co-creation workshops and user questionnaires are planned to evaluate cultural appropriateness, aesthetic value, comprehensibility, trust, cultural identification, and willingness to wear. The re-sulting framework comprises four layers: cultural knowledge, AI collaboration, wearable design, and user experience. By positioning AI as an inspectable, traceable, and revisable collaborator rather than a cultural authority, the study offers a responsible method for integrating traditional cultural resources into contemporary fashion design and human–AI co-creation.

K260205

The Four-Relationship Theory and Organizational Culture in Handweaving: A Case Study of the "Weaving House" in the Seediq Zhongyuan Tribe

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Keywords: handweaving, four-relationship theory, dignity of labour, cultural heritage, Seediq tribe

Abstract:
This study draws on John Ruskin's theory of dignified labour as its philosophical foundation and integrates Cesare Brandi's dual framework of aesthetic and historical conditions from Teoria del Restauro. Adopting a qualitative approach through in-depth interviews and KJ affinity diagram analysis, the study constructs a "Four-Relationship Theory" comprising the weaver's embodied knowledge of materials, autonomous judgment in the creative process, moral imagination toward users, and collective memory as design knowledge rather than mere inspiration. Drawing on Professor Lin Chongxi's concept of "uranium-type organizations," the study reveals that the "Weaving House" — characterized by small scale, high trust, the moral exemplar of unpaid leadership, and collective-consciousness-based evaluation — constitutes the structural condition sustaining these four relationships. Protecting handcraft means protecting the organizational conditions and cultural ecology in which people maintain complete relationships with materials, the creative process, users, and memory.

K260206

Design and Evaluation of a High-Path-Entropy Multi-Hop VPN Based on OpenVPN

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Keywords: Multi-Hop VPN, OpenVPN, Path Entropy, Dynamic Gateway Selection, Traffic Analysis Defense

Abstract:

Traditional Virtual Private Networks (VPNs) route traffic through a single gateway, making transmission paths deterministic and vulnerable to traffic analysis attacks such as website fingerprinting and traffic correlation. To enhance privacy and path unpredictability, this study designs and implements a high-path-entropy multi-hop VPN system based on OpenVPN.

The proposed system employs dynamic gateway selection in a GNS3 emulation environment to construct randomized multi-hop transmission paths. Unlike conventional VPNs with fixed routes, gateway nodes are randomly selected from a node pool, effectively reducing traffic predictability and increasing routing diversity.

To evaluate path uncertainty, this study applies the Chain Rule of Entropy and adopts an equivalent Joint Probability Distribution approach to reduce computational complexity while maintaining theoretical accuracy. This enables efficient analysis of large-scale traffic traces and path combinations.

Experiments were conducted using 280,586 captured packets. Results show that dynamic gateway selection achieves a path entropy of 0.9193 bits in a single-hop environment. Moreover, the calculated joint entropy increases significantly as the number of hops grows, indicating that multi-hop routing effectively enhances path uncertainty and diversity.

Overall, the proposed architecture increases transmission-path unpredictability and strengthens resistance against traffic correlation and timing-analysis attacks. The results demonstrate that combining dynamic route randomization with entropy-based evaluation provides an effective approach for improving privacy protection in OpenVPN-based communication systems.

K260208

Deep Learning-Based Emotion Recognition from Single Heartbeat ECG Using Time-Series Image Encoding and Baseline Signal Normalization

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Keywords: Electrocardiogram (ECG), Emotion Recognition, Deep Learning, Time-Series Image Encoding, Baseline Signal Normalization

Abstract:

Emotion is a complex psychophysiological state that influences both mental and physical health. The growing prevalence of depression and anxiety disorders has increased the demand for accurate emotion recognition systems. Compared with behavioral signals, physiological signals are more reliable, as they reflect internal bodily responses and are less susceptible to intentional manipulation, making them valuable for diagnosis and continuous monitoring of emotional states. This study proposes a deep learning-based framework for emotion estimation and classification using electrocardiogram (ECG) signals. Emotional valence is modeled as both a five-level scale (Level 1–Level 5) and a binary classification (positive vs. negative). ECG signals are segmented into single-heartbeat intervals to capture short-term dynamics. To enhance feature representation, three time-series-to-image transformation methods, namely Gramian Angular Field (GAF), Markov Transition Field (MTF), and Recurrence Plot (RP), are used to convert each segmen into two-dimensional images. ResNet18 is employed for five-level valence estimation, followed by a Multilayer Perceptron (MLP) for binary classification. The dataset is split into 80% training and 20% validation. To reduce inter-individual variability, baseline signals are subtracted from stimulus-induced signals after transformation using the three encoding methods. The resulting images are evaluated individually and in multi-channel combinations, with and without baseline normalization, yielding eight experimental settings. Results show that, without baseline normalization, all four settings achieve suboptimal binary classification accuracies ranging from 68.66% to 80.41%. With normalization, both the MTF-based and three-channel approaches improve accuracy to over 95%. Notably, baseline subtraction enhances five-level valence estimation, which in turn improves binary classification performance. Overall, the proposed framework effectively captures short-term ECG features using advanced image-based representations, outperforming existing approaches and demonstrating strong potential for emotion-aware healthcare applications.

K260209

Development and Design of the Multi-Output Piezoelectric Transducer Driver with Coupled Inductor

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Keywords: piezoelectric transducer, LCC resonant network, coupled inductor, voltage balancing

Abstract:

This paper presents a half-bridge resonant driver that employs a coupled-inductor network to automatically equalize the voltage across multiple piezoelectric transducers and eliminate the problem of poor vibration amplitude caused by variations in transducer impedance and simplifying the circuit. To achieve this purpose, a micro-controller is utilized to generate complementary anti-phase PWM signals, driving a GaN half-bridge inverter to produce a stable high-frequency square wave power source. The power supply is subsequently distributed to two channels configured in an LCC resonant topology. The series resonant inductors of the two channels are tightly wound on a common magnetic core, introducing a dynamic mutual-inductance clamping mechanism. Since each piezoelectric transducer may have a different optimal operating frequency, the output amplitude will vary slightly when the operating frequency of the driver is fixed. This paper proposes a dynamic frequency control strategy that enables each piezoelectric transducer to achieve its optimal operating frequency, resulting in a significant improvement in overall output performance. Finally, a prototype was implemented to verify the feasibility of the proposed method.

K260210

Develop Teachers' AI-TPACK via professional network

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Keywords: AI-TPACK, Learning Circles, Mathematics Pedagogy, Artificial Intelligence Tools

Abstract:

This study investigates the professional development of secondary school mathematics teachers' Artificial Intelligence Technological Pedagogical Content Knowledge (AI-TPACK) through a collaborative learning circle. Utilizing a qualitative research design, data were gathered from focus group interviews and analyzed via thematic analysis, evaluating competencies against an AI-TPACK scale established by Ning et al. (2024). The findings highlight three key instructional themes. First, AI is leveraged for interactive student activities, including gamified quizzes and applets for formula discovery, which sustain student motivation and engagement. Second, teachers use AI to generate novel content representations, such as interactive web applets for geometric transformations and automated blackboard layouts that assist lesson pacing and content comprehension. Third, distinct pedagogical rationales differentiate junior and senior forms; junior instruction utilizes gamification for foundational scaffolding, whereas senior cohorts prioritize exam readiness, conceptual depth, and self-directed error diagnosis using tools like NotebookLM. Despite these pedagogical contributions, teachers encountered distinct technical and accessibility limitations. These include degraded AI graphic quality under extensive prompt revision, unstable mathematical notations failing to format correctly, and geographical barriers for cross-border students alongside tools requiring a virtual private network (VPN). Finally, while the empirical boundaries between distinct AI-TPACK knowledge domains remain heavily integrated and fuzzy in practice, learning circles provide a critical, supportive framework for teachers to successfully execute adaptive, technology-driven instruction.

K260212

Root Cause Analysis for Microservices via Hybrid Causal Propagation with Shapely Attribution

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Keywords: root cause analysis, microservice, causal propagation graph, Shapley value, fault diagnosis

Abstract:

In microservice architectures, anomalies frequently propagate along dependency chains, resulting in root-cause masking, where the true fault source exhibits only weak anomaly signals while downstream victims display prominent deviations. Existing methods either rely on a single data modality or lack rigorous causal attribution, limiting their localization accuracy in large-scale systems. To address this, we propose CPG-Shapley, a novel framework that fuses distributed traces and runtime metrics into a weighted causal propagation graph, leveraging Shapley values to quantify each service's marginal contribution to the observed anomaly. Evaluated on the RCAEval benchmark across three real-world systems under both metric-only and multimodal configurations, CPG-Shapley improves the Avg@5 on Train Ticket from 0.272 to 0.504, and achieves a 0.965 Top-1 accuracy on Online Boutique when traces are integrated.

K260213

Detecting Backdoor Attacks on LoRA Adapters using Activation Path Similarity in Large Language Models

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Keywords: Large language models, Backdoor Attacks, Low-Rank Adaptation, Activation Path Similarity

Abstract:

Large language models (LLMs) are often trained through pre-training to learn linguistic knowledge and world knowledge. However, these models still need fine-tuning on specific tasks to improve task performance. Low-Rank Adaptation (LoRA) is a parameter-efficient fine-tuning method. The core idea is to freeze the original model weights and adapting the model through the low-rank matrices. The LoRA adapter trained for a specific task can be merged with the original model weights, that enabling efficient task adaptation without additional training latency.

However, the feature of LoRA adapters introduces security challenges, making them susceptible to malicious purpose. Attackers can inject hidden backdoors through data poisoning during the fine-tuning. For example, in a jailbreak attack, an attacker injects specific trigger conditions into the training dataset to bypass safety alignment mechanisms. Then, the model continues to work normally when processing standard inputs but generates harmful content once the model meets the trigger conditions. This conditional execution mechanism makes the backdoor difficult to detect through standard work process.

This paper proposes a method to solve the problem by a mechanism called Activation Path Similarity (APS). APS detects hidden malicious patterns in LoRA adapters by distinguishing the relationship between weight activation paths in secure and insecure inference processes. Experimental results show that the proposed APS method can replace the traditional Attack Success Rate (ASR) metric, providing a faster and more clear method for detecting backdoor attacks in large language models.

We compared the time required to detect whether a LoRA adapter had been compromised by a backdoor using APS and ASR, respectively. The analysis using ASR consumed a total of 878.1 seconds. In contrast, APS required only 278.09 seconds. This resulted in a 68.33% reduction in analysis time.

K260215

A Blind Visual Assessment of Generative AI-Assisted Rendering in Interior Design Education

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Keywords: Generative AI, AI-Assisted Rendering, Interior Design Education, Blind Visual Assessment, Perceived Functionality

Abstract:

As generative AI becomes increasingly used in design education, interior design students can now produce visually persuasive renderings with unprecedented speed. Yet a critical question remains: do AI-generated renderings only improve visual impression, or can they also support perceived spatial and functional quality? This study examines generative AI-assisted rendering as a visual design support tool in interior design education. Based on second-year interior design student projects, five spatial scenes were prepared as paired visual stimuli, each including one student-produced rendering and one AI-generated rendering. To reduce source bias, evaluators were not informed of image sources. After data screening, 31 valid responses from students, instructors, and practitioners were analyzed. The renderings were evaluated in terms of creativity, perceived functionality, aesthetics, and overall visual quality. Paired-samples comparisons showed that AI-generated renderings received significantly higher ratings in creativity ($M = 6.47$ vs. 5.68, $p < .001$), aesthetics ($M = 7.05$ vs. 6.44, $p = .001$), and overall visual quality ($M = 78.22$ vs. 75.17, $p = .001$). However, no significant difference was found in perceived functionality ($M = 6.54$ vs. 6.46, $p = .613$). These findings suggest that generative AI can strengthen visual exploration, atmospheric expression, and early-stage design communication, but visually convincing renderings do not necessarily ensure stronger spatial logic, circulation quality, scale accuracy, or functional feasibility. The study contributes to innovation design and creative design education by clarifying the boundary of AI-assisted rendering: it is valuable as a visual ideation and communication tool, but should be integrated with human-led spatial reasoning, critical evaluation, and conventional design training.

K260216

Orchestrating Flow in Cross-Disciplinary Craft Education: An Innovative Instructional Design in the Yan-Zhi Project

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Keywords: Flow Theory, Instructional Design, Intangible Cultural Heritage, Cross-Disciplinary Craft, Curriculum Management

Abstract:

Traditional Intangible Cultural Heritage (ICH) craft transmission often involves long-duration and highly repetitive technical training. In contemporary education settings, while instructors can clearly deliver explicit standard operating procedures (SOPs), learners frequently experience physical fatigue and psychological frustration when faced with monotonous tasks. This structural dilemma of skills being "teachable but hard to retain" leads to a loss of intrinsic motivation and high dropout rates before craft techniques can be fully internalized. To address this critical issue, this study proposes an innovative instructional design model guided by Flow Theory, aiming to systematically manage learner motivation and transform repetitive labor into sustained learning engagement. Using the cross-disciplinary "Yan-Zhi Project"—a 216-hour intensive craft course integrating lacquer art, bamboo weaving, and traditional woodcarving—as an empirical case, this qualitative study investigates the effectiveness of flow-oriented course scheduling. Data was comprehensively collected and triangulated through participant observation, semi-structured interviews, and third-party teaching diaries. The findings reveal that a phased, alternating introduction of the three crafts effectively manages learners' cognitive and physical load, thereby preventing monotony. Furthermore, breaking down the overarching project into clear, session-based micro-goals helps maintain a dynamic balance between challenge and skill. This instructional scaffolding guides learners to perceive immediate material feedback and consciously adjust their actions. Consequently, it successfully transforms tedious repetition into a state of "self-iteration" and flow, facilitating the embodied transformation of explicit instructions into tacit knowledge. Ultimately, this study constructs a scalable curriculum management framework, offering practical, system-level innovations for contemporary ICH preservation and cross-disciplinary craft education.

K260217

Development and Quantitative Decision-Making of Karakuri Mechanisms for Labor-Saving and Ergonomic Enhancement of Middle-Aged Female Operators in Traditional Manufacturing

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Keywords: Traditional Manufacturing, Act of Gender Equality in Employment, Karakuri Mechanisms, Quality Function Deployment

Abstract:

As the workforce in Taiwan's traditional manufacturing industry gradually ages and younger generations show a declining willingness to join production lines, the frontline workforce has become predominantly comprised of middle-aged male and female workers aged 40 to 50. However, the operational environments in traditional manufacturing are often characterized by high physical workloads and repetitive tasks. Female operators frequently bear burdens exceeding their physical capacities, escalating the risk of acute injuries and long-term musculoskeletal disorders, which aligns poorly with the objectives of Taiwan's Act of Gender Equality in Employment regarding reasonable working conditions and the elimination of gender discrimination. Focus on Taiwanese middle-aged female operators, this study proposes a labor-saving and ergonomically friendly improvement solution centered on KARAKURI (low-cost automation) mechanisms. To establish a robust evaluation system, a quantitative decision-making framework is formulated by integrating Quality Function Deployment (QFD), the Analytic Hierarchy Process (AHP), and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). Industry experts were surveyed via questionnaires to gather operational requirements and assess the weight and importance of various requirement dimensions and criteria. Based on the analytical results, a representative KARAKURI prototype was selected for physical fabrication and on-site validation to reduce workload and enhance operational safety and friendliness. The findings of this research provide a quantitative reference for managers in traditional manufacturing when designing intervention strategies. By balancing production efficiency, ergonomic safety, and gender equality, this study further facilitates the development of low-energy, sustainable, and human-centric manufacturing systems, thereby delivering a threefold contribution across academic research, industrial application, and gender equality policy implications.

K260218

Technology Development for Remediating PFAS-Contaminated Soil Using Supercritical CO▮ Extraction Coupled with Persulfate Oxidation

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Keywords: Per- and Polyfluoroalkyl Substances (PFAS), Supercritical carbon dioxide, Soil and groundwater, Persulfate, Advanced oxidation processes (AOPs)

Abstract:

Per- and polyfluoroalkyl substances (PFAS) are emerging contaminants of global concern due to their stable carbon–fluorine bonds, amphiphobic properties, environmental persistence, and bioaccumulation potential. Once released into soil and groundwater, PFAS are difficult to degrade naturally and may cause long-term ecological and human health risks. Current remediation technologies remain limited by low desorption efficiency, high energy demand, secondary waste generation, and restricted field applicability. Therefore, treatment strategies integrating contaminant removal, molecular destruction, and environmental sustainability are urgently needed.

This study aims to develop an integrated remediation system combining supercritical carbon dioxide (SC-CO_2) extraction with persulfate oxidation for PFAS-contaminated soil. Near its critical conditions of 31.1°C and 73.8 bar, SC-CO_2 provides gas-like diffusivity and liquid-like solvating power, enabling penetration into soil pores and enhanced PFAS desorption from solid matrices. By optimizing temperature, pressure, and co-solvent conditions, PFAS extraction and concentration efficiency can be improved. Activated persulfate oxidation will also be incorporated to generate sulfate radicals and related reactive oxygen species, promoting PFAS structural decomposition.

The experimental work includes establishing a rapid ion chromatography method to monitor fluoride and related anions during degradation. Aqueous-phase oxidation tests will evaluate reaction kinetics and oxidative performance, while SC-CO_2 extraction experiments using activated carbon and soil will identify key operational parameters and validate treatment effectiveness. Finally, the integrated process will be assessed for PFAS removal efficiency, technical feasibility, and carbon emission performance. The outcomes may provide a low-solvent, extraction–destruction-oriented strategy for PFAS-contaminated soil remediation and support sustainable treatment of persistent organic pollutants.

K260219

Translating Local Memory through ACG Contexts: A Card-Based Toolkit and Teacher Co-Creation Workshop for Wenshan Coal Mine Culture

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Keywords: AI-Assisted Co-Creation, ACG Contextual Translation, Gamified Learning, Social and Emotional Learning, Wenshan Coal Mine Culture

Abstract:

This study examines how local industrial memory can be reinterpreted through a people–culture–place–production–landscape framework and developed into gamified learning prototypes through a card-based toolkit, ACG (Anime, Comics, and Games) textual frameworks, AI-assisted ideation, and teacher co-creation. Recognizing ACG and game languages as intuitive interfaces for younger learners, it focuses on the Wenshan Coal Mine settlement in Shiding, New Taipei City, treating memory anchors—tunnel spaces, fire-tag systems, mining risks, firefly ecology, and mountain-village life—as place-based learning resources.

A teacher co-creation workshop, "Local Memory and ACG Grammar: A Gamified Teaching Alchemy Workshop," was conducted at Shiding Firefly Bookhouse on May 26, 2026, using the patented Local Revitalization Card Game Device (U-2673-3). The workshop applies a three-layer mechanism. First, participants select a local memory anchor and a local vision. Second, teachers define their expertise and learning objectives; speculative design, design thinking, and an "If Phone Booth" approach serve as thinking tools, while large language models connect these layers to generate a competency-oriented teaching core. Third, this core is transformed through ACG textual logic and interactive forms, with characters, quests, items, card mechanics, maps, and basic digital interaction concepts recombined with AI assistance into local game-experience prototypes for teachers' teaching contexts.

After the scenarios are formed, expert interviews examine the potential of Social and Emotional Learning (SEL) within them. Methodologically, the study adopts design-based research (DBR) and mixed methods, drawing on questionnaires, observations, feedback, card records, and expert interviews. Rather than presenting finalized teaching modules, the workshop shows how teachers use their expertise to initiate original local game-experience prototypes. The study contributes a card-based local memory translation model for transforming cultural materials into narrative, interactive, and extensible ACG learning prototypes.

K260220

MAE-B: Enhancing Masked Autoencoders with BYOL-Based Predictive Learning for Brain MRI Segmentation

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Keywords: Self-Supervised Learning, Masked Autoencoders, Bootstrap Your Own Latent, Brain MRI Segmentation, Medical Image Analysis

Abstract:
The limited availability of annotated medical imaging data remains a major challenge in developing deep learning models for clinical use. Self-supervised learning offers a practical way to learn from unlabeled data, but existing approaches have limitations for medical image analysis. Masked Autoencoders (MAE) can learn useful local image patterns, yet may not fully capture the broader semantic information needed for diagnosis. In contrast, contrastive learning methods can improve semantic representation, but often require large batch sizes, negative pairs, and augmentations that may reduce spatial detail important for segmentation. This study proposes MAE-B, a self-supervised framework that combines masked image reconstruction with Bootstrap Your Own Latent (BYOL)-based predictive learning. The model uses a generative pathway to preserve local spatial information and a predictive pathway to guide the encoder toward more meaningful semantic representations without relying on negative pairs. The proposed method was evaluated using T2-weighted brain MRI scans from the BraTS benchmark, with BraTS 2018 for the main evaluation and BraTS 2017, 2019, and 2020 for unseen temporal datasets. Results show that MAE-B reduced reconstruction error by 98.57% compared with the standard MAE baseline under 40% masking, with statistically significant improvements in reconstruction quality. For brain MRI segmentation, MAE-B achieved a 2.71% improvement over standard MAE and performed as the top self-supervised model among evaluated SSL baselines, including MAE, CMAE, BYOL, and DINO. It also improved CIFAR-10 Top-1 accuracy by 23.13% over standard MAE. The model retained approximately 92.5% of its segmentation performance on unseen BraTS datasets which indicates stable generalization across temporal data shifts. Its strongest performance was observed at mid-range batch sizes, particularly 64 to 128, suggesting reduced dependence on very large batch training. These findings suggest that combining reconstruction-based and BYOL-based self-supervised learning can produce useful visual representations for medical imaging tasks, where annotated data and computational resources are limited.

K260221

Progressive Visual Secret Sharing with Dual OR/XOR Decryption

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Keywords: Visual Cryptography, Progressive Visual Secret Sharing, Dual Decryption, XOR Decryption, Threshold Schemes

Abstract:

Visual secret sharing (VSS) schemes involve a dealer dividing a secret image into n shares such that stacking a sufficient number of shares enables the visual recovery of the secret image, while any insufficient number of shares reveals no recognizable information. This paper investigates the (k, n)-threshold VSS model, where the original image can be perceived only when at least k shares are combined. Among existing decryption mechanisms, the OR operation has been widely adopted because it naturally simulates the physical stacking of transparencies. However, its reconstruction quality is inherently limited due to the accumulation of black pixels. In contrast, XOR-based decryption has attracted increasing attention because it can provide significantly improved visual quality and is now practical due to lightweight digital computation.

Building upon the generalized-Pascal-triangle-based (k, n)-threshold progressive visual secret sharing scheme proposed in 2024, this paper proposes a novel (k, n)-threshold PVSS scheme supporting dual decryption through both OR and XOR operations. The proposed scheme preserves the progressive-viewing property, whereby the recovered image becomes progressively clearer as more shares are combined. Furthermore, the construction retains the mathematical connection between PVSS and the generalized Pascal's triangle, allowing an explicit and systematic design for arbitrary values of $2 \leq k \leq n$. To establish the correctness of the proposed construction, generating functions are employed as an analytical tool to characterize and verify its underlying properties.

To establish the correctness of the proposed method, generating functions are used as an analytical tool to characterize and verify its structural properties. Experimental results demonstrate that the proposed scheme achieves significantly improved reconstruction quality under XOR decryption compared with previous work. Meanwhile, OR-based results remain consistent with the original progressive framework. Overall, the proposed method provides a flexible and efficient PVSS framework with dual-decryption capability and enhanced reconstruction performance.

K260222

An Integrated Smart Parking Guidance and Fallback Routing System Combining LLM-Based Spatial Semantic Perception and Dynamic Crowd-Flow Prediction

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Keywords: Smart Parking, Crowd-Flow Prediction, Spatiotemporal Semantics, Route Optimization, Large Language Model

Abstract:

Conventional urban parking relies heavily on random cruising, which exacerbates traffic congestion and environmental pollution. Existing solutions suffer from critical operational limitations: municipal systems mostly provide real-time parking data across the city, yet a severe gap exists between these instantaneous figures and the actual availability when users arrive at their destinations. Conversely, while private parking operators can predict future vacancies based on their own historical statistics, they cannot access data from competing facilities; this lack of shared information results in low usability for drivers seeking a comprehensive spatial view. To address these research gaps, this study proposes an integrated smart parking guidance system that harmonizes spatial semantic perception and dynamic crowd-flow prediction to deliver proactive and resilient navigation. Operating on a dual-layer offline-online architecture, the proposed system introduces three core innovations. It utilizes a Large Language Model (LLM) paired with geographic APIs to extract structured spatiotemporal parameters from natural language queries, automating global parking lot retrieval. Furthermore, a sequential machine learning model forecasts future vacancy probabilities based on pedestrian dynamics, which are then processed by a multi-criteria optimization algorithm to generate top-N candidate spaces and resilient navigation paths with embedded fallback mechanisms. The feasibility and efficacy of this end-to-end framework are empirically validated using real-world pedestrian flow and parking observation data from Sapporo City, Hokkaido, Japan. Experimental results demonstrate high performance in both prediction accuracy and route-planning adaptability, offering drivers predictive and flexible guidance in dynamic urban environments.

K260223

An XOR-Based Meaningful Visual Multi-Secret Sharing Scheme for Multiple Grayscale and Color Images

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Keywords: Visual Multi-Secret Sharing, XOR Decryption, Meaningful Shares, Visual Cryptography, Bit-Plane Slicing

Abstract:

Visual multi-secret sharing (VMSS) protects confidential image information by distributing multiple secret images into several shares. In an (n, n)-threshold VMSS, all n shares are required to recover the secrets, and any missing share reveals no useful information. Existing meaningful VMSS methods with camouflage shares mainly focus on binary images. Although some studies support grayscale or color images, they usually encrypt only one secret image. To the best of our knowledge, no existing (n, n)-threshold meaningful VMSS simultaneously supports N secret images and grayscale/color image types, where N and n are independent parameters.

To address this issue, this paper proposes an extended XOR-based meaningful VMSS for multiple grayscale and color secret images. Built upon Lo and Juan's XOR-based meaningful scheme for binary images, the proposed method introduces a bit-plane-slicing-based design that enables grayscale and color image data to be processed within the binary XOR-based VMSS framework and reconstructed as meaningful shares. The proposed scheme is evaluated through theoretical analysis and experiments in terms of correctness, security, reconstruction quality, and camouflage quality. Experimental results show that the proposed method can successfully encrypt and recover N grayscale or color secret images, and correct decryption is possible only when all n shares are collected.

Furthermore, to examine the trade-off between efficiency and image quality, two encryption modes, namely 4-bit and 8-bit modes, are designed and compared. The results show that the two modes achieve very similar reconstruction and camouflage performance, while the 4-bit mode significantly reduces encryption and decryption time. These findings suggest that the 4-bit mode is a more practical choice, and confirm that the proposed scheme provides an effective and efficient solution for secure sharing of multiple grayscale and color images.

K260224

Evidence-First, Constrained Vision-Language Extraction of Engineering Drawings for Automated Industrial Quotation

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Keywords: engineering drawing understanding, vision-language model, oriented object detection, active learning, industrial quotation automation

Abstract:

Recognizing engineering drawings for industrial quotation is substantially harder than generic optical character recognition because it couples layout understanding, rotated small-text detection, engineer-ing-symbol recognition, table parsing and cross-block reasoning, and because every extracted value must be auditable before it can enter a commercial quotation. Letting a vision-language model (VLM) read an entire drawing and emit quotation fields directly propagates two systematic errors: the model may output plausible values absent from the drawing, and any optical distortion of an extracted value defeats sub-sequent re-localization. This paper proposes an evidence-first paradigm that inverts this order: the system first constructs localizable candidate evidence, and a constrained VLM is permitted only to select and in-tegrate values from that candidate set, so every reported field is grounded in a candidate identifier, a bounding box and a verification score. The pipeline integrates OpenCV layout normalization, multi-scale OCR candidate generation, a YOLO layout detector and a YOLO-OBB symbol detector for rotated callouts, a six-dimensional candidate-scoring mechanism, rule-based verification, and an active-learning hu-man-in-the-loop. On 19 real fastener drawings, the evidence-first design raises complete-core-field coverage from 10/19 to 17/19 and reduces the human-review rate from 9/19 to 2/19 while increasing grounded evi-dence boxes from 96 to roughly 700, and a five-model local-VLM benchmark identifies grounded, sche-ma-reliable configurations for deployment versus second-pass validation. The approach turns each quo-tation field into a verifiable candidate-id / bbox / score chain, providing an auditable basis for AI-assisted quotation in metal-products manufacturing.

K260225

A Study on the Influence of Visuospatial Attention Characteristics on User Segmentation and Prospective Memory Performance in 3D Virtual Interfaces

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Keywords: Prospective Memory, PRMQ, 3D Cognitive Load, Cluster Analysis, Digital Game Experience

Abstract:

This study aimed to explore the relationship between contextual factors, visual inter-dimensional attention, and subjective prospective memory in 3D virtual games, targeting individuals aged 20 to 29. Previous research has indicated that multidimensional visual exploration increases cognitive load, but traditional memory scales focus on everyday characteristics and cannot measure 3D-specific attentional features.

This study used a self-developed online visuospatial attention questionnaire (N=97) to collect data from May 26 to June 8, 2026. Factor analysis identified four factors: significant dependence on visual cues, cross-dimensional attentional selection load, spatial integration preference for environmental information, and visual path detachment and map-ground separation interference. The visuospatial attention questionnaire showed good internal consistency (Cronbach's α = .892). Cluster analysis categorized users into three groups: autonomous spatial navigation type, high visual guidance dependence type, and adaptive balance type.

The analysis showed that the high visual guidance dependence type scored higher in visual cue salience dependence, cross-dimensional attentional selectivity load, and visual path detachment and map-ground separation interference; the adaptive balance type scored lower, but had the strongest need for spatial information integration; while the autonomous spatial navigation type scored the lowest across all load dimensions. The high visual guidance dependence type had the highest score on the prospective memory questionnaire (a higher prospective memory questionnaire score indicates poorer memory), while the autonomous spatial navigation type had the lowest score. Overall, visual spatial attention characteristics can effectively distinguish user types, and higher visual salience dependence and cross-dimensional attentional load are significantly correlated with decreased prospective and retrospective memory cognitive performance.

K260226

A Tiered Edge Multi-Agent Framework with Semantic Reasoning for Low-Power IIoT Predictive Maintenance

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Keywords: Industrial Internet of Things (IIoT), Edge Computing, Multi-Agent System, Prescriptive Maintenance, Semantic Reasoning, Large Language Models (LLM)

Abstract:

Traditional cloud-based Large Language Models (LLMs) for Industrial Internet of Things (IIoT) faul diagnosis suffer from network latency, high power consumption, and data privacy risks. To address these constraints, we propose an energy-efficient, fully localized heterogeneous edge multi-agent framework. Utilizing a "Compute Tiering" strategy, a resource-constrained Raspberry Pi executes a LightGBM classifier for high-frequency filtering of FFT-extracted vibration features with sub-10ms latency. The system features a highly efficient "event-triggered" mechanism: only upon detecting potential anomalies does it activate an NVIDIA Jetson Orin Nano reasoning agent via the lightweight MQTT protocol. This agent leverages ai offline, lightweight LLM (Phi-4-mini) to translate numerical data into interpretable semantic diagnostic reports. Validated on the NASA Bearing Dataset, this architecture effectively eliminates cloud dependency, drastically reduces communication bandwidth and power consumption, and provides a secure, low-latency, and highly interpretable prescriptive maintenance solution for air-gapped industrial environments.

K260227

Scene-Aware Human Pose Generation for Travel Photography via Fidelity-Guided Conditional Diffusion Models

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Keywords: Diffusion Model, Human Pose Generation, Conditional Image Generation, Travel Photography

Abstract:

With the growing popularity of travel photography on social media, travelers often lack inspiration for suitable poses at famous landmarks, while existing pose recommendation systems mainly rely on predefined templates that offer limited variety and fail to interact with the actual scene. To address this, we propose a scene-aware human pose generation framework based on an Image-to-Image Conditional Diffusion Model, which is conditioned on landmark scene images to generate diverse, context-tailored poses. To train the model, we curated a paired travel photography dataset consisting of approximately 2,000 images across various global landmarks. Through an automated preprocessing pipeline, background scenes were cleared of foreground subjects and paired with their corresponding extracted human skeleton keypoints to serve as generation targets. A Denoising Diffusion Probabilistic Model (DDPM) was employed as the core framework, utilizing a U-Net backbone that takes the concatenation of the scene condition and the noised target image as input. To mitigate limb instability commonly observed in diffusion-based pose generation, we propose a progressive weighted MSE loss that gradually increases the optimization weight of limb regions during training. Experimental results demonstrate that our model generates diverse and scene-compatible poses under different landmarks and viewing angles. Compared to the baseline model, the proposed weighting strategy achieves superior performance in both rule-based skeleton evaluation and Gemini-based assessment, significantly improving pose quality and structural stability. This demonstrates that conditional diffusion models offer an effective and automated solution for scene-aware pose generation in travel photography.

K260228

Designing for Understanding: A Participatory Design Learning Module to Promote Peer Acceptance of Children Using Wrist-Hand Orthoses

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Keywords: participatory design, wrist-hand orthosis, peer acceptance, empathic understanding, inclusive education

Abstract:

Children who use wrist-hand orthoses (WHOs) in elementary schools may experience peer attention, social discomfort, or reduced peer acceptance because such devices are often visually conspicuous and associated with medical use. Previous studies on pediatric assistive-device design have primarily involved device-using children as participants, focusing on improving device appearance, comfort, and user acceptance through co-design. Less attention has been given to engaging typically developing children in design-based learning to better understand peers who use assistive devices.

This study proposes a short-term participatory design learning module aimed at promoting empathic understanding, peer acceptance, and equity awareness among upper-elementary students. The two-week module proceeds as follows: in the first week, students use worksheets, simulated interviews, problem identification, sketching, and group discussion to explore the everyday experiences and needs of children using wrist-hand orthoses. In the second week, selected student concepts are refined by designers and transformed into prototype models, which are then used in classroom usability reflection, questionnaire activities, and peer discussion.

As an initial phase of a broader design-based research project, this paper presents the development and expert review of the proposed participatory design learning module. Three experts are invited to review the module: a design education scholar, an inclusive education specialist, and an occupational therapist specializing in pediatric assistive devices. Their feedback is used to revise the learning tasks, worksheet design, and evaluation activities. The expert review supports the preliminary content validity and practical feasibility of the module.

This study contributes a design-based educational framework that shifts attention from designing only for assistive-device users to designing learning experiences that help their peers understand, accept, and interact fairly with them. The module offers a preliminary model integrating participatory design, assistive-device education, and SDG 4-oriented inclusive learning in elementary schools.

K260229

Integrating Spatial Visual Atmosphere and Aspect-Sentiment Semantics for Cross-Lingual Travel Restaurant Retrieval

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Keywords: Cross-Lingual Recommendation, Multimodal Fusion, Aspect-Based Sentiment Analysis, Contrastive Learning

Abstract:

With the resurgence of international tourism, finding suitable foreign restaurants has become a vital yet challenging part of the travel experience. Existing recommendation platforms present three major gaps: inadequate cross-lingual retrieval, poor translation of domain-specific culinary terms in local reviews, and underutilized visual data from restaurant photos. To address these limitations, this paper proposes an end-to-end multimodal cross-lingual restaurant recommendation framework. First, we design a two-tower retrieval and re-ranking architecture fine-tuned via contrastive learning to align cross-lingual semantic spaces. Second, we introduce an aspect-based sentiment annotation pipeline that extracts structured tags as mediators for data generation, embedding cross-lingual semantic alignments during training to eliminate the need for online translation tools during inference. Finally, we implement an image atmosphere vector fusion mechanism to integrate visual contexts with textual query similarities. Experimental results on a real-world dataset of Japanese food blogs evaluated with Traditional Chinese queries demonstrate the effectiveness of our framework, significantly outperforming baseline models in delivering top-K recommendations that satisfy both semantic and visual atmosphere preferences.

K260230

Effects of Dynamic Lighting Transitions on Player Stress Responses: A Comparative Study of Flickering Light and Sudden Blackout Scenarios

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Keywords: Dynamic Lighting, Game Visual Environment, Psychological Stress, Emotional Response, Player Experience

Abstract:

This study investigates how two types of dynamic lighting transitions, flickering light and sudden blackout, affect player stress responses in game visual environments. A one-factor repeated-measures design was adopted, and 53 valid responses were collected. The results showed that both lighting conditions produced psychological effects above the neutral point of the seven-point scale. Flickering light produced a higher overall mean score ($M = 4.79$, $SD = 0.89$) than sudden blackout ($M = 4.29$, $SD = 0.94$). A paired-sample t-test further indicated a significant difference between the two conditions, $t(52) = 3.585$, $p = .001$. The findings suggest that flickering light is more likely to induce tension, alertness, and discomfort, while sudden blackout tends to increase uncertainty and fear. This study provides design implications for using dynamic lighting transitions to shape emotional atmosphere and player stress in game visual environments.

K260231

EML-Head: A Stabilized Exp-Minus-Log Head for Differentiable Symbolic Regression

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Keywords: Symbolic Regression, Interpretable Machine Learning, Differentiable Programming, Exp-log Operators, Numerical Stability

Abstract:

Symbolic regression discovers compact, inspectable equations, but differentiable formula learners with exponential and logarithmic operators are hard to train reliably: log branches require positive domains, while exp branches can overflow or yield unstable gradients. We present EML-Head, a stabilized Exp-Minus-Log head for differentiable symbolic regression, studied through numerical trainability rather than expression capacity alone.

Our first contribution decomposes the failure modes of base EML-Head variants. Raw EML follows the exp-minus-log primitive but fails across all 20 random trials due to log-domain invalidity. Enforcing positivity on the log branch (PosOnly EML) restores successful training, showing domain invalidity is the earliest hard failure. We then examine exp-side clipping: it must be calibrated, since overly conservative clipping induces underfitting, whereas a calibrated threshold protects without observable penalty on the benchmark.

As our second contribution, we introduce Refined EML-Head, a recipe-locked pipeline combining EML-biased templates, multi-start selection, warm restart, L-BFGS refinement, and affine calibration. Two variants, Refined EML-Head-Q and -A, use quadratic- and affine-corrected templates. We evaluate on a deterministic one-dimensional benchmark of nine target functions, plus a hard-stress follow-up increasing exponential-overflow risk, comparing against PySR, an open-source evolutionary symbolic-regression system.

Under the matched protocol, Refined EML-Head-Q reaches an aggregate mean test MSE of 0.0013629 versus 0.00147239 for PySR at similar runtime; the small margin indicates competitive, not broadly superior, behavior. In the hard-stress follow-up, Refined EML-Head-A and -Q obtain finite-metric aggregate mean MSE of 560.52 and 580.31, while PySR reports 6104.95 with four nonfinite runs. These results suggest EML-style heads can be made practical with explicit numerical protection, calibration, and deterministic refinement. EML-Head is best viewed as a trainable numerical object with an exp/log inductive bias, offering a controlled path toward interpretable differentiable symbolic regression.

K260232

A Task-Aware Mixed Reality Knowledge Graph Using Meta Quest 3 MRUK: Spatial Anchor Transformation and Rule-Based Risk Reasoning

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Keywords: mixed reality, knowledge graph, Mixed Reality Utility Kit (MRUK), task reasoning, risk reasoning

Abstract:

Mixed-reality scene APIs expose rooms, surfaces, anchors, and geometry, but do not encode task requirements, hazards, or warning evidence. This paper presents MR-KG, a task-aware knowledge graph for Meta Quest 3 applications using the Mixed Reality Utility Kit (MRUK). MRUK-compatible records ar transformed into typed spatial nodes while pose, bounds, labels, confidence, timestamps, and coordinate-frame provenance are preserved. TaskNode, RiskNode, UserStateNode, and ActionFeedbackNode support deterministic checks of placement, tool accessibility, and procedural prerequisites. The principal experiment is a reproducible MRUK-compatible simulation benchmark. Five indoor contexts generated 350 anchors; latent states and answer keys were created before observed JSON records were corrupted by 10% missing labels, 8% incorrect labels, and class-conditioned geometric noise. The experiment also contained 300 task-risk cases, equally divided among placement, retrieval, and procedural tasks, with 2-5% missing fields, 3.5-5% Boolean flips, and measurement noise, plus 120 answer-keyed graph queries. Compared with an MRUK-only baseline, MR-KG increased anchor-mapping macro-F1 from 0.809 to 0.950, query success from 76.7% to 92.5%, and risk-detection F1 from 0.565 to 0.924. Ablation identified spatial relations as the largest contributor. The study contributes a task-risk reasoning method and a controlled simulation protocol that establishes reproducible algorithmic validity before external headset and user evaluation.

K260233

A Low-Power Embedded mmWave Radar System with IMU-Based Dynamic Swing Compensation for Navigation Assistance to the Visually Impaired

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Keywords: Assistive technology, electronic travel aid, millimeter-wave radar, sensor fusion, vibrotactile feedback

Abstract:

Visually impaired people face substantial risks during daily mobility. The conventional white cane senses only ground-level contact and cannot detect obstacles suspended at torso-to-head height; ultrasonic aids offer a narrow field of view and report only scalar distance without bearing information; and vision-based aids degrade severely under backlight, darkness, or rain and fog. Moreover, most navigation aids for the visually impaired rely on audio feedback, which masks the ambient sounds users depend on for environmental awareness. To address these gaps, this study develops a smart navigation aid built into the standard white-cane form factor. Running on a low-power embedded platform centered on a dual-core ARM Cortex-M33 microcontroller, it provides forward spatial perception that is robust to lighting and weather and conveys directional information.

The system uses a 24 GHz millimeter-wave radar to acquire the range and bearing of multiple targets ahead, exploiting its ability to penetrate rain and fog and operate independently of ambient light for all-weather detection. An inertial measurement unit continuously estimates the cane's swing attitude during walking, and a rotation-matrix transformation compensates the radar coordinates into a stable, body-referenced frame, eliminating the spurious displacement caused by the cane's swinging motion; this dynamic swing compensation is the core innovation of the study. Sensor-data reception and transfer are handled automatically in hardware, letting the processor maintain a deterministic, low-latency response without polling. Obstacle range and bearing are then encoded as haptic vibration feedback, conveying spatial information without occupying the user's hearing.

Experiments show stable ranging accuracy and bearing discrimination within the core navigation range, together with all-day endurance under low-power operation. This work demonstrates the feasibility of integrating millimeter-wave sensing, inertial compensation, and haptic feedback on a resource-constrained embedded platform, offering an aid that balances all-weather capability, portability, and low power.

K260234

Application and Evaluation of an AR-Assisted Dynamic Visualization System for Footwear Design Presentation and Flow Experience

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Keywords: Footwear design, Augmented reality, Dynamic visualization, Flow experience, Design education, Human-computer interaction

Abstract:

In footwear design education, conventional two-dimensional renderings often limit learners' perception of spatial details, material transitions, and dynamic visual characteristics. To address this limitation, this study developed and evaluated an augmented reality (AR)-based dynamic visualization system for presenting footwear design concepts. Based on flow theory, it examined whether transforming 2D footwear renderings into AR-based dynamic visualizations could enhance design students' flow experience during design observation.

A within-subject experimental design was adopted, and 32 valid paired samples were analyzed. Participants viewed conventional 2D footwear renderings and their corresponding AR-based dynamic visualizations. After each viewing condition, they completed a flow experience scale. Flow experience was examined through focused attention, sense of control, immersion, enjoyment, altered sense of time, and self-perceived flow state. Semi-structured interviews were also conducted to explore participants' perceptions of AR-assisted design visualization. Descriptive statistics and paired-samples t-tests were used to compare the 2D and AR conditions.

The results showed that AR-based dynamic visualization significantly improved participants' overall flow experience compared with conventional 2D renderings. Item-level analysis further indicated significant improvements in perceived real-world context, sense of control, enjoyment of the viewing process, altered sense of time, and self-perceived flow state. Interview findings showed that AR visualization encouraged participants to observe footwear design details from multiple visual angles and increased their intention to interact with design elements, including colors, materials, and surface features.

This study contributes to applied system innovation by demonstrating how AR can function as a computer-aided design presentation system for footwear design education. The findings provide empirical evidence that immersive visualization technologies can support design concept observation, design communication, and early-stage product visualization.

K260235

A Study on Museum Staff's Agency in Curatorial Design within Indigenous Local Museums

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Keywords: Indigenous local museum, Curatorial design, Museum staff agency, Tsou, Tsou Natural and Cultural Center

Abstract:

Confronting friction between state bureaucracy and traditional tribal society, alongside the pervasive scarcity of frontline human and material resources, Taiwan's indigenous local museums are often deemed destined for failure due to standardized performance appraisals and a lack of tribal recognition. Grounded in curatorial design, this study analyzes how indigenous local museum staff exercise agency to transform curation into an intervention for institutional innovation and relational reconstruction. This research investigates the Tsou Natural and Cultural Center, located at the geopolitical intersection of the Tfueuy and Tapangu communities. Data were collected via semi-structured interviews with cultural specialists to gather primary data, and analyzed using the KJ method to systematically consolidate fieldwork texts.

The findings reveal staff's curatorial design agency in three dimensions: (1) Regarding institutional and spatial curation, staff achieved a platformization of museum governance through technical supplement and network mobilization. (2) Regarding relational and participatory curation, staff coordinated among local communities, empowering tribal members to become active agents who autonomously quality-control exhibitions. (3) Regarding intangible cultural curation, staff activated and translated memories of elders through decolonial knowledge translation, transforming their shared memories and perspectives into curatorial vehicles for diverse cultural transmission.

In conclusion, museum staff's curatorial design agency serves as the linchpin for transforming institutional friction, providing empirical references for sustainable governance and participatory curation in local indigenous museums.

K260236

Developing a Multimodal Deep Learning System for Social Media Image Anti-Fraud: Investigating the Impact of Dataset Ratios on Feature Generalization

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Keywords: Online Scam Detection, Multi-Modal Analysis, Deep Learning, YOLOv8, EasyOCR

Abstract:

In recent years, with the ubiquity of smart devices and the rapid evolution of social media, online scam cases have continuously escalated. Fraudulent information now propagates widely within brief intervals, posing a severe threat to public financial security. Consequently, effectively enhancing the detection and identification of online scam messages has emerged as a critical research imperative.This study investigates the impact of varying training data ratios on scam detection model performance, constructing three independent datasets with positive (scam) to negative (non-scam) ratios of 50:50, 60:40, and 70:30 for empirical analysis. Utilizing the Roboflow platform, spatial bounding boxes were annotated for scam-related texts and imagery. The framework integrates YOLOv8, EasyOCR, and a Gradio user interface to construct an end-to-end multimodal fraud detection pipeline, evaluated using academic metrics including Precision, Recall, and F1-Score.Experimental results demonstrate that among the three configurations, the 70:30 dataset yields the most superior and optimal performance in terms of F1-Score . This suggests that moderately augmenting the proportion of adversarial scam instances effectively reinforces the neural network's capacity to learn target features. Furthermore, it significantly refines the deep learning model's performance regarding both spatial localization and feature generalization when processing deceptive information, ensuring overall architectural stability.The empirical insights and methodology developed in this study provide a definitive benchmark for training dataset design, model implementation, and optimization strategies in future research, thereby enhancing the practical application and long-term viability of anti-fraud engineering technologies.

K260238

Incremental Learning for Passenger Boarding-and-Alighting Safety: Mitigating Catastrophic Forgetting via Backbone Freezing and Imbalance-Aware Adaptation

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Keywords: Bus-door anti-entrapment, catastrophic forgetting, class imbalance, incremental learning, YOLO

Abstract:

Bus-door pinch and dragging incidents during passenger boarding and alighting remain a persistent public-transit safety problem, particularly for elderly passengers, children, and those whose belongings—backpacks, handbags, or clothing—become trapped as doors close. Vision-based anti-entrapment systems offer a proactive alternative to conventional pneumatic anti-pinch mechanisms, yet a detector deployed across real fleets must continually accommodate newly observed hazards and operating conditions, while retraining from scratch on all accumulated data is impractical under the storage, privacy, and compute constraints of on-vehicle operation. This study presents an incremental-learning framework for boarding-and-alighting safety that updates a YOLO-based detector of passengers and belongings across a sequence of class additions while resisting catastrophic forgetting. To preserve previously acquired representations, the detector backbone is frozen and only the higher detection layers are adapted as new hazard categories are introduced; to counter the severe old-versus-new class imbalance inherent to incremental updates, we combine class-aware resampling, tuned augmentation, and custom class-loss weighting, supported by a small bounded exemplar buffer. Under a class-incremental protocol, and using naive fine-tuning and joint training as references, we analyze whether backbone freezing and imbalance-aware adaptation can retain performance on previously learned hazards while accommodating new ones. The resulting framework offers an affordable, retrofittable path toward continually adaptive door-safety monitoring for existing buses.

K260239

Self-Calibrating CNN-DNN Fusion for Long-Term Indoor Positioning

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Keywords: Indoor positioning, Signal fingerprinting, Dynamic indoor environment, Precision enhancemen, Crowd-sourced data

Abstract:

Indoor positioning systems (IPS) based on wireless signal fingerprinting are widely used, but their accuracy frequently degrades over time due to dynamic environmental changes and signal fluctuations. Maintaining long-term accuracy usually requires frequent, labor-intensive site surveys to update fingerprint databases, which incur significant data collection costs. To address this challenge, this paper proposes an adaptive precision enhancement framework that achieves long-term, high-accuracy indoor localization while keeping data collection costs remarkably low. The core of the system uses a CNN-DNN fusion neural network; the Convolutional Neural Network (CNN) serves as a feature extractor to capture spatial dependencies from Received Signal Strength Indicator (RSSI) measurements, while the Deep Neural Network (DNN) serves a the label predictor to estimate the user's location. Unlike traditional static systems, the proposed framework employs a continuous, self-calibrating mechanism consisting of a Distance Error (DE) Analyzer and a Fine Tune Regulator. Using limited, crowd-sourced feedback, such as corrected location labels provided by maintenance crews, the DE Analyzer monitors the Mean Distance Error (MDE) at specific Reference Points (RPs). When the localization error exceeds a predefined threshold, the Fine Tune Regulator adapts the model's weights using targeted, limited data. To prevent the model from overfitting to specific reference points, the system also implements periodic overall model updates using small amounts of complete data. Experimental evaluations conducted over several months using real-world environments and public datasets demonstrate that this "RP Specialized Fine Tune" approach significantly outperforms traditional deep learning models and conventional update methods. The proposed system successfully maintains high localization precision and robust long-term adaptability to environmental changes, all while eliminating the need for expensive, large-scale dataset reconstruction.

K260240

Development of an Intelligent Control System for Cucumber Powdery Mildew Suppression in Greenhouse Environments

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Keywords: Powdery Mildew Suppression, Intelligent Control System, Fuzzy Control, Reinforcement Learning

Abstract:

Powdery mildew is a common disease in greenhouse cucumber cultivation, and its occurrence is closely associated with environmental conditions such as low temperature, high humidity, and poor ventilation among plants. To reduce the risk of powdery mildew occurrence while considering the construction cost and practical applicability of the control system, this study developed an intelligent control system for suppressing powdery mildew in cucumbers. The system performs localized environmental control in the plant-growing area through a self-designed air duct and hot-air regulation mechanism, aiming to reduce humidity, increase temperature, improve ventilation, and minimize leaf overlapping and adhesion. Accordingly, a disease-suppression control model suitable for greenhouse environments was established.

The system developed in this study adopts a hot-air supply mechanism composed of a fixed heat source and a fan. Based on the negative-gain characteristic that the outlet air temperature decreases as the fan speed increases, a hot-air temperature control strategy was established. By adjusting the fan speed in real time, the system can drive the outlet air temperature toward the setpoint within a relatively short transient response time. In terms of the control architecture, edge computing hardware was introduced and integrated with a reinforcement learning-assisted fuzzy control method to improve the real-time performance, stability, and adaptability of hot-air temperature control. Furthermore, this study conducted multiple target-temperature control experiments to evaluate the control performance of the intelligent control system under a fixed heat source configuration. The experimental results showed that the system achieved an average steady-state temperature error of 0.62 °C, demonstrating stable temperature regulation capability. Meanwhile, the experimental results also helped clarify the system limitations and practical application range under the fixed heat source architecture.

K260241

Design of a fault phase detector for partial discharge of rotating motor stator

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Keywords: three-phase rotating motor, partial discharge, three-phase amplitude-time relation diagram, fault phase detector

Abstract:

Defects in the insulation layer of rotating motors during manufacturing or prolonged operation can lead to insulation breakdown during operation, resulting in equipment shutdown and economic losses. Partial discharge (PD) detection is an effective method for assessing the insulation condition of power equipment and early fault identification. This study employs a three-phase amplitude-time relation diagram (3PATRD) to design a fault phase detector for partial discharge in the stator windings of three-phase rotating motors. By analyzing the amplitude and time of measured signals, it can not only identify whether partial discharge occurs but also directly determine which winding phase experiences partial discharge from the distribution diagram results, accurately locating the fault phase.

Applying the three-phase amplitude-time relation diagram to locate the fault phase of a rotating motor's stator winding has another significant advantage. It is not affected by noise interference that reduces identification accuracy. Since noise in the three-phase stator winding produces signals with identical amplitudes and timings, the corresponding distribution points on the three-phase amplitude-time relation diagram will cluster around the origin. Signals occurring at the origin are considered noise and can be disregarded, that will effectively minimize misjudgments caused by noise interference.

K260242

Bridging Theory and Practice in Robotics Education via a Two-Stage Jigsaw Method

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Keywords: Robotics education, Jigsaw method, Reverse role-interchange, Theory and practice integration

Abstract:
While the 'Robot Control and Practices' course aims to integrate automatic control theory with hands-on skills, students often exhibit polarized preferences—excelling solely in theory or exclusively in practice—hindering this goal. This study proposes a two-stage Jigsaw design. First, a traditional Jigsaw consolidates inherent strengths. Second, a reverse role-interchange mechanism fortifies respective weaknesses. Using mixed methods, initial quantitative tests showed non-significant differences, though qualitative feedback indicated cognitive shifts. However, after a three-week practical verification phase, delayed post-tests demonstrated significant improvements and knowledge retention across both low-achieving groups. Ultimately, this approach rectifies functional divisions and fosters well-rounded skill development.

K260243

A Reference-Based Strategy for Synthetic Defect Generation in Imbalanced Industrial Datasets

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Keywords: 2D image processing, image acquisition, stable diffusion

Abstract:

Abstract—Precise inspection of metal surfaces is critical for enhancing product quality and production efficiency. However, industrial datasets are often imbalanced, with limited defective samples, hindering model accuracy. This paper proposes the Metal Defect Detection and Synthesis (MDDS) framework, integrating Stable Diffusion with an image-to-image pipeline and mask enhancement. By dynamically adjusting defect shape, size, and location, MDDS generates realistic and diverse defect images. Additional processing, including Canny edge detection, contour analysis, and nonlinear distortion, ensures defects retain key features and color consistency while increasing variability. Preliminary experiments demonstrate that MDDS effectively augments data, enhancing defect detection performance and supporting industrial quality control by reducing manual workload and production losses.

K260244

Optimizing Specimen Placement Process in Hospital Laboratory Medicine Department – A Case Study of National Taiwan University Douliu Branch

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Keywords: Medical Laboratory, General Design, Visual Indicators, Error-Proofing Design

Abstract:

With Taiwan's aging population becoming increasingly severe and the proportion of elderly people constantly rising, the Department of Laboratory Medicine at National Taiwan University Douliu Branch is experiencing a surge in patient testing demands, leading to various problems. This study, through on-site investigation, identified pain points in the laboratory, including unclear labeling of specimen placement areas, resulting in increased patient errors and affecting testing accuracy. This also facilitates specimen correction by third parties, increasing contact frequency and raising hygiene concerns. Therefore, this study, focusing on the needs of patients of different age groups, designed a universal and efficient process to improve specimen placement.

This study, through on-site investigation to identify pain points, reviewed literature, referenced domestic and international implementation plans for universal designs, and used semi-structured interviews and scenario simulation analysis to identify bottlenecks and propose solutions. For error prevention, a collection box with shape and color matching the test tubes was developed. When the color and shape match, the test tubes can be successfully placed into the collection box. This solution is provided for the hospital's reference, testing, and modification to ensure timely resolution of specimen placement issues in the future.

K260245

Multi-Factor Analysis of Particulate Matter Emissions in Small-scale Coffee Roasting

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Keywords: Coffee Bean Roasting, Airborne Particulate Matter, PM2.5, PM10, Health Risk Assessment

Abstract:

The International Agency for Research on Cancer (IARC) has classified outdoor particulate matter (PM10) as a Group 1 carcinogen because it deposits deep in the lungs and causes serious health risks. While everyone knows about pollution from cars or waste burning, we still do not know much about the dust and particles coming from coffee roasting. This study tries to fill this gap by looking at how four main things affect these emissions: bean variety (Arabica vs. Robusta), where they came from (Kenya, Colombia, and Indonesia), how they were processed (natural, washed, and honey), and how long they were roasted. By measuring both PM2.5 and PM10, we built an emission factor model to see how these particles behave. Our data show that during dark roasting, PM2.5 and PM10 levels peak at 87 ug/m3 and 143 ug/m3. According to the Taiwan Ministry of Environment, these levels are "unhealthy for all groups" and "unhealthy for sensitive groups." Because of this, we recommend upgrading ventilation and air conditioning systems, using personal protective gear, and putting in local exhaust systems to protect workers. These results can be a helpful guide for making safety rules in the coffee roasting business.

K260246

Capsule Press Through Packaging Defect Detection Using a YOLOv13-Based Object Detection Approach

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Keywords: Press Through Packaging, Nitrile Butadiene Rubber, Aluminum Foil, Food Safety, YOLOv13

Abstract:

With the growing demand for health food products, capsule formulations are widely used due to their stable dosage, complete enclosure, and convenience of administration. Press Through Packaging (PTP) helps maintain product quality and prevent moisture and contamination. However, during high-speed automated production, defects such as missing capsules or foreign materials, including nitrile butadiene rubber (NBR) glove fragments and aluminum foil, may occur, leading to potential food safety and quality concerns. This study applied YOLOv13-based object detection to develop an automated inspection model for detecting safety and quality defects in capsule PTP. Image data of capsule appearance, foreign materials, and defect categories were collected and analyzed to train the model for real-time abnormality detection. The YOLOv13 model achieved a Precision of 92.0%, Recall of 85.8%, and F1-score of 0.8879, indicating its potential for automated defect detection in capsule PTP production.

K260250

A Methodology for Interpreting Complex Practice Structures in Design Organisations

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Keywords: Industrial Design, Design Practice, Design Typology

Abstract:

Contemporary design practice has become increasingly diversified, expanding both its roles and modes of practice. Design practice subjects often engage in multiple forms of design practice rather than a single orientation. Nevertheless, they are generally understood through a dominant practice or representative orientation. For example, corporations are typically regarded as market-oriented, while public organizations are perceived as public-interest-oriented. Such perspectives are limited in explaining the diverse practices and resource allocation patterns that coexist within a single subject.

To understand this diversification, a previous study(Cheon, 2026) proposed an analytical model based on the ideal-type methodology, structuring design practice along two dimensions: value orientation and problem approach. Building on this model, the present study proposes a methodology for interpreting the orientation structure of design practice subjects by synthesizing the analytical results of multiple design practices.

Individual design practices are defined as practice units and assessed using a three-level scale based on indicators of value orientation(X-axis) and problem approach(Y-axis). Rather than precise measurement, this approach supports the interpretation and comparison of orientation structures. The resulting positions are visualized through resource-weighted bubble maps, allowing orientation and resource allocation to be represented simultaneously. Distribution patterns are then used to interpret practice diversity and orientation.

Two hypothetical companies with different orientations are used as illustrative cases. The study explores how the proposed framework can capture differences among practice subjects and represent complex practice structures that are difficult to reveal through single-type classifications.

This study extends the scope of analysis from the interpretation of individual practice types to the interpretation of orientation structures at the practice-subject level. It contributes a methodology for understanding how diverse design practices are distributed and concentrated within a practice subject.

K260251

Understanding Consumer Adoption of BNPL Services in Taiwan: A Value–Risk Perspective across Product Involvement Contexts

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Keywords: BNPL, FinTech, Technology Acceptance Model, Value-based Adoption Model, perceived risk

Abstract:

Buy Now, Pay Later (BNPL) has become a rapidly growing financial technology (FinTech) payment solution that enables consumers to obtain products immediately while deferring payments through installments. Although BNPL offers convenience and financial flexibility, it may also increase consumers' perceived financial risk. This study investigates the factors influencing consumers' intention to adopt BNPL by integrating the Technology Acceptance Model (TAM), the Value-based Adoption Model (VAM), and perceived risk theory.

Using Taiwan's survey data analyzed with PLS-SEM, the results indicate that perceived value positively influences BNPL adoption intention, whereas perceived risk negatively affects usage intention. Perceived usefulness, promotional incentives, and social influence significantly enhance perceived value, while perceived ease of use does not have a significant effect. Furthermore, product involvement contexts moderate consumers' decision-making processes. Perceived value exerts a stronger influence in low-involvement contexts, whereas perceived risk has a greater impact in high-involvement contexts. The findings enrich the FinTech literature on digital payment adoption and provide practical implications for BNPL providers in developing product designs and marketing strategies that balance consumer value and risk perceptions.

K260252

Design and Implementation of an Intelligent Automated Eggshell Quality Inspection System Based on YOLO11

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Keywords: Eggshell Defect Detection, Deep Learning, Computer Vision, Smart Agriculture, Automated Inspection System

Abstract:

Eggs commonly exhibit two major types of defects during the production process. The first type is shell cracks caused by collisions, which render the eggs unsuitable for sale and require their removal from the production line. The second type is fecal contamination occurring during handling and production, where the affected eggs must undergo cleaning before entering the distribution channel. In this study, egg samples were collected from a large-scale poultry farm and categorized into three classes: normal, cracked, and contaminated eggs.

Conventional egg quality inspection in poultry farms primarily relies on manual visual examination. This approach is labor-intensive, time-consuming, and highly dependent on inspectors' experience and subjective judgment, which may lead to incorrect classification of defective eggs. Such limitations can negatively affect food safety, product quality, and market competitiveness. To reduce labor costs and improve inspection efficiency and accuracy, this study proposes an intelligent eggshell quality inspection system that integrates artificial intelligence and computer vision technologies to achieve automated egg quality assessment.

The proposed system adopts the YOLO11 (You Only Look Once v11) deep learning model as its core detection framework. By leveraging YOLO11's powerful feature extraction and multi-scale feature fusion capabilities, the system effectively improves defect detection accuracy while maintaining real-time processing performance. Experimental results demonstrate that the proposed method achieves an overall classification accuracy of 96% in distinguishing normal, cracked, and contaminated eggs.

To evaluate its practical applicability, the developed fully automated inspection system was validated in a real poultry farm environment. The results indicate that the proposed system can significantly reduce labor requirements, enhance egg quality control, and improve production efficiency. The proposed system demonstrates the potential of AI-driven inspection technologies for smart poultry farming and sustainable agricultural production.

K260253

Resilience Generation of Community Governance in the Con-text of Non-Market Exchange: The Hidden Dynamic Mecha-nisms of Layperson Subject Transformation

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Keywords: Non-market Exchange, Reciprocal Practice, Community Resilience, Community Governance

Abstract:

Existing studies on community governance have primarily focused on institutional design and public participation, with limited attention to how local public action continues after formal community development projects. Drawing on a six-year longitudinal field study of the Riverside Community along the Liuchuan River in Taichung, Taiwan, this study examines how non-market exchange and reciprocal collaboration stimulated cross-community exchange and supported the continuity of local public action. The findings show that local practices created a demonstration effect that encouraged neighboring communities to engage in shared learning and exchange. This study proposes Reciprocal Practice as an analytical perspective for understanding how non-market exchange supports the continuity of local public action.

K260254

Semantic Detection and Defense Against Data Poisoning Attacks in Federated LLM Fine-Tuning

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Keywords: Federated Learning, Large Language Model, Fine tuning, Data Poisoning Attack, Security Repair

Abstract:

In recent years, Large Language Models (LLMs) have demonstrated remarkable capabilities in natural language understanding and generation, leading to their widespread adoption in intelligent assistants, question-answering systems, content generation, and programming assistance. To address privacy concerns and distributed training requirements, Federated Learning (FL) has been increasingly applied to the fine-tuning of LLMs. However, in FL environments, malicious clients may launch data poisoning attacks by injecting harmful samples into their local training datasets. Such attacks can cause models to learn unsafe behaviors and upload contaminated model updates, thereby compromising the safety of the global model.

This study proposes a behavior-based malicious client detection and defense framework for federated large language model fine-tuning. The proposed framework first employs an Harmful Score Gap (HS-GAP) detection mechanism to identify high-risk clients whose behaviors significantly deviate from those of other participants. To reduce false detections caused by fluctuations in a single communication round, a Suspicious State Transition Mechanism is further introduced to track client behaviors across multiple rounds and verify whether abnormal behaviors persist over time, thereby improving the stability and reliability of the detection process. An Attack Level assessment mechanism is established to categorize malicious clients according to different risk levels and quantify the severity of security threats. By leveraging harmful-data-guided safety alignment, we propose a repair strategy, based on Panacea mechanism, to suppress the accumulation of harmful behaviors.

Experimental results demonstrate that the proposed HS-GAP mechanism effectively mitigates the impact of compromised clients and enhances the security and stability of federated LLM fine-tuning by combining with aggregation exclusion and defense-oriented repair strategies.

K260255

A Neuromorphic Human Detection System Using Thermal and Event Cameras for Humanoid Robotics

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Keywords: human detection, event camera, energy-efficiency

Abstract:

Humanoid robots require efficient perception systems capable of detecting and recognizing humans while operating under strict power and computational constraints. Conventional vision systems based on RGB cameras often face challenges related to privacy concerns, sensitivity to lighting conditions, and high processing requirements. Neuromorphic sensing technologies offer a promising alternative by providing event-driven data acquisition and low-latency operation.

In this work, we propose a multimodal human detection system that combines a thermal camera and an event camera for neuromorphic humanoid robotic applications. The event camera is used to detect motion and identify regions of interest, while the thermal camera provides temperature information that can be used to distinguish human subjects from surrounding objects. By integrating these complementary sensing modalities, the proposed system aims to achieve robust and privacy-preserving human recognition with reduced computational overhead.

The system is currently under development, including sensor integration, data acquisition, and hardware implementation. Preliminary results demonstrate the feasibility of combining thermal and event-based sensing for human perception tasks. The proposed approach has the potential to support energy-efficient perception systems for future humanoid robots operating in real-world environments.

K260256

A Study on A Dual-Loop Controlled Generative AI System in Education

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Keywords: Dual-Loop Controlled GAI System(DLCGAIS), Generative AI (GAI), Retrieval-Augmented Generation (RAG), AI Collaborative Teaching, Knowledge Base, AI Hallucination

Abstract:

With its powerful content generation, Generative AI (GAI) is widely used to enhance learning effects. However, its tendency to prioritize fluency over accuracy conflicts with educational requirements, often causing serious issues such as learner hallucination, divergence, or cognitive overload due to inaccurate or extraneous content.

To address these challenges, coupling GAI with a Retrieval-Augmented Generation (RAG) accessed curricular knowledge base provides an effective solution. Instructors can construct this knowledge base using class syllabi, teaching contents, FAQs, and instructional materials. RAG constrains the GAI to retrieve information exclusively from this verified base, eliminating hallucinations. Furthermore, when a learner's query falls outside the knowledge base's scope, it signals potential learning divergence or an extra learning need, prompting instructors to review and potentially enhance the curricular content.

Based on this approach, this paper proposes a Dual-Loop Controlled GAI System (DLCGAIS):

1. The Inner Loop: Constrains GAI-generated content within the curricular scope of the instructor-constructed knowledge base via RAG. This prevents hallucination, divergence, or overload, thereby consolidating learning paths, accelerating knowledge internalization, and achieving adaptive learning.
2. The Outer Loop: Governs the revision and enhancement of the knowledge base. When learners submit queries outside the established scope, instructors can consult an external general-purpose GAI to acquire the relevant content and update the knowledge base accordingly to satisfy student needs.

With this dual-loop architecture, the proposed DLCGAIS successfully mitigates the inherent risks of standard GAI, ensuring accurate, focused content delivery while maintaining curricular flexibility to enhance overall educational effects.

K260257

Co-Creation and Collaborative Practices in Interdisciplinary Creative Teams

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Keywords: Rapid Production, Interdisciplinary Collaboration, Audience Participation, Creative Anxiety

Abstract:

As the production cycle of audiovisual content continues to shorten, creators are increasingly challenged to balance production speed with artistic depth. At the same time, audiences have become more active participants in the construction of meaning. In contemporary media production, interdisciplinary collaboration has emerged as a prevalent creative model, bringing together individuals from diverse backgrounds to generate innovative ideas. While such collaboration expands creative possibilities, it also introduces challenges related to communication, coordination, and creative decision-making. Roland Barthes' concept of the "Death of the Author" suggests that meaning is not solely determined by the creator's intention but is co-constructed through audience interpretation. This perspective provides a useful framework for examining contemporary collaborative creative practices.This study investigates the relationships among rapid production, interdisciplinary collaboration, and audience participation through a practice-based research approach. The research team consisted of three graduate students with backgrounds in film production and three graduate students from non-art and design disciplines. Over a three-week course, the team collaboratively produced a stop-motion animated short film. Throughout the creative process, participants reflected on their roles as creators and considered how audiences might engage with and interpret the work. The findings indicate that rapid production constraints encouraged participants to abandon individual creative routines and rely on continuous discussion and adaptation. Interdisciplinary collaboration enabled the integration of diverse expertise, allowing the team to complete the project despite limited resources and time. Furthermore, audience participation was reflected in the team's expectation that the work would remain open to multiple interpretations and reinterpretations. These three dimensions—rapid production, interdisciplinary collaboration, and audience participation—were found to be mutually reinforcing throughout the creative process.

K260259

Compact Band-Pass Filter Using Coupled Microstrip-Coplanar Lines

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Keywords: compact, band-pass filter, coupled microstrip-coplanar lines, coupled microstrip lines

Abstract:
This paper proposes a compact band-pass filter using the coupled microstrip-coplanar lines. Compared to the band-pass filter using the coupled microstrip lines, the band-pass filter using the coupled microstrip-coplanar lines has a length of 9.1285 mm, which is significantly shorter than the length of 63.6067 mm of the band-pass filter using the coupled microstrip lines, resulting in an 85.65% reduction of the overall circuit size. Besides, the first harmonic frequency of the filter can be pushed farther away from the filter’s passband, enhancing the filter's out-of-band rejection. To verify the simulation results of these filters, the compact band-pass filter using the coupled microstrip-coplanar lines and the band-pass filter using the coupled microstrip lines are implemented and measured, where the measurement results agree with the simulation results.

K260262

NHURO-MT: Event-Driven Reflexive Multithreading for Resource-Constrained Humanoid Platforms

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Keywords: Humanoid Robotics, Multithreading Execution, Robot Operating System, Robot SDK, Event-Driven Control

Abstract:

Modern humanoid robotics often faces a trade-off between the sophisticated middleware abstractions of ROS 2 and the hard real-time requirements of embedded motor control. This paper introduces NHURO-MT a novel multi-threaded execution architecture designed specifically for resource-constrained bipedal platforms using the NHURO SDK. We propose an event-driven reflexive architecture that decouples high-level task planning from low-latency hardware safety interrupts. By leveraging the ROS 2 MultiThreadedExecutor in combination with a custom hardware abstraction layer (HAL) that monitors torque-based pressure telemetry, our architecture ensures that safety-critical maneuvers—such as pressure-limited grasping or autonomous fall recovery—are executed with deterministic latency, regardless of the system's global CPU load. While current development and preliminary evaluation focus on voice-command integration and nascent force-limited grasping capabilities, the results demonstrate the feasibility of our decoupled execution model. This approach mitigates the common "blocking-call" bottleneck found in single-threaded Python-based robotic drivers and provides a scalable framework for next-generation, interactive humanoid systems.

K260263

NHURO-Vision: Edge-AI-Based Real-Time Object Recognition and Tracking for Humanoid Robotic Security

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Keywords: Humanoid Robotics, Edge AI, Object Detection, Object Tracking

Abstract:

Humanoid robots require visual perception to understand their surroundings and respond to dynamic environments. Vision-based object detection is, therefore, a key prerequisite for navigation, manipulation, and other object-related operations. However, small humanoid robot platforms often have limited onboard computing resources, making it difficult to deploy heavy perception models for real-time operation. To address this issue, this paper integrates a lightweight YOLO-based object detection module into the NHURO SDK, providing the robot system with object-level information, such as object category, position, and tracking status. The prototype is evaluated on a humanoid robot using real-time object detection and tracking scenarios.

K260264

NHURO-Care: Implementation of Integration and Force-Limited Control of an Active Bionic Grasper for Assistive Humanoid Tasks

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Keywords: Humanoid Robotics, Active Bionic Grasper, Object Handling, Assistive Humanoid Tasks

Abstract:

Humanoid robots are increasingly expected to support assistive tasks in human-centered environments. Many of these tasks require physical interaction with lightweight objects, such as bottles, cups, small boxes, and containers. However, small humanoid robot platforms often have limited object-handling capabilities, and simple open/close grasper control alone is insufficient for repeatable grasping tasks. To address this issue, this paper presents NHURO-Care, an assistive object-handling module that integrates an active grasper into the NHURO SDK and coordinates grasper operation with predefined arm-motion sequences. A set of object-handling experiments is conducted to evaluate grasp success rate, release reliability, supported object weight, and task completion time.

K260265

Comparison of Slicing Aided Hyper Inference versus InferenceSlicer on YOLOv9-Based Detection of CBB-Infested Coffee Berries

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Keywords: coffee berry borer (CBB), computer vision, precision agriculture, Slicing Aided Hyper Inference (SAHI), YOLOv9

Abstract:

Slicing Aided Hyper Inference (SAHI) and Roboflow Supervision's InferenceSlicer are known slicing-based techniques for improving small-object detection in modern object detection models, yet the two have not been directly benchmarked against each other on a shared agricultural task. This study addresses that gap by presenting a comparison of both algorithms when paired with YOLOv9, using the identification of Coffee Berry Borer (CBB)–infested coffee berries for their evaluation. The two tools share a slice-and-merge workflow but differ in their post-processing strategy: SAHI defaults to Non-Maximum Merging, while the InferenceSlicer relies on standard Non-Maximum Suppression. The berries were then classified as CBB-Infested, Non-Infested, or Unknown. Experimental results from 111 samples revealed a performance gap: the SAHI implementation achieved an overall accuracy of 84.68% with zero false positives, while the InferenceSlicer implementation yielded only 29.73%. These findings indicate that although the InferenceSlicer offers a lightweight integration path, the original SAHI library, through its NMM-based merging, remains the more effective tool for the demands of agricultural small-object detection, providing a foundational reference for post-harvest sorting.

K260266

An Evaluation on Hand Pose-Enhanced and Raw Image Datasets for FSL Recognition using SqueezeNet

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Keywords: Filipino Sign Language (FSL), hand pose skeleton overlay, enhanced dataset, raw image model, t-Test, p-Value

Abstract:

Filipino Sign language (FSL) amassed a lot of research regarding assistive technologies for connecting individuals proficient and not proficient in FSL; however, the importance of further refining the accuracy for determining both complex and similarly distinct gestures remains a challenge for some. The paper has the goal of testing the performance of hand pose skeleton overlay on images compared to traditional raw images for image classification. It is noticeable that the enhanced dataset achieved 94.4% accuracy while the Non-Overlay Model received 97.7% accuracy in turn. The independent samples T-Test = -0.991, P-Value = 0.335 result enforce that there’s no significant difference between the two trained models. With the unexpected result of the enhanced dataset, an important conclusion can be made by directly inspecting both models’ confusion matrix and studying the gesture classes they misclassified.

K260267

FPGA-based Neuromorphic Acceleration of Spiking Neural Networks for Event-Driven Humanoid Robotics

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Keywords: Neuromorphic Computing, Spiking Neural Networks, FPGA Acceleration, Event-Driven Computing, Humanoid Robotics

Abstract:
The growing computational and energy demands of modern AI models present significant challenges for deployment in embedded humanoid robotic systems. Neuromorphic computing, through event-driven processing and spike-based information representation, offers a promising approach for achieving low-power and low-latency intelligence.

This work presents the implementation of a Spiking Neural Network (SNN)-based classification/generative model on the AMD VCK5000 Versal FPGA platform. The proposed neuromorphic accelerator exploits spike sparsity and FPGA reconfigurability to reduce computational complexity and memory access overhead while enabling real-time inference. A hardware–software co-design methodology is adopted to map SNN operations onto programmable logic for efficient execution.

The implementation focuses on deploying the software SNN model onto FPGA hardware using a hardware–software co-design flow. It covers event-driven execution on reconfigurable hardware and enables analysis of system-level behavior, execution flow, and resource utilization of spike-based processing.

K260268

Ensemble Learning with Bayesian Optimization for Dark Condiment Sauce Classification using Electronic Nose

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Keywords: electronic nose, ensemble learning, Bayesian optimization, volatile organic compounds, condiments

Abstract:
Condiment sauces such as soy sauce, fish sauce, oyster sauce, and Worcestershire sauce play an important role in culinary practices and cultural identity, particularly in the Philippines. These products exhibit distinct volatile organic compound (VOC) profiles that define their aroma and flavor. With increasing demand, accurate and efficient classification methods are required to support quality control and product authentication. Conventional approaches such as sensory evaluation and laboratory-based chemical analysis are often costly, time-consuming, and subjective. This study proposes an electronic nose (e-nose) system utilizing Ensemble learning models optimized through Bayesian Optimization for the classification of dark condiment sauces. The system em-ploys an array of MQ-series gas sensors interfaced with an Arduino Mega 2560 for data acquisition, while a Raspberry Pi 5 handles data processing. Sensor data is standardized and reduced using Principal Component Analysis (PCA) prior to classification. A total of 120 samples were used for training and testing, with 60 additional samples reserved for validation. The optimized ensemble-based e-nose system achieved a classification ac-curacy of 100%, demonstrating its effectiveness as a portable and reliable tool for condiment authentication and quality control.

K260269

Performance Analysis of Ensemble Models for Lightweight Video-Based Ear Recognition Algorithm

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Keywords: ear biometrics, ear biometric system, YOLOv12, EfficinetNet-4, Raspberry Pi 5

Abstract:

The ear is a widely accepted biometric supported by extensive research in the academic field. However, it remains disconnected from real-world deployment. Building upon our principal study to bridge this gap, we aim to extend our progress by evaluating nine ensemble models on a Raspberry Pi-based embedded hardware configuration. All models were fine-tuned and validated using the unconstrained VGGFace-Ear and UERC 2019 datasets. System-level testing with eight participants identified that the best-performing model (YOLOv11n + EfficientNet-B4) achieved 78.50% accuracy with an F1-score of 0.6860, while maintaining real-time performance at approximately 11.8 frames per second. System metrics indicate moderate CPU utilization (<60%), stable memory usage (~18%), and consistent power consumption (~13 W). The findings demonstrate that accurate and efficient ear biometric recognition can be achieved on resource-constrained embedded platforms, highlighting the trade-off between model complexity and system performance.

K260270

Comparative Analysis of Computer Vision Models in Grading Assessment of Annona Squamosa L. using One-Way ANOVA

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Keywords: object detection, YOLOv9, Annona Squamosa L, Raspberry Pi 5, faster R-CNN

Abstract:

Object detection is a pivotal task in computer vision that identifies and locates objects using bounding boxes and class labels. This study evaluates the accuracy and efficiency of three state-of-the-art deep learning models: YOLOv9, RT-DETR, and Faster R-CNN. One-Way Analysis of Variance (ANOVA) was employed to statistically validate performance differences among these architectures. The comparative analysis demonstrated that RT-DETR achieved superior predictive proficiency with an average accuracy of 88.00%, significantly outperforming YOLOv9 (82.00%) and Faster R-CNN (74.00%), as confirmed by statistical testing ($F=130.47$, $p < 0.05$). While the transformer-based RT-DETR offers better feature extraction, it requires higher computational resources. Consequently, this paper recommends utilizing high-performance GPUs and increasing dataset diversity to fully leverage the model's capabilities. These findings guide researchers in selecting the most appropriate model by balancing high accuracy with hardware constraints, specifically highlighting the need to optimize RT-DETR for future edge device deployment.

K260271

Optimization of Switching Frequency and RC Time Constant for Active Battery Balancing

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Keywords: Batteries balancing, Active Balancing, Sine wave charging

Abstract:

This study investigates how switching frequency and RC time constant affect lithium-ion battery active balancing and thermal response. Results demonstrate that lower switching frequencies (e.g., 320Hz) near the battery's minimum AC impedance frequency equalize voltage significantly faster than higher frequencies (e.g., 8kHz). High frequencies introduce harmonics that dissipate as waste heat, causing undesirable temperature rises. Furthermore, smaller RC time constants (e.g., 0.5RC) accelerate balancing by allowing a higher average current, whereas larger constants (e.g., 50RC) restrict the current and make the process impractically slow. Ultimately, combining a lower switching frequency with a smaller RC time constant is the optimal configuration, ensuring rapid voltage equalization, high energy efficiency, and minimal heat generation.

K260272

Guinea Pig Re-Identification Using YOLOv11-nano Detection and ResNet-50 Embeddings on Raspberry Pi 5

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Keywords: YOLOv11-nano, ResNet-50, Raspberry Pi 5, re-identification, metric learning

Abstract:

This paper designed an edge-computing solution for guinea pig re-identification, using a Raspberry Pi 5 paired with a Camera Module 3. The proposed architecture couples a YOLOv11-nano detector with a ResNet-50 embedding network, trained on an 80:15:5 split of a 300-subject dataset comprising American, Peruvian, and Abyssinian breeds. To maximize intra-class compactness and inter-class separability, the training phase implemented a metric-learning framework combining Identity and Triplet Losses under a strict P x K sampling protocol (P=10, K=8). Testing conducted on 15 enrolled individuals using 100 query images achieved 80% Rank-1 accuracy, demonstrating the system's resilience to varying lighting, angles, and environments (caged, open, and enclosed). These results demonstrate the effective deployment of lightweight models such as YOLOv11-nano and ResNet-50 on low-power hardware for robust animal monitoring.

K260273

Vehicle Classification Using Instance Segmentation: A Comparative Analysis of SOLOv2, YOLOv8s-seg, and YOLOv11s-seg

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Keywords: vehicle classification, instance segmentation, SOLOv2, YOLOv8s-seg, computer vision

Abstract:
Accurate vehicle classification and segmentation are fundamental to intelligent transportation systems operating in dense and heterogeneous traffic environments. While instance segmentation models have demonstrated strong performance, their comparative behavior under mixed traffic conditions and embedded deployment constraints remains insufficiently examined. This study presents a comparative evaluation of three instance segmentation models—SOLOv2, YOLOv8s-seg, and YOLOv11s-seg—using a dataset of 2,100 annotated images across seven vehicle classes, including locally distinctive jeepney types. All models were evaluated on a Raspberry Pi 5–based embedded platform. Performance was assessed using Mean Intersection over Union (mIoU), Mean Average Precision (mAP), and confusion matrix analysis. Experimental results indicate that SOLOv2 achieved the highest segmentation accuracy with an overall mIoU of 94.7%, while YOLOv11s-seg obtained the highest mAP of 66.8% and demonstrated more consistent detection performance across classes. In comparison, YOLOv8s-seg showed lower and less stable performance. These results highlight the trade-offs between segmentation accuracy and detection robustness and suggest that YOLOv11s-seg is the most suitable model for embedded vehicle classification in complex traffic environments.

K260274

Comparative Study of Instance Segmentation Models for Banana Leaf Disease Classification

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Keywords: instance segmentation, model comparison, ANOVA, performance metrics, banana leaf classification

Abstract:

Comparative evaluation of instance segmentation models is essential in determining the most effective approach for automated banana leaf disease classification. This study presents a comparative analysis of instance segmentation models for banana leaf disease classification. Banana leaves are first localized through a detection stage, followed by instance segmentation using YOLOv8-Seg, Mask R-CNN, and SOLOv2 to identify diseased regions. A dataset of approximately 750 images was utilized, with 525 images for training, 150 for validation, and 75 samples for evaluation. Model performance was assessed using F1 score, mean Average Precision (mAP50 and mAP50–95), inference time, and classification accuracy. Results show that YOLOv8 achieved the highest overall performance, while SOLOv2 demonstrated competitive accuracy with faster inference. Mask R-CNN exhibited lower performance and higher computational cost. One-way ANOVA confirmed that differences among models are statistically significant. The findings provide insights into selecting suitable segmentation models for automated banana leaf disease classification.

K260275

An Interpretable Weighted-Stacking and LSTM-Ready Framework for Remaining Useful Life Prediction on NASA C-MAPSS FD001

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Keywords: predictive maintenance, remaining useful life, C-MAPSS, FD001, weighted stacking, LSTM, interpretable machine learning.

Abstract:

Remaining useful life (RUL) estimation is a central task in predictive maintenance because maintenance scheduling, spare-parts planning, and risk control all depend on stable life predictions under noisy multivariate degradation trajectories. This paper studies the NASA C-MAPSS FD001 benchmark and compares three interpretable baselines—Linear Regression, Ridge Regression, and Random Forest—with a weighted-stacking model that fuses linear and nonlinear estimators by inverse-validation-error weighting. Using the packaged FD001 experiment outputs, the proposed ensemble achieves the best balance among the completed runs with RMSE 26.20, MAE 18.81, and R^2 0.602. To strengthen technical completeness, this expanded manuscript also formalizes the feature-engineering rationale, documents the evaluation protocol, analyzes model-wise error behavior, and specifies a fair LSTM extension path for a journal-grade revision

K260276

Applying a Metaverse Exhibition Platform to Design Work Presentation and Audience Experience: A Case Study of the Metasteps Virtual Exhibition

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Keywords: metaverse exhibition, digital curation, virtual reality, audience experience, physical–virtual integration

Abstract:

This study examines the application of the Metasteps metaverse exhibition platform to design work presentation and audience experience. A senior-level multimedia design course in Taiwan was used as the implementation context, including digital curation, narrative planning, virtual exhibition construction, industry feedback, public exhibition, and audience feedback analysis. The student-created exhibitions were later presented at the Young Designers' Exhibition and the Vision Get Wild Award, two major graduation exhibition platforms for design-related departments in Taiwan.

The questionnaire was revised based on the System Usability Scale (SUS), Technology Acceptance Model (TAM), Questionnaire for User Interaction Satisfaction (QUIS), and studies on virtual reality immersion. I evaluated overall satisfaction, perceived value, ease of use, interactivity, and immersion. A total of 167 valid responses were collected, including 103 students, 49 general audience members, and 15 professional-related participants. Results showed positive evaluations of the platform, with overall satisfaction scoring highest (M = 4.376), followed by perceived value (M = 4.365), ease of use (M = 4.328), interactivity (M = 4.280), and immersion (M = 4.241).

Descriptive trends showed that professional-related participants reported higher perceived value, satisfaction, and interactivity, indicating stronger recognition of the platform's potential for design work presentation and future applications. Students also showed positive evaluations, suggesting its value for digital curation, work presentation, and online portfolio development. However, general audiences reported relatively lower immersion and interactivity, indicating the need to improve guidance clarity, operational fluency, and interactive prompts.

This study demonstrates that metaverse exhibitions can support design work presentation, audience engagement, work preservation, and physical–virtual integrated exhibition practices. The findings provide a practical case for applying metaverse platforms to public design exhibitions and digital transformation in design presentation.

K260277

Analysis of the Effects of Slot Structure Parameters on the Performance of a Permanent Magnet External Rotor Generator

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Keywords: Outer Rotor Permanent Magnet Generator, Ansys Maxwell, Taguchi Method, Slot Structure Optimization Design

Abstract:
The permanent magnet generator (PMG) is an electromechanical device for direct conversion of mechanical energy into electrical energy based on Faraday's law of electromagnetic induction. In this, a 12-pole, 16-slot outer rotor permanent magnet generator was selected, and an analytical framework integrating experiments and simulations was established. First, a performance testing platform was established for high-speed operation at 5,000 rpm, and the output characteristics of the generator were measured. The finite element analysis (FEA) model was established and validated using Ansys Maxwell, and the reliability of the simulation results was verified. Finally, optimization of the slot structure was performed using the Taguchi Method. Then, slot opening, slot bottom width, stator tooth width, and slot depth were selected as control factors. Parametric analysis and optimization were conducted using an L9 orthogonal array. The experimental results indicated an output power of 120 watts at 5,000 rpm, and a generator efficiency of 85.143% was achieved. Furthermore, analysis of variance (ANOVA) identified the slot bottom width as the most influential factor affecting generator efficiency. Following parameter optimization, the generator efficiency was increased from 85.143% to 91.50%, corresponding to an improvement of 6.36 percentage points. The effectiveness of integrating finite element analysis and the Taguchi Method for generator optimization was demonstrated, and a valuable reference for the development of high-efficiency outer rotor permanent magnet generators was provided.

K260280

Effect of Geometric Dimensions of Etching Hole on Spin Drying

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Keywords: wet etching, high aspect ratio, spin drying

Abstract:
The effect of the geometric dimensions of holes etched into a wafer during the drying process on the spin-drying rotational speed of the drying machine and equipment is investigated. Some equations are theoretically derived to determine the relation between the dimensions of holes and angular speed. It is determined by angular speed, the mass of the liquid filling the hole, and hole's position. The results show that, under the same conditions, the larger hole width induces the lower spin-drying speed. Furthermore, the results indicate that the spin-drying speed increases rapidly and nonlinearly as the hole width decreases. For the effect of hole depth, under the same conditions, a deeper hole induces a faster spin-drying speed. The tendency is that the required spin-drying speed increases rapidly and nonlinearly with increasing hole depth. The hole position on the wafer has no significant effect on the spin-drying speed. Overall, the aspect ratio has the most significant effect on the spin-drying speed. As the aspect ratio increases, the spin-drying speed increases dramatically.

K260283

Ultrasound-Based Detection of Pancreatic Cystic Lesions Using DCLG-U Image Enhancement and YOLO12

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Keywords: pancreatic cystic lesions, ultrasound imaging, image preprocessing, YOLO12, lesion detection

Abstract:

Pancreatic cystic lesions (PCLs) are increasingly being detected during routine abdominal ultrasounds and can represent a range of pathological conditions, from benign cysts to precancerous and cancerous lesions. Early detection is crucial for clinical decision-making and long-term patient management. However, accurate identification of PCLs in ultrasound imaging remains challenging due to speckle noise, low image contrast, operator dependence, and the presence of small lesions with indistinct boundaries. To address these challenges, this study proposes an AI-assisted framework for detecting pancreatic cystic lesions in ultrasound imaging. An ultrasound-oriented image preprocessing method, called DCLG-U (Contrast-Limited Adaptive Histogram Equalization, Laplacian Sharpening, and Gamma Correction for Ultrasound Images), is introduced to enhance image quality, improve lesion visibility, and preserve critical structural information. The enhanced images are then analyzed using a YOLO12-based object detection model designed to improve the localization performance of small lesion targets. Ultrasound images were collected retrospectively under the approval of the Ethics Review Board (IRB No. 202600915B0) and annotated by experienced clinicians. The proposed framework aims to increase the accuracy of detecting pancreatic cystic lesions, particularly small and hard-to-identify lesions, while providing an efficient computer-assisted diagnostic tool for ultrasound-based screening and monitoring applications.

K260284

An Intelligent Rescue Drone Platform Integrating YOLO Segmentation and Sequential Image Based Event Recognition

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Keywords: Disaster Search and Rescue, Unmanned Aerial Vehicles, Instance Segmentation, Injured Person Detection, Real-Time Video Analytics

Abstract:

Disaster sites often involve blocked roads, occlusion, unstable lighting, and secondary collapse risks, making ground based search and rescue dangerous and time consuming. This study presents an intelligent rescue drone platform for locating injured victims. The initial system used YOLO object detection and bounding box judgment, while the enhanced system adopts YOLO Segmentation with dense polygonal annotations following visible body outlines. Instead of enclosing the target with a rectangular box, the annotation follows the head, torso, limbs, and body boundaries, allowing the model to learn body shape and occlusion boundaries while reducing dependence on background regions. On the validation set, the Detect model achieved a best Box mAP@0.5 of 0.914 and a final epoch value of 0.886, while the Segmentation model achieved a best Mask mAP@0.5 of 0.716 and a final epoch value of 0.697. Detect had higher validation scores, but its boxes often included background areas and gave limited descriptions of prone postures and occluded body regions. Segmentation generated pixel level masks that more clearly represented injured victims and better supported event assessment, visualization, and human observation. For this reason, This makes YOLO Segmentation a suitable method for the system.

The platform was redesigned as a modular architecture with a Laravel command center and a Python inference service. The drone captures real time video, while the Python service performs image processing, segmentation inference, target tracking, and event state assessment. The command center supports live stream display, system monitoring, rescue event management, and debugging visualization. To reduce false alarms from single frame detections, consecutive frame confirmation converts results into three states: Detected Injury, Suspected Injury, and Rescue Needed. Local AI and MCP assisted functions provide event explanations, status queries, and operational interaction. The platform has evolved from a detection prototype into an event oriented rescue system integrating segmentation, dense contour annotation, real time streaming, modular services, and AI assisted command center functions.

K260285

Effect of Geometric Dimensions of Circular Clamped Plate on Pull-in Voltage

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Keywords: pull-in voltage, circular clamped plate, electrostatically actuated

Abstract:

MEMS devices are often electrostatically actuated. As the applied voltage increases, the pull-in phenomenon occurs. In MOEMS, a circular clamped structure could be used as a focusing mirror to change the focal length. In this work, the effect of geometric dimensions of a circular clamped plate on the voltage of pull-in phenomena starting to happen is investigated. The equations of their relations by the energy method and theory of plates and shells are theoretically derived. The results show that increasing the thickness of the plate would increase the pull-in voltage. While increasing the radii of the plates, the pull-in would decrease. However, the effect of Young's modulus and Poisson's ratio is insignificant for three different materials often used in MEMS. It is found that the gap between the plate and ground electrode has a significant effect on pull-in voltage. The pull-in voltage will nonlinearly increase as the gap increases.

K260286

Investigation on Synthetic ECG Data Augmentation Using Generative Adversarial Networks Combining Bidirectional Mamba and Convolutional Neural Networks

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Keywords: ECG, Mamba, State Space Model, WGAN-GP, Long-Sequence Modeling

Abstract:

Electrocardiogram (ECG) signal generation is an effective approach for addressing data imbalance in intelligent healthcare applications, particularly when abnormal cardiac rhythms are scarce. Existing studies have widely adopted Bidirectional Long Short-Term Memory (BiLSTM)-based Generative Adversarial Networks (GANs). However, these models often suffer from information loss in long-range temporal dependencies, unstable training, and mode collapse when generating long ECG sequences.

To address these limitations, this study proposes a novel ECG generation framework, termed BiMamba-CNN WGAN, which integrates a Bidirectional Mamba State Space Model (BiMamba), one-dimensional Convolutional Neural Networks (1D-CNNs), and a Wasserstein Generative Adversarial Network with Gradient Penalty (WGAN-GP). BiMamba is employed to model long-range temporal dependencies, while 1D-CNN layers extract local waveform features.

A multi-class ECG dataset was constructed from MIT-BIH Arrhythmia and MIT-BIH Atrial Fibrillation databases, including: Normal Beat (N), Ventricular Beat (V), Paced Beat (/), and Atrial Fibrillation (AF). Experiments were conducted using sequence lengths of 512 and 1024 samples. Compared with the BiLSTM-CNN GAN baseline, the proposed BiMamba-CNN WGAN achieved improved performance on the 1024 sample generation task. The Percentage Root-mean-square Difference (PRD), Root Mean Square Error (RMSE), and Fréchet Distance (FD) were reduced by 13.2%, 11.6%, and 13.2%, respectively. In addition, the average FD of abnormal rhythm classes decreased by 11.4%.

Qualitative analysis shows that the generated ECG signals preserve representative characteristics of each rhythm category, including the P-QRS-T morphology of normal beats, irregular RR intervals in atrial fibrillation, widened QRS complexes in ventricular beats, and pacing-related waveform patterns in paced beats. At 1024 samples, the proposed model achieved an average PRD of 62.890, FD of 0.394, and RMSE of 0.258.

The results suggest that BiMamba-CNN WGAN is a promising approach for long-sequence and multi-class ECG generation, demonstrating its potential for medical signal augmentation.

K260287

Artificial Neural Network-Based Motion Parameter Inference for Contour-Following Motion Control Using Edge Computing

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Keywords: Contour-following motion control, Motion parameter inference, Artificial neural network, Edge computing, Energy consumption

Abstract:

In contour-following motion control, acceleration and deceleration parameters directly affect contour accuracy, machining efficiency, and energy consumption. When the load or motion conditions change, velocity, acceleration, and jerk parameters must be properly adjusted to balance accuracy, motion time, and energy-saving requirements. This study develops an artificial neural network-based motion parameter inference model using experimental data from an XY Table contour-following motion system. The model is implemented on an edge computing platform based on the NVIDIA Jetson AGX Orin. The proposed mode uses trajectory shape, velocity, acceleration, and accelerometer-based vibration information as inputs to predict contour error, cycle time, and energy consumption. Based on these predictions, the required motion parameters for three operation modes, namely Efficiency, Normal, and Precision, are further inferred. Experimental results show that the coefficients of determination (R^2) for contour error, cycle time, and energy consumption prediction reach 0.969, 0.979, and 0.947, respectively. Under the Efficiency, Normal, and Precision modes, the prediction errors of contour error are 0.95%, 0.30%, and 1.77%, respectively; those of cycle time are 0.73%, 0.02%, and 5.69%; and those of energy consumption are 0.32%, 3.01%, and 7.93%. These results indicate that the proposed method can be applied to motion control parameter planning and decision-making under different machining requirements, while balancing accuracy, efficiency, and energy-saving demands.

K260289

De-Skilling or Re-Structuring? A Theoretical Critique of Generative AI in Architectural Design Practice

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Keywords: generative AI, architectural design, bipolarization, residual liability, hermeneutics of strangeness

Abstract:

The rapid integration of generative AI into architectural design workflows has intensified a structural asymmetry in how design knowledge is produced and valued. This paper proposes a diagnostic theoretical framework to examine what we term the "bipolarization" phenomenon: the simultaneous inflation of front-end visual ideation and back-end photorealistic rendering, alongside the structural compression of the middle-phase work encompassing structural coordination, regulatory compliance, material detailing, and construction logic.

Drawing on three interrelated theoretical lenses—the sociology of knowledge (Mannheim, 1936; Polanyi, 1966), the hermeneutics of strangeness (Jauss, 1985; Orange, 2011), and aporetics (Kostić, 2018)—this paper argues that AI does not merely accelerate design; it reconfigures which forms of knowledge are rendered visible and which are structurally marginalized. AI-generated images constitute a "familiar strangeness": their visual completeness induces a technological illusion that conceals unresolved structural, regulatory, and constructional problems from both clients and practitioners.

The paper introduces three original concepts to characterize this condition: residual construction knowledge , the tacit middle-phase labor that digital systems cannot absorb; residual liability , the non-transferable professional responsibility that persists regardless of automation; and micro-iterative corrective labor , the cumulative human calibration that distinguishes architectural practice from image generation.

Grounded in Schön's reflective practitioner framework and the author's professional experience in Taiwanese architectural practice, this paper argues that design generation may be automated, but responsibility cannot be outsourced. The findings carry implications for architectural education, professional ethics, and the institutional governance of AI in design.

Keywords: generative AI, architectural design, bipolarization, residual liability, hermeneutics of strangeness, reflective practice

K260290

A Novel Piecewise Polynomial Fuzzy Networked Output-Feedback Control System for Quadrotor UAVs

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Keywords: Networked Control Systems, Novel Piecewise Polynomial Fuzzy Systems, Quadrotor UAVs.

Abstract:

This paper presents a novel piecewise polynomial fuzzy networked output-feedback control system for quadrotor UAVs and proposes a sum-of-squares (SOS)-based robust stability theorem with guaranteed H∞ performance. The proposed modeling approach significantly reduces the number of fuzzy rules, thereby decreasing the computational burden on the onboard microprocessor and lowering the overall hardware cost. Furthermore, considering the presence of external disturbances, model uncertainties, network-induced time delays, and packet dropouts, robust stability conditions for the networked control system are derived using a minimum-type piecewise polynomial Lyapunov function. Since the proposed method requires fewer stability conditions than existing approaches, the feasible solution space of the SOS optimization problem is enlarged, resulting in improved control performance. Finally, the proposed robust piecewise polynomial fuzzy networked controller is validated through both computer simulations and experimental studies of quadrotor path-tracking control. The results demonstrate that the proposed approach achieves superior performance compared with existing methods.

K260291

Design of an Ultra-Wideband Warehouse Storage Bay Positioning Algorithm Based on Hidden Markov Model and Tukey Loss Function

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Keywords: Ultra-Wideband (UWB), Indoor Positioning System, Warehouse Management, Hidden Markov Model (HMM)

Abstract:

In warehouse management, the failure of personnel to place goods according to regulations frequently leads to erroneous system registration of pallet storage locations. To address the characteristics of finished goods warehouses—specifically low item movement frequency and a primary focus on confirming final locations—this study introduces a positioning algorithm based on Ultra-Wideband (UWB) technology. Utilizing topological information of storage bays, the algorithm restricts the continuous spatial field into a finite state space defined by storage bay reference points to construct a Hidden Markov Model (HMM). To reduce the impact of extreme range measurement outliers on positioning accuracy, the observation model integrates the Tukey loss function to enhance robustness. The system identifies the specific storage bay of the tag through per-measurement range updates and single-step Maximum A Posteriori (MAP) estimation. For validation, UWB tags were secured to pallets within an operational warehouse to collect range measurements across at least 20 distinct storage bays over a duration of 20 minutes. The experimental results demonstrate that the proposed algorithm effectively maps the measurement data to the corresponding storage bays, confirming the feasibility of this positioning algorithm for identifying pallet storage bays in practical warehouse environments.

K260292

Local Industry Integration in Freshman Interior Design Education: A Curriculum Overview of a Service-Learning Studio

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Keywords: Interior design education, service learning, curriculum description, local industry.

Abstract:

This presentation outlines the preliminary pedagogical framework of a first-year interior design studio focused on service learning. The core design prompt centers on collaborating with the local Wufeng Farmers' Association to connect freshman students with regional agricultural industries. Through basic site observation and introductory spatial planning exercises, students are guided to understand the relationship between community needs and physical spaces.

However, this abstract solely describes the instructional activities, the design brief, and the curriculum timeline. As the project is structured purely as an introductory local engagement exercise for freshmen, there is no formal academic methodology implemented. Furthermore, no empirical data, statistical evaluation of learning outcomes, user feedback mechanisms, or theoretical design frameworks are presented or analyzed at this stage. This submission serves exclusively as an anecdotal record of a teaching activity rather than a completed research study with quantifiable or qualitative results.

K260294

Monocular Vision for Real-Time 3D Motion Analysis and Action Recognition in Sports Applications

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Keywords: Monocular Vision, 3D Spatial Perception, Action Recognition, Distance Estimation, Sports Event Understanding

Abstract:

The rapid advancement of computer vision and deep learning technologies has accelerated the development of intelligent sports analytics systems. However, most existing solutions rely on multiple cameras, specialized sensors, or sport-specific designs, limiting their scalability and deployment in real-world environments. To address these challenges, this study proposes a monocular vision-based framework that integrates object tracking, human action recognition, distance estimation, and three-dimensional spatial perception for intelligent sports scene understanding.

The proposed framework first employs deep learning-based object detection and tracking techniques to identify and continuously monitor key targets within sports environments. Simultaneously, human detection and action recognition modules are utilized to capture athletes' movements and behavioral patterns. The extracted spatial and temporal information is further combined with monocular distance estimation techniques to infer depth-related cues from a single camera view. By fusing object trajectories, human actions, and distance information, a unified 3D spatial perception model is constructed to represent dynamic interactions among athletes, sports equipment, and the surrounding environment.

Building upon the generated 3D scene representation, a sports event understanding module is developed to recognize meaningful events and interactions occurring during sports activities. Furthermore, a physics-based motion model is incorporated to analyze object motion and predict future trajectories, enabling advanced applications such as movement reconstruction, event analysis, and performance assessment.

The proposed architecture provides a flexible and cost-effective solution for intelligent sports analytics using only a single camera. The framework can be generalized across various sports scenarios, including baseball, basketball, soccer, tennis, badminton, and athletics. The integration of monocular 3D spatial perception and action analytics offers a practical foundation for real-time sports monitoring, coaching assistance, and athlete performance evaluation.

K260295

Investigation of Ultrasonic-Assisted Machining for Enhancing Surface Quality and Machining Accuracy of Tungsten Carbide Materials

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Keywords: Ultrasonic Machining, Tungsten Carbide, Surface Roughness, Toolpath Optimization, Machining Efficiency

Abstract:

Traditional machining methods largely relied on polycrystalline diamond (PCD) tools with a hardness exceeding that of tungsten carbide, or electrical discharge machining (EDM), in which electrical energy is converted into high temperature for precise material removal. Or both methods were applied in parallel to improve machining efficiency. However, the increased tool wear was observed in PCD tools due to graphitization, while low machining efficiency and poor surface finish were noted using EDM. The parallel application of both methods resulted in higher costs for equipment and labor. Therefore, a three-axis Computer Numerical Control (CNC) machine equipped with an ultrasonic machining (USM) tool was chosen for 2.5D and 3D geometric machining of tungsten carbide materials. Three different tungsten carbide materials were selected for DR14C (89.0 HRA), TR15C (87.0 HRA), and KG5 (90.0 HRA). Diamond poi grit sizes ranging from #100 ~ #800 and a tool extension of 20 mm were used. Then, process parameters and toolpaths were adjusted and optimized, including a spindle speed of 8,000 rpm, feed rates between 133 and 600 mm/min, axial depths of cutting (ap) from 0.6 ~ 8 mm, radial depths of cutting (ae) from 0.006 ~ 0.03 mm, and ultrasonic vibration at 100% power with frequencies ranging from 24.4 ~ 24.7 kHz. Surface roughness and machining efficiency were enhanced through the optimization of parameters. Experimental results have confirmed that material removal efficiency was improved. Tungsten carbide powder adhesion on the diamond points' surface was reduced compared to 80% (with conventional machining). Compared with conventional machining methods, accuracy was improved by 7.8%. Surface roughness was reduced and changed from Ra 0.427 μm/mm ~ 0.280 μm/mm, and an improvement of approximately 34.4% was achieved. The surface roughness of toolpath optimization was achieved ~Ra 0.063 μm/mm, and a substantial enhancement of the tungsten carbide surface quality was achieved. Significant improvements in machining efficiency, dimensional accuracy, surface quality, and process stability were confirmed through USM of tungsten carbide materials.

K260296

Development of a Porous Ceramic Composite Planter with Moisture-Gradient Regulation Using Recycled Tile Manufacturing Sludge

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Keywords: tile manufacturing sludge, circular economy, porous ceramic, passive water regulation, moisture-gradient planter

Abstract:
This study responds to the circular economy and sustainable design by exploring the reuse of waste sludge from tile manufacturing. Containing impurities like glaze residues, grinding dust, and silicon carbide, tile sludge exhibits unstable composition and low plasticity, traditionally limiting its use to low-value construction aggregates. To break these limitations, this study transforms tile sludge into functional porous ceramic planters integrating material circularity, passive water regulation, and composite planting applications.

The methodology centers on ratio testing and firing analysis. To overcome the low plasticity of tile sludge, varying proportions of clay were added to enhance green body adhesion and forming stability. Firing temperature tests were conducted to evaluate their effects on structural strength, pore characteristics, and water permeability. By utilizing the coarse texture of abrasive particles and employing low-temperature bisque firing, complete vitrification was avoided, allowing the ceramic body to retain optimal open pores and capillary water permeability, thereby balancing structural stability and water transmission.

Structurally, the planter features adjacent water storage and planting zones. This design leverages the open reservoir to accommodate aquatic plants or floral arrangements. Combined with the soil moisture gradient decreasing outward via capillary action, it establishes a multi-tiered moisture continuum. This gradient differentiates planting zones within a single vessel: the reservoir supports aquatic cultivation, the high-moisture inner zone suits hygrophilous plants, and the low-moisture outer zone accommodates drought-tolerant species, functioning as a micro-scale composite planting system with zoned water management.

Experimental results indicate that under optimal parameters, the planter maintains structural strength while providing passive water supply. The fully filled reservoir maintains water supply for 3 to 7 days, creating distinct moisture zones for varied plant configurations, demonstrating a sustainable design model for micro-ecological development.

K260298

Aesthetic Predispositions and Generative AI How Photography and Painting Preferences Shape Usage Intentions

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Keywords: Generative AI, Aesthetic Preference, Technology Acceptance Model (TAM), Behavioral Intention, User Adoption.

Abstract:

Driven by the rapid advancement of artificial intelligence, generative AI has reshaped contemporary visual arts. However, how traditional aesthetic values influence users' psychological acceptance of this technology remains understudied. This study investigates the impact of users' photography and painting preferences on their behavioral intention to use generative AI tools. Integrating the Technology Acceptance Model (TAM), a scenario-based survey was conducted with 100 participants who evaluated AI-generated images reflecting distinct photographic and painterly qualities. The regression analyses revealed that individuals with strong photography preferences exhibited higher perceived usefulness and stronger adoption intentions, primarily due to AI's proficiency in rendering realistic lighting and framing. Conversely, those with strong painting preferences demonstrated lower perceived ease of use and weaker intentions, driven by a perceived lack of authentic brushstrokes and emotional depth in AI outputs. These findings bridge the gap between traditional aesthetics and emerging technology, providing practical implications for AI developers to optimize user interfaces and algorithm designs for diverse artistic cohorts.

K260299

Traditional Memory and Contemporary Spectatorship: Local Youth Perspectives on the Transformation of Beigang Mazu Yi-Ge

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Keywords: Intangible Cultural Heritage, Living Folk Tradition, Cultural Transformation, Local Youth Perspectives

Abstract:

Beigang Mazu Yi-Ge procession is an important folk tradition in Taiwan. In recent years, tourism promotion, social media, non-local participation, and gift-giving practices have reshaped its cultural meaning and public image. This study focuses on local youth who experienced more traditional Yi-Ge in childhood but later witnessed its transformation under tourism and media influence. Through semi-structured interviews, the study ex-plores how they perceive these changes and negotiate emotional tensions between pre-serving tradition and accepting contemporary influences.

K260300

Beyond SGF: An ODF-Compliant Data Schema for Efficient Storage and Parsing of Go AI Variations

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Keywords: Computer Go, Data Schema, Olympic Data Feed (ODF), Smart Game Format (SGF)

Abstract:

Modern Go research and tournament analysis heavily rely on massive, multi-dimensional data generated by artificial intelligence, including win-rate fluctuations, score leads, search depths, and style modeling. However, the prevailing Smart Game Format (SGF), constrained by its legacy nested-string design and unstandardized extension attributes, encounters severe file bloat and parsing performance bottlenecks when processing deep-analysis records containing extensive AI variations.

To address this challenge, this study proposes a novel JSON-based data schema that integrates the event-driven architecture and standardized metadata model of the Olympic Data Feed (ODF). By applying array-based node compression and a flattened relational tree structure, the proposed method transforms the \$O(N)\$ sequential parsing complexity of traditional SGF into a structured data model supporting \$O(1)\$ efficient queries.

Performance evaluations indicate that when loading game records with over 100,000 AI analysis nodes, the proposed ODF-compliant format significantly outperforms traditional open-source SGF parsers in both deserialization latency and peak memory usage. Additionally, the streamlined key-value design effectively mitigates the file size expansion typical of naive nested JSON formats. This architecture not only improves the storage and parsing efficiency of massive AI analysis data but also establishes a scalable, standardized foundation for advanced applications, such as real-time data broadcasting for major international tournaments, big data mining, and the quantitative evaluation of AI anthropomorphism.

K260301

Microclimate-Driven Evapotranspiration and Vapour Pressure Deficit Assessment for Smart Irrigation Scheduling in Durian Cultivation under Tropical Conditions

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Keywords: durian cultivation, evapotranspiration, vapour pressure deficit, smart irrigation, microclimate monitoring

Abstract:

Efficient irrigation scheduling is essential for durian cultivation under tropical conditions, where high temperature, variable humidity, and atmospheric water demand can influence crop water requirement and fruit development. This study evaluates microclimate-driven evapotranspiration and vapour pressure deficit patterns using half-hourly evaporation-station data collected from 4 February to 3 March 2026 in a durian cultivation environment. The dataset consisted of outdoor temperature, relative humidity, wind speed, wind direction, light intensity, evapotranspiration, latent heat flux, heat flux, vapour pressure deficit, atmospheric pressure, indoor temperature and indoor relative humidity. Data screening the outdoor temperature ranged from 21.60°C to 32.62°C, while outdoor relative humidity varied from 55.70% to above 100%, indicating the need for humidity sensor quality control. Vapour pressure deficit ranged from 0.06 to 2.24 kPa after quality screening, with low and moderate atmospheric water stress conditions representing 42.5% and 43.3% of the valid observations, respectively. High and very high vapour pressure deficit conditions occurred mainly during warmer daytime periods, indicating potential irrigation-sensitive windows. Correlation analysis showed that vapour pressure deficit was strongly and negatively associated with relative humidity and moderately associated with air temperature, confirming its suitability as a practical atmospheric water stress indicator. The findings provide a preliminary data-driven framework for smart irrigation scheduling in durian cultivation by integrating temperature, humidity, vapour pressure deficit, light intensity, wind speed, and evapotranspiration indicators. This study contributes to the development of precision irrigation strategies for durian plantations and provides a foundation for future integration with soil moisture, irrigation volume, and fruit quality parameters such as total soluble solids, aril percentage, fruit firmness, and uneven ripening.

K260302

Maestro: A Lightweight Hand Gesture Recognition System for Touchless Presentation Control

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Keywords: Hand Gesture Recognition, Touchless Presentation Control, Real-Time Systems, Lightweight Deep Learning, Human-Computer Interaction

Abstract:
Presentation control remains largely dependent on physical input devices, such as keyboards and clickers, which can restrict presenter mobility and reduce natural interaction with digital content. Although hand gesture control offers a promising touchless alternative, many existing video-based approaches process raw RGB frames and require substantial computational resources. To address these limitations, we present Maestro, a real-time hand gesture recognition system for touchless PowerPoint control that requires only a standard webcam and runs on commodity hardware without GPU acceleration, depth sensors, or specialized controllers.

Maestro adopts a lightweight skeleton-based recognition pipeline. It first uses MediaPipe to extract hand landmarks from webcam input, and then applies a Two-Stream Bidirectional Long Short-Term Memory (BiLSTM) architecture enhanced with Multi-Head Attention to model temporal gesture patterns. The system recognizes ten gesture classes specifically designed for presentation control, covering essential presentation interactions, including slide navigation, zoom control, pointing, and idle detection. To improve generalization across different users and environments, the model is trained on a curated and harmonized multi-source dataset derived from three public gesture recognition benchmarks.

Experimental results show that Maestro achieves 96.43% top-1 accuracy and a 96.60% macro F1 score, while using only approximately 1.21 million parameters and 0.025 GMACs per inference window. In comparison, representative video-based baselines that process raw RGB frames require 46 to 51 million parameters and 15 to 22 GMACs, making them less suitable for deployment on resource-constrained devices. These results demonstrate that the proposed skeleton-based design substantially reduces computational cost while maintaining high recognition performance. These findings suggest that skeleton-based temporal modeling can enable practical, low-cost, and accessible gesture-based presentation control in everyday environments.

K260303

An Integrated Multi-Agent Decision-Support Framework for Visual Inspection and Quality Knowledge Management in Metal Machining

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Keywords: Multi-Agent System, Defect Detection, Knowledge Graph

Abstract:

Visual defect detection alone is insufficient for metal machining inspection because inspection-record management, cause tracing, and corrective-action support are also required. However, current workflows still rely on operator experience and fragmented records, resulting in inconsistent judgments and limited knowledge reuse. This study therefore proposes an integrated decision-support framework combining visual detection, PostgreSQL, Neo4j, and an n8n-based multi-agent workflow for metal pipe-connector inspection. The dataset contains six categories: Scratch, Stain, Strip, Ball, O-ring, and Thread. The first three represent defects, Ball and O-ring support component-presence checking, and Thread identifies the thread region. Among the baseline models, YOLOv8s-NoP2-Origin achieved the best overall performance, with 86.00% precision, 72.28% recall, 77.18% mAP@50, and 54.75% mAP@50–95. After preprocessing evaluation, CLAHE combined with gamma correction and edge enhancement achieved the highest recall of 78.24% and mAP@50 of 83.01%. PostgreSQL stores inspection records, while Neo4j represents defect features, possible causes, process contexts, and corrective actions. The n8n workflow invokes suitable tools according to user queries and verifies evidence grounding. In a 55-case benchmark, structured few-shot prompting with retry achieved a 98.18% pass rate. The proposed framework extends visual inspection into traceable data management, knowledge retrieval, and quality decision support.

K260305

The Influence of Strobilanthes cusia Indigo Dye Preparation and Fermentation Conditions on the Spectroscopic Reflectance and Color Character of Indigo-Dyed Fabrics

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Keywords: Indigo Dyeing, Strobilanthes cusia Indigo Dye, Indigofera tinctoria Indigo Dye, Indigo, Indirubin

Abstract:

Indigo dyeing is an ancient and global natural dyeing technique that produces a single blue color, with variations only in shades and intensities. The dye, prepared using Strobilanthes cusia or Indigofera tinctoria, is called indigo dye. Indigo dye has a complex and diverse composition, containing not only the main component indigo, but also indirubin, the two being isomers. It is currently known that the ratio of indigo to indirubin in indigo dye significantly affects its color expression, thus increasing the diversity of color representation; however, these differences in color expression are not easily discernible to the human eye. Using a spectrophotometer to analyze indigo-dyed fabrics dyed with Strobilanthes cusia indigo dye, this study found that when the color difference value ($\triangle E^*ab$) was less than 1, regardless of whether the indigo dye was prepared using a traditional or optimized process, the indigo-dyed fabrics dyed with these dyes after indigo fermentation using different carbon sources or different carbon source ratios all had different spectrophotometric reflectance spectra. This means that these indigo-dyed fabrics have different color expressions, which is different from the color expression of Indigofera tinctoria indigo dye.

K260306

Digital Link-Enabled GSID for Transparent Data Disclosure

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Keywords: GSID (Global Security Identity), PI Code (Personal Identifier Code), Personal Information Center (PIC), Personal Digital Link, Cross-System Parsing

Abstract:

Digital Link-Enabled GSID for Transparent Data Disclosure

This paper extends the GS1 Application Identifier (AI) Code framework—a standardized prefix-based encoding system for supply chain barcodes—to personal identity management. We propose PI Code (Personal Identifier Code), which uses parenthesized prefixes such as (H1) for name, (H2) for date of birth, and (H10) for address to annotate personal data with explicit semantics for automated cross-system parsing. Building on PI Code, we introduce GSID (Global Security Identity), integrating PI Code with Persona Digital Link URLs—inspired by GS1 Digital Link—and the OpenID Connect (OIDC) protocol. The Person Digital Link is the core enabler of GSID's transparent data disclosure: as a standardized URL, it carries structured personal information in machine-readable form while remaining human-accessible via web browsers. GSID operates through a Personal Information Center (PIC) serving as both OIDC Identit Provider and PI Code issuer. Third-party applications initiate OIDC authorization; after authentication, the GSID PIC issues a JWT embedding PI Code data in a custom GSID attribute. Through GSID and GSID PI the system addresses the Data Minimization principle required by data protection regulations—a limitation of conventional OAuth Scope. Using GSID's object-grouping and tiered disclosure strategies, users assign different data disclosure ranges for distinct recipients. When initial authorized data is insufficient, the GSID (as a Personal Digital Link URL) enables dynamic redirection back to the GSID PIC for supplementar authorization. For example, a shopping platform may receive only basic info via OAuth Scope; to verify a tutor's qualifications, it redirects via that person's GSID URL to retrieve their degree certificate. To verify a handyman's license, the platform redirects via the GSID URL to obtain their technician certification. This work demonstrates how Digital Link technology bridges barcode encoding and digital identity to enable transparent, user-centric data disclosure.

K260307

Intelligent Collision Avoidance and Guidance Design of Unmanned Surface Vessels

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Keywords: Intelligent design, avoidance, guidance

Abstract:
This study establishes a collision avoidance algorithm for an actual unmanned surface vehicle (USV). The system includes route planning, obstacle avoidance, trajectory tracking, and vessel motion simulation. The system inputs include the waypoints, satellite maps, obstacle detection information, prohibited navigation areas, and navigable areas. The algorithm first converts the waypoints into a local XY coordinate system. It then downloads satellite maps and identifies the water areas and land areas in the Real Map. After that, an occupancy grid, an electronic geofence, and a planning safety area are established. Subsequently, the trajectory generator forcibly applies the bidirectional FAA* algorithm to all adjacent original waypoints and uses cubic spline interpolation to optimize the trajectory, thereby establishing the reference route. During actual vessel navigation, the algorithm uses sensors to detect obstacles and generates obstacle avoidance paths through either the local bidirectional FAA* algorithm. The guidance system integrates a collision risk indicator, a collision avoidance timing indicator, collision avoidance condition judgment, collision avoidance trajectory planning, speed reduction control, and stopping conditions. In addition, an artificial intelligence-based collision avoidance algorithm is introduced to switch among different navigation modes and select the current optimal tracking target. The controller adopts an adaptive nonlinear mixed $H2/H\infty$ control method to calculate the thrust and rudder angle, and a 3-DOF vessel model is used to simulate the motion of the USV. Finally, the system outputs records, path CSV files, and trajectory figures. Simulation analysis and actual vessel tests are mutually verified to evaluate the feasibility of the proposed collision avoidance algorithm. The algorithm inputs include the original GPS waypoints, satellite maps, obstacle detection information, prohibited navigation areas, and navigable areas. The algorithm first processes the map and route, and then uses the guidance system, controller, and actual vessel dynamic model to simulate and experimentally test the navigation of the USV.

K260308

A Knowledge-Enriched Small Language Model for Low-Resource Indigenous Knowledge Translation

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Keywords: Indigenous knowledge translation, small language models, low-resource language translation, lexical augmentation

Abstract:
While artificial intelligence (AI) applications for Indigenous languages and knowledge often rely on large language models (LLMs), these models require substantial computational, financial, and engineering resources that are often beyond the reach of small Indigenous communities. This study presents a knowledge-enriched small language model for low-resource Indigenous knowledge translation, using Paiwan-to-Traditional-Chinese translation as an initial empirical case. The proposed framework combines parameter-efficient fine-tuning with layered lexical augmentation using a local dictionary, online lexical resources, fuzzy matching, and vector-based retrieval. Rather than relying solely on knowledge encoded in model parameters, it treats community-maintained lexical knowledge as an external and controllable layer that can be updated, validated, and selectively applied during inference. We compiled a cleaned Paiwan–Chinese parallel corpus containing 7,714 records for training, validation, and testing. Translation performance is evaluated using BLEU, chrF, TER, semantic similarity, and terminology-preservation metrics. Multiple ablation settings compare a base small language model with its fine-tuned counterpart under progressively enriched retrieval configurations. Preliminary results show that the proposed knowledge-enriched small model achieved performance close to the same framework coupled with a state-of-the-art proprietary LLM. Both knowledge-enriched configurations outperformed the proprietary LLM without external lexical augmentation. The study examines whether small language models combined with structured external knowledge can provide a resource-efficient alternative to fine-tuning large models and deploying large-scale retrieval-augmented generation systems. Beyond translation performance, the approach supports culturally appropriate Indigenous AI through local deployment, knowledge provenance, community-led correction, and greater community control over culturally relevant lexical resources.

K260310

Top-k Sparse Routing in Heterogeneous Mixture-of-Experts for Network Intrusion Detection

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Keywords: Network Intrusion Detection, Mixture of Experts, Top-k Sparse Routing, Heterogeneous Neural Networks, Conditional Computation

Abstract:

Detecting network intrusions requires models that can capture the heterogeneity of network traffic while supporting efficient inference. However, a single deep learning model may be unable to adequately represent diverse attack patterns because different attack types exhibit distinct statistical, spatial, temporal, and global dependencies. This paper investigates a heterogeneous mixture-of-experts model with Top-k sparse routing for multi-class network intrusion detection. The proposed model consists of multilayer perceptron, convolutional neural network, long short-term memory, Transformer encoder, and CNN–Transformer experts. These experts are independently pretrained to learn complementary traffic representations, while a gating network dynamically selects the most appropriate experts for each input flow and assigns aggregation weights to their outputs. This conditional computation mechanism increases model capacity without requiring all expert submodels to be activated during inference. The model was evaluated on the CSE-CIC-IDS2018 dataset, which contains highly imbalanced benign and malicious traffic across 15 classes. Various Top-k routing configurations were assessed in terms of accuracy, precision, recall, F1-score, class-wise detection performance, expert utilization, and inference time. The results showed that sparse expert routing achieved effective multi-class intrusion detection and improved the detection of minority attack classes compared with a single global model. Moreover, increasing the number of activated experts did not necessarily yield proportional performance gains. Instead, an intermediate value of k provided a more favorable trade-off between detection performance and inference time. The analysis of expert utilization patterns further revealed differentiated routing behavior and collaborative processing among the heterogeneous neural experts. These findings indicate that Top-k sparse routing is a promising approach for balancing model heterogeneity, detection performance, and inference efficiency in network intrusion detection.

K260311

A Frequency-Aware Vision Mamba Network for Finger Vein Authentication

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Keywords: Computer vision, Deep learning, Vision Mamba, Biometric authentication, Finger vein

Abstract:

Due to their inherent liveness characteristics, resistance to forgery, and high security features, finger veins have received widespread attention in recent years. However, finger vein images typically suffer from low contrast and weak vascular textures, which continue to pose challenges for deep learning models in capturing discriminative finger vein features. To address the aforementioned issues, this study proposes a Frequency-Aware Vision Mamba Network for finger vein authentication. This method integrates the long-range dependence modeling capability of Vision Mamba with the proposed frequency-aware module to enhance the model's representation capability for fine-grained textures and overall vascular structures in finger vein images. By reinforcing high-frequency vascular textures and low-frequency structural information within finger vein images through the frequency-aware module, and employing Vision Mamba for global context feature modeling, the model can effectively capture inconspicuous vein texture features in low-contrast images, thereby obtaining more discriminative finger vein feature representations. Experimental results demonstrate that the proposed method achieves competitive authentication performance on public finger vein datasets while maintaining favorable inference efficiency. These results confirm that combining the frequency-aware module with state space model can effectively improve the model's representation capability for finger vein texture and structural features, offering practical value for constructing reliable and efficient finger vein authentication systems.

K260312

A Vision Transformer with Mamba Attention Mechanism for Facial Expression Recognition

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Keywords: Computer vision, Deep learning, Vision transformer, Mamba attention mechanism, Facial expression recognition

Abstract:

Due to subtle inter-class differences, large intra-class variations, and occlusion, facial expression recognition remains a challenging task. Although Vision Transformer (ViT) has strong capabilities in modeling long-range dependencies, its self-attention mechanism typically suffers from high computational complexity and may not effectively enhance local structural features related to facial expressions. To address these challenges, this study proposes a ViT-based network integrated with a Mamba attention mechanism for facial expression recognition. The proposed method can enhance the capability to extract local spatial structures and global semantic features, enabling the model to preserve discriminative facial textures. Specifically, the Mamba attention mechanism utilizes 2D polyline path scanning strategies to improve the ability of conventional structural masks to represent spatial relationships in images and generates corresponding polyline path masks, thereby more effectively preserving the adjacency relationships between facial image tokens. Experimental results on public facial ex-pression recognition dataset demonstrate that the proposed method achieves superior recognition performance compared with previous studies. The results indicate that the Mamba attention mechanism can enhance the feature representation capability of ViT in facial expression recognition tasks.

K260313

Reconstructing and Extending the BYODT Custom Datatype Pipeline in TVM Relax IR: Implementation and Evaluation with Posit Arithmetic

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Keywords: Apache TVM, Posit, BYODT, Relax IR, Numerical Precision

Abstract:

Generally, model training and inference use IEEE-754 FP32 as the default floating-point data type. Based on the observation that not every operator or component in a model requires high precision computation, various lower precision floating point formats have been proposed, such as Bfloat16, FP8, and posit numbers, in order to alleviate memory access overheads. Posit is an alternative to the IEEE 754 standard. With its dynamic precision allocation and configurable exponent size, this format has the potential to provide superior numerical behavior under the same bitwidth.

Apache TVM is an open source, end to end deep learning compiler. It provides a technique named BYODT (Bring Your Own Data Type) for integrating customized data types into model execution. This technique allows users to easily support target specific data types and evaluate their impact at an early stage. To effectively handle dynamic shape models, such as Transformers, TVM introduces Relax IR, the next generation compilation framework of Apache TVM. However, the existing BYODT support in TVM is primarily built upon the legacy Relay IR and its compilation flow; therefore, it cannot be directly applied to the new Relax IR based compilation flow.

In this paper, we reconstruct and extend the BYODT custom datatype pipeline within TVM Relax IR. We redesign and implement a custom datatype support flow for Relax IR, establishing a complete compilation path that proceeds from model import, through floating point operation type conversion, Relax IR rewriting, and TIR lowering, to execution via external runtime libraries. We use the introduction of posit numbers via BYODT to illustrate and validate the entire implementation and execution process. Through this workflow, some floating point operations in a model can be automatically converted into posit custom datatype operations according to specific requirements. Experimental results show that the proposed architecture effectively supports the application of posit types in neural network inference tasks, while enabling the analysis of how different posit configurations and accumulation strategies affect model accuracy and execution efficiency.

K260314

Identification and Classification of Lactuca Sativa Variants in the Philippines Using MobileNetV3

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Keywords: Lactuca Sativa, MobileNetV3, Raspberry Pi, Image Classification

Abstract:

This study classifies six Lactuca sativa (lettuce) variants in the Philippines—Romaine, Iceberg, Curly Green, Lollo Rosso, Butterhead, and Oak Leaf—using the MobileNetV3 architecture and a Raspberry Pi 4 Camera A dataset consisting of 1,200 self-collected images of individual lettuce leaves was developed and enhanced through data augmentation. The dataset was divided into training, validation, and testing sets using a 70:20:10 ratio. The proposed system achieved a validation accuracy of 99.66% in classifying six Lactuca sativa variants using the MobileNetV3Small architecture deployed on a Raspberry Pi 4. These results highlight the system's potential as an efficient tool for lettuce variant identification.

K260317

A Sustainability-Oriented Evaluation Framework for Integrating Community Cultural Elements into Interior Design in Historic Streets

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Keywords: Sustainable Buildings, Adaptive Reuse, Historic Streets, Interior Design, Evaluation Framework

Abstract:

Historic streets increasingly face physical deterioration, functional obsolescence, cultural homogenization, and the need for sustainable reuse. Although adaptive reuse and cultural-led regeneration have been widely discussed in sustainable building studies, there remains a lack of operational evaluation tools for assessing how community cultural elements are translated into interior and spatial design decisions at the micro scale. This study develops a sustainability-oriented evaluation framework for integrating community cultural elements into interior design in historic streets. A three-stage framework development approach was adopted. First, literature on cultural representation, place identity, spatial narrative, participatory governance, accessibility, adaptive reuse, and sustainable maintenance was synthesized to identify preliminary dimensions and indicators. Second, two contrasting historic street contexts, Wanhua District in Taiwan and Gion Matsuri in Kyoto, Japan, were reviewed to examine whether the indicators could be supported by observable evidence. Third, expert review was used to refine indicator clarity, category fit, and evidence types. The resulting framework consists of five dimensions and twenty indicators: cultural representation and recognition quality, spatial narrative and atmospheric experience, usability and accessibility, legitimacy of community engagement and local co-creation, feasibility and sustainable maintenance. The framework links cultural translation with practical evidence such as material decisions, circulation diagrams, sensory cues, stakeholder records, maintenance plans, and regulatory considerations. The findings suggest that integrating community culture into historic street interiors should not be limited to decorative symbolism, but should be evaluated through cultural accuracy, experiential quality, inclusive use, governance legitimacy, and long-term maintainability. This study contributes a reusable checklist for design briefing, assessment, and decision-making in sustainable regeneration projects. Future research may extend the framework through expert-based weighting, such as AHP, and broader case validation.

K260318

A Simulation-Based Explainable AI Framework for Anatomical Recognition and Motion Analysis in Endotracheal Intubation Training

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Keywords: Endotracheal intubation, Explainable artificial intelligence, Anatomical segmentation, Motion analysis, Simulation-based training

Abstract:

Endotracheal intubation requires accurate recognition of laryngeal anatomy and real-time interpretation of procedural motion. Trainees may have difficulty identifying key structures and understanding tube movement during insertion. This study proposes a simulation-based explainable artificial intelligence framework for anatomical recognition and motion analysis in endotracheal intubation training. All image and video data were obtained from a medical training manikin. No human participants or clinical data were involved. The framework includes an anatomical segmentation module and a temporal motion-analysis module. YOLOv8 segmentation models were trained with polygon annotations to identify the epiglottis, glottis, and accessory cartilages of the larynx. A convolutional neural network–long short-term memory model classified motion from sequential frames. The experiments used leave-one-video-out cross-validation. In each fold, one complete video was reserved for testing, while the remaining videos were used for model development. This design prevented frames from the same video from appearing in both sets. The segmentation module was interpreted using Gradient-weighted Class Activation Mapping, per-pixel boundary difference analysis, and visualization of non-maximum suppression. The temporal module was examined using frame-wise attention and temporal masking. Across the three anatomical structures, the segmentation models achieved precision of 0.939–1.000, recall of 0.989–1.000, and mAP@0.5 of 0.990–0.995. The temporal model also showed high performance in distinguishing no-action and tube-insertion states. Both modules were integrated into a software system that displays anatomical masks, motion predictions, and model explanations for uploaded or streamed videos. These preliminary findings support the feasibility of combining anatomical segmentation, temporal motion analysis, and multi-level explainability for manikin-based intubation training. The system is intended for simulation and education rather than clinical use. Further studies should evaluate multiple manikin models, trainees, recording conditions, and clinical data.

K260324

Which early-stage startup characteristics are most predictive of acquisition success?

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Keywords: startups, venture capital, funding analysis, logistic regression, statistical significance, entrepreneurial outcomes

Abstract:

The evaluation of startup success is a complex problem influenced by financial, structural, and market-driven factors. This study investigates the relationship between total funding, venture capital (VC) backing, and startup outcomes using a dataset of 923 startups categorized by acquisition and closure status. Descriptive statistics and inferential methods, including mean comparison, distributional analysis, a two-sample t-test, and logistic regression, are applied to assess whether funding structure is associated with startup success. Results indicate that acquired startups exhibit significantly higher mean and median funding than closed startups; however, this difference is not statistically significant at the 95% confidence level ($p = 0.104$). Additionally, VC-backed startups demonstrate a lower success rate than non-VC-backed startups. A logistic regression model achieves moderate predictive performance (AUC = 0.65), suggesting that funding and VC status provide limited explanatory power in predicting outcomes. Overall, findings indicate that startup success is only weakly associated with financial input variables alone.

K260325

An Agentic AI-Driven Decision Framework for Automated pH and EC Regulation in a Hydroponic Cyber-Physical System

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Keywords: agentic artificial intelligence, cyber-physical systems, intelligent control, pH control, electrical conductivity control

Abstract:

In recirculating hydroponics, small deviations in pH and electrical conductivity (EC) can turn routine nutrient dosing into a control-risk event. Existing automated controllers typically respond to these deviations as isolated threshold crossings, providing limited support for contextual diagnosis, action review, and traceable actuation decisions. This paper presents a safety-gated agentic AI decision framework for automated pH and EC regulation in a hydroponic cyber-physical system (CPS). The framework integrates embedded sensing and dosing hardware with an orchestrated agentic workflow for monitoring, diagnosis, decision selection, dose planning, consistency review, and bounded command execution. The system was evaluated through calibration, dosing characterization, and controlled disturbance benchmarking using an implemented hydroponic CPS prototype. The proposed controller was compared with a rule-based baseline using a seven-day controlled-disturbance benchmark in a 20 L reservoir covering stable operation, pH disturbances, EC disturbances, mixed pH/EC disturbances, and extreme stress-test cases. The recoverable-regulation comparison used 1,047 validated readings from stable and non-extreme disturbance episodes, while extreme stress-test episodes were analyzed separately. The baseline generated 67 dosing events, whereas the agentic controller generated 46, reducing total dosing events by 31.34% and lowering dosing frequency from 12.76 to 8.81 events per 100 readings. Combined pH-and-EC compliance remained comparable, with the agentic controller achieving 85.82% compliance compared with 87.24% for the baseline controller, although the agentic controller exhibited longer response-time estimates. These results indicate that agentic AI can serve as an auditable orchestration layer for hydroponic nutrient regulation, with the principal benefit being fewer actuator interventions while maintaining broadly comparable range-control performance.

K260327

Enhancing Cultural Care and Health Support through an AI-Based Indigenous Health Station Model: Design and Experimental Evaluation

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Keywords: Cultural care, AI virtual care assistant, Indigenous cultural and health station, Physiological monitoring

Abstract:

This study develops and evaluates an AI-based cultural care and health support model for Atayal elders, with the aim of enhancing cultural care and health outcomes for older adults at an urban cultural and health station in Zhudong Township, Hsinchu County, as well as reducing the workload of caregivers. A total of 16 elders were recruited; eight elders in the experimental group wore smartwatches and received AI-supported instruction and physiological monitoring, while eight elders in the control group participated in traditional teaching. The AI station infrastructure included smartwatches, a CareSpot device, cloud-based physiological data monitoring and reporting, an AI virtual care assistant, and software–hardware development for AI-based instructional methods. The experimental results indicated that (1) elders receiving AI-based instruction had significantly higher cultural care scores than those receiving traditional instruction, supporting that the AI station leads to better cultural learning outcomes than traditional stations; (2) elders in the experimental group showed significantly longer and more frequent active interactions with the AI system than the control group's more passive responses to caregivers, suggesting that the AI teaching method deepens and broadens elders' cultural learning; (3) the AI station achieved better health-support outcomes through continuous recording and reporting of physiological data, enabling the detection of potential problems, providing timely care, and supporting clinical decision-making; (4) the system's average usability score was 81.5 (grade B), indicating good user experience and emotional acceptance among elders; and (5) caregivers affirmed that the AI station and AI-based instructional method help reduce their work burden.

K260328

Feasibility of green shotcrete construction, operability, and on-site anchor spraying application on coastal landslide-prone slopes

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Keywords: Sustainability, recycling and reuse, mortar, marine waste fiber, coastal landslide-prone slopes

Abstract:

The resource transformation and engineering application of marine plastic waste are key strategies for achieving environmental sustainability and resilient land construction. This study focuses on the development of recycled fiber-reinforced green shotcrete from marine waste, exploring its potential for application in slope protection projects on coastal landslide-prone slopes, with the aim of balancing marine waste reduction and low-carbon benefits. The experimental design is based on the main variables of 5% and 15% recycled-fiber volume fractions from marine waste, with a fixed water-cement ratio of 0.41 used in the proportioning design to establish a benchmark for material properties. After standard curing, the specimens underwent systematic testing of mechanical properties and matrix behavior, followed by a 7-day compressive strength test. The results showed that the compressive strength of the low dosage group (5%) was 48.95 MPa, while the high dosage group (15%) was affected by the increase in fiber volume proportion, which affected the density of the matrix and reduced the strength to 42.44 MPa, resulting in an overall strength reduction of about 13.3%. However, at a high dosage of 15%, its 7-day compressive strength still exceeds 42 MPa, demonstrating excellent early structural strength and engineering application value. More importantly, the addition of marine waste fibers not only reduces the brittleness of the sprayed concrete matrix but also significantly improves the material's crack, shear, and salt-damage resistance in coastal environments. This improved characteristic gives it strong potential to meet the mechanical support and deformation requirements of coastal collapse-prone slopes under wind waves and rainstorm erosion. This research not only mitigates the impact of marine debris on the ecological environment but also offers a low-carbon shotcrete solution for coastal slope engineering that combines structural safety, cost-effectiveness, and environmental sustainability, thereby advancing the practical application of the circular economy in engineering materials.

K260329

Sequential Cohort Calibration: Estimating Historical Licence Issuance Cohorts from Contemporary Registry Data

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Keywords: Sequential Cohort Calibration, Registry Analytics, Cohort Analysis, Historical Inference, Tourism Employment

Abstract:

Administrative registries are widely used for operational and regulatory purposes but often lack historical records required for longitudinal analysis. While contemporary registry snapshots provide information on active registrants, historical licence issuance patterns are frequently unavailable. Consequently, cohort formation and long-term registration trends remain difficult to examine despite the existence of extensive administrative records. This study proposes Sequential Cohort Calibration (SCC), a methodology for estimating historical licence issuance cohorts from contemporary administrative records. The approach combines sequential identifier ordering, expiry-boundary detection, seasonal reset calibration, and temporal consistency rules to estimate annual licence issuance cohorts when original issuance records are unavailable. SCC was evaluated using a deduplicated national tourist guide registry containing 8,400 active records. The reconstructed series produced annual cohort estimates spanning 1990–20

K260330

Evolutionary Attention-Guided Detection of BGA Solder Ball Defects for Smart Semiconductor Packaging Inspection

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Keywords: BGA Inspection, Semiconductor Packaging, Small Object Detection, Smart Manufacturing, YOLOv9-tiny

Abstract:

Defect inspection in semiconductor packaging has become increasingly important for ensuring product reliability and manufacturing quality. Among various packaging de-fects, missing and damaged Ball Grid Array (BGA) solder balls represent critical small-object detection challenges because of their tiny size, dense arrangement, and complex background interference. This study proposes an evolutionary attention-guided detection framework based on YOLOv9-tiny for real-time BGA solder ball defect inspec-tion. The proposed framework integrates grid-based segmentation, target-aware cropping, image enhancement, Squeeze-and-Excitation (SE) attention, Convolutional Block Attention Module (CBAM), and Genetic Algorithm (GA)-based hyperparameter opti-mization. To improve the visibility of tiny solder balls, a localized image partitioning strategy is employed. Furthermore, SE and CBAM modules enhance feature discrimina-tion while maintaining lightweight computational complexity. A Genetic Algorithm is adopted to automatically optimize training hyperparameters, improving convergence stability and resource efficiency. Experimental results demonstrate that the proposed framework achieves superior Precision, Recall, mAP, and F1-score compared with base-line YOLOv9-tiny models. The optimized architecture also reduces GPU memory con-sumption and training time, making it suitable for edge-AI deployment in semiconductor packaging inspection systems.

K260331

Optimizing training efficiency by minimizing idle time in heterogeneous GPUs

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Keywords: parallel training, Heterogeneous GPUs, Straggler problem

Abstract:

As the complexity of deep learning models continues to increase, parallel training has become the mainstream method for improving training efficiency. However, in real-world applications, budget constraints often prevent the complete replacement of hardware with high-end equipment, making heterogeneous environments—which mix hardware of different generations and specifications—are highly common. Applying traditional Distributed Data Parallel (DDP) with a static uniform allocation strategy to such environments triggers the straggler problem, where high-performance GPUs waste idle time waiting for slower ones during gradient synchronization, severely degrading overall training efficiency. To overcome this bottleneck, this paper proposes an adaptive dynamic load-balancing algorithm for single-machine with heterogeneous multi-GPU, aiming to minimize the model training time by reducing the idle time between GPUs. The core mechanism of this method consists of two stages. First, a Cold-Start Mechanism utilizes profiling before formal training. Without cross-GPU communication, it inputs a specific model and dataset for parallel computation testing to accurately evaluate the actual computing power ratio among the GPUs. Simultaneously, it estimates the maximum batch size each GPU can accommodate to set an upper limit, avoiding Out of Memory (OOM) interruptions. After establishing the computing baseline and initially allocating the data volume, the system enters the second stage: a dynamic fine-tuning mechanism. The proposed mechanism monitors training time gap between different GPUs in real-time and dynamically adjusts the batch size for each GPU based on the actual training time of the previous epoch, ensuring that every subsequent round allocates the appropriate amount of data according to the true hardware load capacity. To verify the algorithm, experiments were conducted on a single machine with an NVIDIA RTX 5070 Ti and an RTX 2080 Ti. Results show our method significantly reduces gradient synchronization delay and shortens total training time by 27.5%, improving efficiency via optimized data allocation in resource-constrained environments.

K260333

Graph-Theoretic Rule Deployment for Optimized Intrusion Response in Collaborative Networks

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Keywords: Network Security, Network Intrusion Detection Systems (NIDS), Collaborative Intrusion Detection Network (CIDN), Intrusion Response System (IRS)

Abstract:

With the proliferation of sophisticated cyberattacks, Collaborative Intrusion Detection Networks (CIDN) have emerged as a scalable and systematic solution to identify threats by leveraging the collective knowledge of cooperating Intrusion Detection Systems (IDSs). While CIDNs effectively identify intrusions a robust defense requires active response mechanisms, such as the strategic deployment of detection rules to appropriate IDSs to prevent recurring attacks via diverse paths. However, existing literature primarily focuses on high-level IDS placement, often neglecting the low-level details of rule assignment. Improper rule distribution not only degrades CIDN efficiency but also increases network vulnerability and privacy risks.

This research proposes an Intrusion Response System (IRS) featuring an optimized Rule Deployment Mechanism (RDM) to provide fine-grained rule control within a CIDN. RDM employs a Select Candidate IDS Nodes (SCIN) algorithm designed to identify the Critical Vertex Cut Set (CVCS), a minimal group of IDSs required to secure specific detection domains. By modeling network topology as a τ-π graph that maps paths between potential threats (τ) and victims (π), the mechanism ensures both topology-awareness and performance-awareness. The RDM consists of three core components: the Super Agent (SA) for management, the Rule Generator (RG) for signature mapping, and the Rule Installation (RI) unit for final deployment.

Experimental evaluations conducted using the National Science Foundation Network (NSFNET) topology demonstrate the effectiveness of the proposed mechanism. Comparisons against baseline strategies (including random selection and highest-degree node selection) reveal that RDM significantly reduces the total number of rules installed across the network while maintaining 100% detection coverage for identified threats. Furthermore, RDM ensures a more balanced rule distribution, preventing single-node performance bottlenecks caused by excessive rule processing. This study provides a foundational framework for exploring best practices in enhancing the security posture and operational efficiency of collaborative defense systems.

K260334

Identification of Edible Sea Cucumbers Using YOLOv8

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Keywords: Sea Cucumbers, Object Identification, YOLOv8, Computer Vision

Abstract:

Post-harvest misidentification of sea cucumbers in Southeast Asia undermines marine resource management and compromises the security of the seafood trade. Traditional taxonomic methods are time-consuming and require specialized knowledge, which makes rapid monitoring of small-scale fisheries difficult. This study aims to develop a post-harvest identification system that uses the YOLOv8 object detection model to identify three economically vital Philippine species: Holothuria scabra, Holothuria atra, and Holothuria edulis. The specific objectives are to (1) capture images of live specimens using a camera module, (2) train a YOLOv8 model to identify the three classifications, and (3) evaluate the performance of the system using a multi-class confusion matrix. The researchers fabricated a 45 cm x 30 cm x 40 cm hardware enclosure running on a Raspberry Pi platform to maintain a fixed camera distance and stable illumination over specimens in a water basin. Through geometric and photometric data augmentations, the training dataset was expanded to 2,520 images to improve robustness. When tested against 120 unseen post-harvest samples, the system was able to differentiate between the three classifications of sea cucumbers and achieved an overall accuracy of 85.83%

K260335

Machine Learning-Based Analysis of Experiential Marketing Drivers and Customer Loyalty in the Gaming Industry: Evidence from Random Forest and Bootstrapping

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Keywords: Experiential Marketing, Customer Loyalty, Random Forest, Bootstrapping, Feature Importance

Abstract:

This study examines how experiential marketing drivers influence customer loyalty in the gaming industry, focusing on non-linear relationships and the bridging role of customer satisfaction. Using survey data from 219 participants in Nintendo Switch 2 trial events in Taiwan, the study applies a Random Forest model with 1,000 bootstrap replications to analyze hierarchical feature importance under controlled demographic conditions. The results show that playfulness and act experience are the strongest predictors of loyalty. When customer satisfaction is introduced, the importance of these dominant factors declines only partially, suggesting that satisfaction functions as a bridging mechanism rather than a full mediator. The findings further indicate that participants with a monthly income between NT$30,000 and NT$50,000 exhibit the highest conversion efficiency. This study contributes to business intelligence and consumer analytics by demonstrating how machine learning and bootstrapping can provide robust insights into experiential marketing and precision targeting in the gaming industry.

K260336

mart Eyewear: Blue Light Exposure Monitoring and Blocking Using YOLOv8 for Device Identification

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Keywords: Smart Eyewear, Blue Light Monitoring, YOLOv8, Computer Vision, Wearable Technology

Abstract:
Excessive exposure to blue light emitted from digital devices has become a growing concern due to its potential effects on eye health, sleep quality, and visual comfort. This study presents the design and development of a smart eyewear system capable of monitoring and mitigating blue light exposure through real-time device identification and ambient light sensing. The proposed system integrates a Raspberry Pi Zero 2 W, a VEML6040 ambient light sensor, and a camera module to detect blue light sources and assess exposure conditions. YOLOv8 is utilized to identify common blue light-emitting devices, including smartphones, laptops, and televisions, while Kernel Density Estimation (KDE) is employed to classify exposure levels into safe, moderate, and excessive categories. The system is designed to provide contextual awareness of blue light exposure and support preventive eye health measures. The study contributes to the development of wearable intelligent health-monitoring technologies by combining computer vision, embedded systems, and sensor-based exposure assessment. Prototype implementation and model training are currently underway, with future work focused on performance evaluation, system optimization, and real-world validation.

K260337

Staleness Detection in Roasted Coffee Beans using an Electronic Nose and SVM

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Keywords: Coffee, Electronic Nose, Support Vector Machine, Volatile Organic Compounds, Machine Learning

Abstract:
Roasted coffee is a globally significant specialty beverage whose value relies heavily on its freshness and distinct aroma. As coffee stales, the degradation of volatile organic compounds (VOCs) significantly diminishes its sensory appeal and overall consumer experience. Maintaining this quality is critical, yet conventional analytical techniques like gas chromatography mass spectrometry for tracking volatile emissions are costly, complex, and impractical for real-time field deployment. To address this limitation, this study proposes a low-cost electronic nose system integrated with a Support Vector Machine (SVM) classifier to detect staleness in whole roasted Arabica coffee beans of the Brazil Santos variety. The hardware utilizes an array of broadly sensitive MQ series metal oxide gas sensors to capture gaseous aroma fingerprints. Sensor data is digitized and acquired using an Arduino Uno, with a Raspberry Pi 5 serving as the primary processing unit. Unlike approaches that rely on arbitrary commercial shelf life, staleness in this study is defined by human perceptible sensory degradation induced through open air exposure. The raw sensor data undergoes rigorous preprocessing, including noise reduction, outlier removal, and standardization, before being fed into the SVM model for binary classification of stale versus not stale samples. The developed system achieved a classification accuracy of 96%, as evaluated using a confusion matrix and standard performance metrics. These findings highlight the viability of combining affordable gas sensor arrays with machine learning as a practical, scalable alternative to subjective human evaluation or expensive chemical profiling. The system offers direct applications for rapid freshness screening and automated quality control within the coffee industry.

K260338

G-XCI: A Preprocessing-Aware Multi-View Diagnostic for Tabular Explanation Reliability

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Keywords: explainable artificial intelligence, explanation reliability, SHAP, Grey Relational Analysis, rank consistency

Abstract:

Explanation reliability is often inferred from one attribution run, although stable local rankings may disagree with a population-level relational view. This paper presents G-XCI, a preprocessing-aware diagnostic that reports Local Attribution Stability (LAS), Global Relational Stability (GRS), and a Structural Consistency Coefficient (SCC). The global view is explicitly conditioned on robust standardization and min–max normalization before Grey Relational Analysis. Across IBM HR Attrition and UCI Adult Income, Adul retains negative SCC under all tested permutation, sample, and top-K settings, whereas IBM HR is strongly top-K sensitive. The results support G-XCI as a conditional engineering audit protocol rather than a universal ground-truth explanation metric.

K260341

Classification of White-Flesh Fish Fillets Using YOLOv8

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Keywords: YOLOv8, computer vision, deep learning, fish fillet classification, image classification

Abstract:

White-flesh fish species, including Tilapia (Oreochromis niloticus), Bangus (Chanos chanos), Apahap (Lates calcarifer), Maya-Maya (Lutjanus malabaricus), and Cream Dory (Pangasianodon hypophthalmus), are widely consumed in the Philippines. However, processing these fish into skinless fillets removes their external morphological characteristics, making species identification through visual inspection difficult. This study presents a computer vision-based fish fillet classification system using the YOLOv8 classification model to distinguish visually similar white-flesh fish fillets. Fish fillet images were captured using a Raspberry Pi Camera Module 3 within a controlled imaging enclosure under standardized lighting conditions to ensure consistent image quality. The collected images were preprocessed before model training and evaluation. Experimental results showed that the proposed system achieved an overall classification accuracy of 94.44%, demonstrating its capability to accurately distinguish fish fillets across the target classes under controlled imaging conditions. The findings highlight the potential of deep learning and computer vision as practical tools for fish fillet classification and computer-assisted seafood inspection, providing a foundation for future image-based fish species identification.

K260342

Digital Board Game-Based Co-Learning for Dementia Care Education: Intergenerational vs. Peer Approaches among Nursing Students

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Keywords: Digital Board Game, Intergenerational Co-Learning, Peer Co-Learning, Dementia Care Competence, Nursing Education

Abstract:

Background and Purpose: With the accelerating global aging population, dementia care is a critical focus in nursing education. However, traditional didactic teaching lacks immersive situational context, limiting its effectiveness in enhancing students' communication and care competence. This study investigates a "Digital Board Game-Based Co-Learning Model" on nursing students' dementia care competence, comparing "Intergenerational Co-Learning" (paired with older adults) and "Peer Co-Learning" (paired with peers).

Methodology: Adopting a quasi-experimental design, this study developed a digital board game for dementia education. Utilizing a Monopoly-inspired gamification system with task-driven mechanics and real-time feedback, the game integrates core content: dementia concepts, symptom identification, cognitive assessment, communication strategies, Behavioral and Psychological Symptoms of Dementia, person-centered care, and cognitive stimulation. Nursing students (N=116) were assigned to either the intergenerational group (n=41) or the peer group (n=75). Quantitative data were collected pre- and post-intervention to evaluate changes in competence.

Results: In the inter-group comparison, the intergenerational group demonstrated significantly greater improvements in empathetic reflection and reflective communication than the peer group. Conversely, the peer group exhibited higher efficiency in acquiring care knowledge, specifically regarding the causes and characteristics of dementia.

Conclusions and Contributions: This study validates the digital board game-based co-learning model as a complementary, innovative approach for nursing education. While peer co-learning effectively enhances fundamental professional knowledge, intergenerational co-learning excels in fostering empathy and communication. These findings provide empirical evidence for collaborative, game-based learning in nursing curricula, advancing dementia care education and smart long-term care talent cultivation.

K260343

Clinical Assessment of Postoperative Rehabilitation Efficacy via CPM Device and Inertial Measurement Unit (IMU) Gait Analysis System

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Keywords: Gait Analysis, Rehabilitation Efficacy, Continuous Passive Motion (CPM), Inertial Measurement Unit (IMU), Clinical Validation

Abstract:

This study focuses on patients undergoing THA and integrates a smart Continuous Passive Motion (CPM) rehabilitation device, an Inertial Measurement Unit (IMU)-based gait analysis system, and clinical assessment procedures to establish a comprehensive platform for postoperative rehabilitation training and functional evaluation.

The major achievements of this project's second phase include: (1) CPM device developing an integrated control system (PLC, Human-Machine Interface (HMI), and sensors) for parameter configuration, status monitoring, and safety protection; (2) completing medical electrical safety and Electromagnetic Compatibility (EMC) testing in compliance with IEC 60601 standards; (3) establishing an IMU-based gait analysis system using Xsens DOT sensors and Python for gait event detection, parameter analysis, and symmetry assessment; (4) validating the system via an optical motion capture system to perform error analysis for gait events like Initial Contact (IC), Toe-Off (TO), and Stride Time; and (5) conducting clinical trials and longitudinal follow-ups integrating CPM training, gait analysis, and muscle strength assessment across recovery stages.

The clinical trial results demonstrate that using the CPM device effectively increased muscle strength by 10%–17%, improved the hip flexion height of both legs by 8%–10%, and enhanced gait symmetry by 16%–23% within one month postoperatively. These findings confirm that the developed smart CPM rehabilitation device possesses satisfactory structural safety, control stability, and clinical feasibility. Furthermore, the IMU-based gait analysis system can effectively identify gait events and quantify gait parameters, while optical-system validation confirms its good temporal consistency and accuracy. Future work will continue to expand clinical participant recruitment and further compare outcomes between the experimental and control groups to evaluate the effectiveness of the smart CPM rehabilitation device on postoperative functional recovery, thereby providing a reference for clinical rehabilitation assessment and intelligent healthcare applications.

K260344

TCN-Based Rehabilitation Motion Recognition and Quality Quantification

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Keywords: Temporal Convolutional Network, Dynamic Time Warping, Motion quality assessment

Abstract:
This study presents a rehabilitation motion recognition pipeline based on a Temporal Convolutional Network (TCN). MediaPipe Pose is used to extract upper-limb skeletal landmarks from RGB-D image streams. The coordinates are centered, view-corrected, in-terpolated, and smoothed before being converted into a fixed-length temporal feature ten-sor. A four-layer dilated TCN with residual blocks captures long-range motion patterns over a 60-frame sequence, while Dynamic Time Warping (DTW) converts the classifica-tion result into motion-quality indicators for rehabilitation feedback.

K260345

Single-stage Intelligent Multi-reservoir Manipulation Decision

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Keywords: fuzzy logic, heuristic algorithms, neural networks

Abstract:

Operating multiple reservoirs requires not only anticipating future variations in reservoir water levels, but also comprehensively assessing how upstream release decisions propagate through the basin to influence downstream conditions. Key considerations include reservoir inflow forecasting, flood control management, and hydropower scheduling. Reliance on human experience alone has proven insufficient to reliably address these complex requirements, and optimizing basin-wide reservoir decision-making remains a formidable challenge. Moreover, with the increasing frequency of short-duration heavy rainfall events driven by climate change, coupled with the dispatching demands of power grids characterized by high penetrations of wind and solar generation, reservoir operation decisions must be generated with greater timeliness and responsiveness. Such improvements are essential to stabilize the power grid, mitigate flood risks, reduce economic losses, and safeguard livelihoods, agriculture, fisheries, and industrial activities.However, the process of selecting the optimal decision candidate solution set and fusing the temporal and spatial aspects of the runoff model suffers from excessive computational complexity. Therefore, the goal of this study is to propose a single-stage intelligent multi-reservoir operation decision framework to simplify the computational load.

K260348

The Impact of Corporate ESG Homepage Design on Enhancing User Experience: An Exploratory Factor Analysis

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Keywords: ESG, User Experience (UX), Web Design

Abstract:

Purpose:

This study focuses on user experience to explore how to design ESG (Environmental, Social, and Governance) website homepages that are both attractive and effective in delivering sustainability messages. It analyzes user experiences on corporate ESG homepages to help managers improve website usability and brand communication.

Design/methodology/approach:

Many current ESG homepages suffer from unclear structures, weak interactivity, and low visual appeal. To address these issues, the study combines theory and survey-based research. This study delves into user-centered design strategies for corporate ESG homepages. By conducting a questionnaire survey, this research investigates users' experiences and expectations regarding these platforms. The survey instrument was developed based on a comprehensive literature review encompassing ESG, user expe-rience (UX), and web design, focusing on four key dimensions: information architecture, visual presentation, navigation, and interactivity.

Findings:

This questionnaire survey aimed to evaluate users’ experience with ESG website homepages across four key dimensions: information architecture, visual presentation, navigation design, and interactivity. User responses regarding these aspects were col-lected through the survey and analyzed using the SAS statistical software. The analysis included tests of sampling adequacy, exploratory factor analysis, and reliability testing to further investigate the impact of each design element on user experience and to ensure the validity and consistency of the questionnaire instrument. Using questionnaires and ex-ploratory factor analysis, it identifies three key factors that affect user experience: (1) smooth interface and clear functions, (2) interactive and multimedia engagement, and (3) well-organized and easy-to-understand content.

K260352

Effect of Yttrium Doped ZnO on the Piezoelectric Output Performance of Polydimethylsiloxane (PDMS) Based Flexible Nanogenerators

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Keywords: flexible piezoelectric nanogenerator, Y-doped ZnO, solution casting, solution casting, chemical co-precipitation, polydimethylsiloxane (PDMS)

Abstract:

This study aims to investigate the effects of yttrium (Y) doping on the morphology, crystal structure, and piezoelectric properties of zinc oxide (ZnO) and its application in flexible piezoelectric nanogenerators based on polydimethylsiloxane (PDMS). Pure ZnO and Y-doped ZnO nanopowders with doping concentrations (5, 10, 15, and 20 mM) were synthesized through chemical co-precipitation. The nanopowders were incorporated into PDMS at varying weight percentages (10, 20, 30, and 40 wt%) and processed into ZnO/PDMS composite films using solution casting. X-ray diffraction (XRD) spectra confirmed the effective incorporation of Y into the ZnO lattice. No secondary phases were observed at doping concentrations of 5–15 mM, whereas a diffraction peak corresponding to the Y (222) plane emerged at 20 mM, indicating that the solid solubility limit had been exceeded. Scanning electron microscopy revealed an increase in ZnO nanorod length with higher Y concentrations, and energy-dispersive X-ray spectroscopy verified the presence of Y in the doped samples. Piezoelectric performance was evaluated under periodic finger tapping at 1.5 Hz. The composite film with 15 mM Y doping and 30 wt% filler exhibited the highest output, delivering a power density approximately six times higher than that of the undoped ZnO/PDMS film. These results demonstrate that Y doping significantly enhances the piezoelectric response of ZnO/PDMS composite, underscoring their potential for flexible self-powered devices and energy harvesting systems.

K260353

Counterfactual Explainable AI for Teaching Quality Analysis: Evidence on Mathematics Learning Outcomes in Low- and Middle-Income Countries Using PISA-D Data

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Keywords: Counterfactual AI, Explainable AI, Teaching quality, Education policy

Abstract:
Artificial intelligence (AI) is increasingly used to predict educational outcomes, yet relatively little research has explored how AI can support evidence-based policy by answering actionable “what-if” questions. This study employs counterfactual AI to estimate how hypothetical improvements in teaching quality could make students reach the average proficiency in mathematics in low- and middle-income countries (LMICs). Using data from the Programme for International Student Assessment for Development (PISA-D), we compare conventional Ordinary Least Squares (OLS) regression with Random Forest machine learning to model relationships between multiple dimensions of teaching quality and student mathematics achievement. We then generate counterfactual explanations to simulate realistic instructional improvements and estimate their predicted effects on student performance. Unlike traditional predictive models that explain existing outcomes, the proposed framework identifies feasible instructional changes associated with improved learning while maintaining model interpretability. The comparison between econometric and machine learning approaches demonstrates the added value of nonlinear AI models for capturing complex educational relationships and supporting policy simulations. The study contributes to Explainable Artificial Intelligence (XAI) by illustrating how counterfactual reasoning can transform educational data into transparent and actionable decision-support tools. Beyond education, the proposed approach provides a general framework for applying responsible AI to public policy problems where stakeholders require understandable, policy-relevant, and human-centered recommendations rather than predictions alone. The findings demonstrate the potential of counterfactual AI to support equitable educational decision-making and strengthen AI-driven policy innovation in resource-constrained settings.

K260354

Detection of Pineapple Diseases Using YOLOv9

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Keywords: YOLOv9, ResNet50, Raspberry Pi, Detection, Pineapple

Abstract:
Pineapple cultivation remains vulnerable to diseases that reduce crop quality and productivity. This study developed a standalone pineapple disease detection and classification system using YOLOv9 and ResNet-50 deployed on a Raspberry Pi 5 with a 1080p webcam and a 5-inch LCD display. A dataset of 4,000 locally acquired pineapple images was collected to train and evaluate the proposed models. Experimental results achieved an overall classification accuracy of 96.66%, demonstrating reliable disease detection under controlled testing conditions. The developed system demonstrates the application of deep learning and embedded computer vision technologies in supporting precision agriculture and improving crop management practices

K260355

Classification of Fabric Blends using ResNet50

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Keywords: YOLOv9, ResNet50, Computer Vision, Fabric Blend Classification, Raspberry Pi Model 5

Abstract:
Fabric serves as the foundation of most products that are essential in day-to-day lives, such as clothing and furniture associated by their various functions. The following study developed an automated prototype used to classify Fabric Blends using YOLOv9 and ResNet50 employed using Raspberry Pi 5 equipped with a 1080p camera and 7-inch display. The study utilized 6600 self acquired images which were trained on the mentioned models. The system achieved an overall classification accuracy of 96.17%, demonstrating reliable performance under controlled conditions. This prototype highlights the potential of integrating deep learning and embedded systems for modern textile classification.

K260356

Design and Optimal Numerical Simulation of Broadband Solar Absorbers Based on Multilayer Stacks and Metasurfaces

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Keywords: absorber, finite element method, thermophotovoltaic (TPV) devices, numerical simulation, electromagnetic field distributions

Abstract:

High-efficiency broadband solar absorbers were designed and analyzed to elucidate the influence of distinct structural mechanisms on optical absorption performance. In this study, two classes of metamaterial absorbers were investigated and optimized: multilayer metal–dielectric stacks and patterned metamaterial surface structures. Numerical simulations of the proposed absorber structures were performed using COMSOL Multiphysics® based on the finite element method (FEM) to evaluate and optimize their optical absorption characteristics across the target spectral ranges. In the multilayer design, optimization of individual layer thicknesses enhanced impedance matching and combined plasmonic resonance with cavity interference effects, resulting in broadband absorption across 300–3000 nm. The optimized structure showed an average absorption of ~0.90 under AM1.5G solar spectrum weighting. In parallel, a cross-shaped metamaterial absorber was designed, where localized surface plasmon resonance (LSPR) was tuned through geometric parameter adjustments. Parametric analysis results showed strong spectral tunability, with the optimized design attaining a weighted average absorption of ~0.96. Through the investigation of electric and magnetic field distributions, impedance characteristics, and polarization-dependent simulations, LSPR, Fabry–Perot (FP) resonance, and multilayer coupling effects were identified as the dominant absorption mechanisms. The multilayer stack of the absorbers ensured smooth and stable broadband absorption through interference and impedance matching, whereas the cross-shaped metamaterial relied on geometry-induced localized resonances, offering stronger absorption intensity and enhanced spectral control. By comparing the absorption performance and physical mechanisms of the two metamaterial absorbers, the advantages and limitations of design strategies for broadband solar absorption, and the key parameters for optimization were identified. The results can be used for for the development of high-efficiency solar absorbers, thermophotovoltaic systems, and related optoelectronic devices.

K260358

Effects of Design Parameters on the Mechanical Response of Late-Stage Acetabular Liner Defects

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Keywords: Total hip arthroplasty (THA), Acetabular liner, Structural design, Defect

Abstract:

Objective: This study investigated the biomechanical mechanisms of prosthetic dislocation associated with late-stage acetabular liner defects and evaluated the effects of implant geometric design parameters on hip joint stability under impingement conditions.

Methods: A three-dimensional finite element model of a total hip prosthesis was developed to simulate impingement-induced subluxation. Hip joint stability was assessed using the maximum dislocation moment, while peak contact stresses in the impingement and dislocation regions were also analyzed. The femoral head, femoral neck, acetabular shell, and UHMWPE liner were modeled using appropriate material properties. Six late-stage liner defect configurations were generated in SolidWorks®. The effects of implant geometry were evaluated by comparing two head–neck ratios, three rim chamfer configurations (Types A–C), and four femoral head diameters.

Results: Finite element analysis demonstrated that increasing the head–neck ratio and femoral head diameter increased the maximum dislocation moment, thereby improving hip joint stability under late-stage acetabular liner defect conditions. For the 32-mm femoral head, a head–neck ratio of 3.0 provided greater dislocation resistance than a ratio of 2.5. Among the three rim chamfer configurations evaluated with a 32-mm femoral head and a head–neck ratio of 2.5, the Type B rim chamfer exhibited the highest resistance to dislocation. Under the Type A rim chamfer with a head–neck ratio of 2.5, joint stability increased progressively with femoral head diameter.

Conclusion: Increasing the femoral head diameter and head–neck ratio enhanced hip joint stability in the presence of late-stage acetabular liner defects. In addition, the Type B rim chamfer provided the greatest resistance to dislocation, indicating that optimized rim chamfer geometry can further improve implant stability. These findings provide biomechanical guidance for optimizing acetabular cup design and reducing the risk of late-stage dislocation following total hip arthroplasty.

K260359

The Agency-Primacy Hypothesis in AI-Augmented Learning: Creative Authorship as the Proximal Determinant of Design Satisfaction

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Keywords: agency-primacy hypothesis, creative agency, AI-augmented learning, cognitive depth of cultural translation, design satisfaction

Abstract:

Educational technology design rests on a largely untested assumption that deeper cognitive support naturally yields better learner experiences. In AI-augmented creative learning, this implies that deeper cultural knowledge should lead to greater satisfaction with one's design work. This study proposed and provided initial empirical testing of the Agency-Primacy Hypothesis in AI-Augmented Learning—the proposition that in technology-mediated creative work, perceived creative authorship, rather than cognitive knowledge alone, is the more proximal determinant of learner satisfaction. Cross-sectional data were collected from undergraduate visual communication design students ($N = 123$) following an eight-week intervention with a metacognitive scaffolding platform and conventional AI tools. Confirmatory factor analysis established that cognitive depth of cultural translation and creative agency, though substantially correlated, constitute empirically distinguishable constructs—a prerequisite for valid mediation testing. Mediation analysis revealed that the indirect path from cognitive depth through creative agency to design satisfaction was significant (bootstrap 95% CI [0.048, 0.265]), accounting for 28.8% of the total effect, while the direct path was substantially attenuated after accounting for agency. Students using the metacognitive scaffold reported higher satisfaction than those using conventional AI tools (differential = 0.52, $t = 2.39$). Behavioral log data corroborated self-report findings: learners with higher behavioral autonomy reported stronger creative agency. These findings provide initial evidence that restoring creative authorship, rather than merely deepening domain knowledge, may be the more effective intervention target in AI-mediated learning. The hypothesis is explicitly bounded to technology-mediated creative work and requires longitudinal replication before generalization.

K260360

Beyond Self-Report: A Multi-Source Triangulation Framework for Evaluating AI-Scaffolded Learning Platforms

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Keywords: educational technology evaluation, System Usability Scale, multi-source triangulation, System Usability Scale, metacognitive scaffolding

Abstract:

Educational technology evaluation relies predominantly on self-report instruments—the System Usability Scale and technology acceptance questionnaires—to determine platform readiness for adoption. These instruments were developed for productivity software designed to minimize cognitive demands, not for learning platforms that introduce structured cognitive engagement as their pedagogical mechanism. A persistent methodological blind spot exists: self-report and behavioral usage data may capture fundamentally different constructs, and platforms that fail usability benchmarks may possess genuine pedagogical value invisible to questionnaires alone. This study proposed and demonstrated a Multi-Source Triangulation Framework through an eight-week deployment of an MBS metacognitive scaffolding platform with undergraduate design students (N = 55). Self-report usability scores fell below the industry-standard threshold for the majority of users. Had evaluation relied solely on this metric, the platform would have been deemed not adoption-ready. However, pedagogical satisfaction and acceptability ratings were substantially above scale midpoints, and the correlation between usability and satisfaction was moderate ($r = 0.51$), confirming that these instruments assess distinct constructs. Behavioral log data across 14 dimensions revealed sustained cognitive engagement—high learner autonomy, low AI dependency, structural complexity in cultural reasoning, and consistent multi-session task completion—that self-report measures systematically failed to capture. The framework specifies three evaluative criteria in descending diagnostic weight: behavioral engagement depth, pedagogical outcome satisfaction, and self-report usability. Platforms warranting adoption demonstrate strength on the first two dimensions irrespective of the third. This framework provides educational technology research with an evaluation approach calibrated to the distinctive affordances of AI-scaffolded learning, where structured cognitive demands may constitute not a design flaw but the mechanism of effectiveness.

K260361

Detection and Classification of Invasive Plant Seeds on Varied Soil Backgrounds Using RetinaNet

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Keywords: Invasive plant seeds, RetinaNet, object detection, soil background, computer vision

Abstract:
Invasive plant species threaten native biodiversity by spreading rapidly and competing with native vegetation. Early detection at the seed stage can support monitoring and management before invasive plants become established. This study developed a RetinaNet-based object detection system for detecting and classifying three invasive plant seed species in the Philippines across loam, clay, and sandy soil backgrounds. Specifically, the study aimed (1) to design and create a prototype that captures images of seed samples for detection and classification, (2) to create a dataset using invasive seeds consisting of Siam weed (Chromolaena odorata), cogon grass (Imperata cylindrica), and mile-a-minute vine (Mikania micrantha), (3) to train, validate, and test the RetinaNet model using seed images captured on loam, clay, and sandy soil backgrounds, and (4) to evaluate the system's performance using a confusion matrix, accuracy to assess its effectiveness in distinguishing the selected invasive seeds across varied soil backgrounds. A prototype system was implemented using a Raspberry Pi 5, Raspberry Pi High Quality Camera, 7-inch touchscreen display, and a controlled lighting environment. The model was evaluated using a separate test dataset consisting of 90 images and 450 seed instances. Results showed that the system achieved 100% accuracy on loam soil, 98% accuracy on clay soil, and 96.67% accuracy on sandy soil, with a total accuracy of 98.22%. The results indicate that the system performed effectively under controlled soil background conditions.

K260362

Importance-Guided Mixed-Precision Quantization Strategy for Tiny Object Detection

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Keywords: mixed-precision quantization, tiny object detection, tiny-object-aware scoring, edge AI

Abstract:
Tiny object detection is a crucial task in various real-world applications such as foreign object debris detection and industrial micro-defect inspection. Since these applications typically operate in resource-constrained environments, on-device inference is strongly demanded. To reduce computational costs, mixed-precision quantization has been widely utilized as a key technique. However, conventional quantization methods optimize general performance during precision allocation while ignoring object scale. This approach fails to preserve the fine-grained details that are important for tiny objects, leading to significant performance degradation. To address this issue, we propose a tiny object-aware mixed-precision quantization strategy. The proposed method determines the crucial layers for tiny object detection by evaluating layer importance that is derived from gradient sensitivity and their contribution to tiny object features. Based on this importance, it assigns an appropriate bit precision (e. g., FP16, INT8, or INT4) to each layer. Ultimately, our method achieves an optimal trade-off between detection accuracy and model compression efficiency. Experimental results on the FOD-A dataset demonstrate that our method achieves remarkable improvement of detection performance over the uniform INT8 baseline while maintaining a comparable latency.

K260363

A Study of How Microinteraction Design in AI Chat Interfaces Affects Usability

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Keywords: generative artificial intelligence, AI chat interface, microinteraction, usability, user experience

Abstract:
With the rapid development of generative artificial intelligence, AI chat interfaces have gradually become important tools for information searching, concept understanding, and everyday learning support. However, most existing generative AI chat interfaces primarily present responses in a linear text format. When users read lengthy responses, encounter unfamiliar terms, continue asking follow-up questions, or review previous answers, they may still face difficulties such as unclear key points, interrupted comprehension, and additional operational burden. Therefore, this study focuses on generative AI chat interfaces and investigates the effects of microinteraction design on usability, user experience, and perceived readability.

Based on the literature review and the usage context of generative AI chat interfaces, this study developed a generative AI chat interface prototype. The prototype incorporated several microinteraction designs, including highlighted key text, terminology prompts, recommended follow-up questions, and a side response-position indicator. These designs aimed to support users during the processes of reading, understanding, continuing inquiries, and reviewing previous responses. This study adopted user testing as the research method. Participants completed three operational tasks, and their user experience was evaluated through the System Usability Scale (SUS), the User Experience Questionnaire (UEQ), and semi-structured interviews The collected data were used to analyze the performance of the interface prototype in terms of usability, user experience, and perceived readability.

This study aims to supplement existing generative AI research from an interface design perspective, especially by focusing on interaction details that have received relatively less attention. It also proposes microinteraction design directions that can be applied to generative AI chat interfaces. The findings may serve as a reference for future AI chat tools in the contexts of information comprehension, learning support, and user experience design.

K260366

Image Processing-Based Classification of Four Bamboo Species and Their Associated Diseases in the Philippines

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Keywords: Bamboo classification, disease detection, MobileNetV3, Image-Processing, TensorFlow Lite, deep learning, Philippine Bamboo, Agriculture AI

Abstract:

Bamboo plays a vital resource in the Philippines, but they are struggle with the time it consumes time in manual methods on identifying the bamboo species and detecting bamboo leaf diseases, which often lead to impaired yield and crop damage. This study developed an image-processing device with the processor of Raspberry Pi 4 and deep learning model of MobileNetV3 to classify the four kind of bamboo species- Bayog (Bambusa Blumena varietly Luzonensis), Giant Bamboo (Dendrocalamus Giganteus), Kawayan Kiling (Bambusa vulgaris), and Kawayan Tinik (Bambusa Blumeana). And their associated disease, such as Phakopsora leaf blight, Puccinia leaf rust, and Phoma leaf spot. The system trained 3,218 field captured image and gained an impressive accuracy rates of 94-97% for the species identification and around 95% for the leaf diseases identification, while it provides a confidence level assessment of leaf infections. The prototype offers a user- friendly interface platform that allows users to real-time classification and early identification of leaf diseases, enabling farmers to take advantage of reducing crop losses up to 80%. In this study to gives a cost effective for the agricultural AI application in the Philippines, with the recommendation for future enhancements including the high camera resolution and battery capacity for better field usage.

K260367

Classification of Sugarcane Leaf Diseases Using YOLOv9

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Keywords: Image classification, Raspberry Pi 5, ResNet50, Sugarcane leaf diseases, YOLOv9

Abstract:
Sugarcane leaf diseases remain a major concern in crop production because they can affect plant health, yield, and farm management. This study presents a portable disease screening system that applies YOLOv9 and ResNet50 on a Raspberry Pi 5 platform for the image classification of sugarcane leaf conditions. The proposed system uses YOLOv9 to detect and extract sugarcane leaf regions from captured images, after which ResNet50 classifies the cropped samples into healthy, mosaic virus, sugarcane smut, or downy mildew. The ResNet50 classifier obtained a test accuracy of 98.53%, while the complete YOLOv9-ResNet50 pipeline reached approximately 98.00% crop-level accuracy on unseen test images. The proposed system offers a practical foundation for a prototype that can assist farmers and researchers in early disease screening, crop monitoring, and decision support for sugarcane disease management.

K260368

A Curriculum-Progress-Based Retrieval Ranking Model for RAG Knowledge Base

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Keywords: Curriculum progress, Knowledge anchor, Learning divergence, Association distance (dist), RAG (Retrieval-Augmented Generation)

Abstract:

Traditional RAG ranks by semantic similarity alone while ignoring curriculum progress, causing progress divergence (premature exposure to future content) and scope divergence (retrieving beyond course scope), both increasing cognitive load. We propose a curriculum-progress-based ranking model using a hierarchical structure (Unit→Topic→Knowledge Point). An undirected graph G=(V,E) models topics as nodes and cross-topic knowledge associations as edges. The association distance dist(Q,P)=Unit(Q)-Unit(P) quantifies cross-unit depth. Knowledge anchors map each knowledge point to textbook paragraphs; boundary knowledge points delimit course scope. Scope divergence is triggered by boundary KPs; progress divergence by dist>0. Per Sweller's cognitive load theory (CLT), both types of divergence elevate intrinsic cognitive load. Progress divergence is dynamic: the same KP shifts among future (divergence), current (none), and learned (review) roles as N progresses, formalized as NU. The ranking has four rules: (1) dist=0 current first; (2) dist<0 ascending (old from farthest to nearest); (3) dist>0 ascending (new from nearest to farthest); (4) same dist by similarity descending. Case N=5: A (dist=0, sim=0.92), B (dist=-2, sim=0.88), C (dist=+1, sim=0.85), D (dist=-1, sim=0.95), E (dist=+2, sim=0.90), final order A→B→D→C→E. This ranking prioritizes current-unit knowledge, recalls old content from farthest to nearest to review stale material first, and presents new content from nearest to farthest to avoid premature cognitive load. Learners locate materials via knowledge anchors for targeted review, creating a clear cross-unit review path. Teachers maintain curricular order without extra markup.

K260371

Identification of learning the ‘Pan-IoTs’ and ‘Pan-security’ issues by the key topic model

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Keywords: Pan-Internet of Things (IoT), Pan-security, Text mining, Topic model, Knowledge graph

Abstract:

Industry 4.0 triggers and has fermented the ‘Pan-IoTs’ (i.e., IoT, IIoT, and AIoT) techniques, and it is being widely applied across various industries through the Internet and digital age, especially in intelligent manufacturing. Intelligent manufacturing utilizes a large amount of ‘Pan-IoTs’ techniques, integrating applications of AI data analysis and cloud computing into industry to provide customers with flexible production methods of products, thereby meeting the demand for highly customized services, reducing delivery times, and improving yields, ultimately achieving the core goal of increasing profits. However, under the digital age and full of Internet data, issues, such as data breaches, ransomware, and hacking attacks, are emerged in endlessly; thus, facing the growingly complex challenges of ‘Pan-security’ (i.e., data, information, cyber, network, and Internet securities) issues is focused. The ‘Pan-security’ challenges are further highlighted, and both enterprises and users must confront the difficulties of this ‘Pan-security.’ To address the challenges, this study proposes a topic model, including some processing steps of text mining: topic identification → data selection and segmentation → data (text) preprocessing → outcome-based visualization → conclusion and managerial implication. In data validation, the study collects five years' literature review of ‘Pan-IoTs’ & ‘Pan-security’ from the Web of Science database during the 2020–2024 as the experimental dataset. In visualization presentation, presentation techniques have the basic revision of Word cloud and the online web-based VOSviewer. Finally, the empirical results conclusively visualize for presentation of the first 10 key terms on this issue and the connection degree of key terms from the extracted results, helpful to better understand the latest important showcasing trends in issues of the ‘Pan-IoTs’ & ‘Pan-security’ to the interested parties. Importantly and interestingly, the series of research processes and study results contribute to promote the more secure and reliable development of Pan-IoTs technology and provide better protection and guidance for the users of related IoT security.

K260374

Trustworthy Swarm Agentic Artificial Intelligence for Autonomous Cybersecurity Operations: A Zero-Trust Govern-ance and Safe Reinforcement Learning Framework

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Keywords: Agentic artificial intelligence, Swarm intelligence, Zero trust architecture, Multi-agent systems, Trustworthy AI

Abstract:
Agentic artificial intelligence is changing cybersecurity automation from passive alert interpretation into autonomous, goal-oriented, and tool-using operations. Although multi-agent frameworks can decompose complex tasks and coordinate spe-cialized agents, their direct use in security operation centers remains risky because autonomous agents may hallucinate, misuse tools, overreach privileges, leak sensitive context, or execute excessive mitigation actions. This paper proposes SwarmGov-AI-ZT, a zero-trust governance framework for trustworthy swarm agentic artificial intelligence in autonomous cybersecurity operations. The proposed framework integrates five components: a mission layer for incident construction, a swarm agent society for role-specialized collaboration, a trust-aware collective reasoning layer, a zero-trust governance plane, and a knowledge and te-lemetry fabric. A dynamic trust model adjusts agent influence according to successful contribution, policy compliance, confi-dence calibration, and harmful recommendation history. A governed consensus mechanism combines agent confidence, evidence strength, and trust scores to produce explainable decisions. For detection and response, the framework incorporates a discrete wavelet transform-enhanced bidirectional long short-term memory detector and a safe deep Q-network response policy con-strained by a governance safety mask. A prototype benchmark using synthetic campus-like network traffic and governance sce-narios was implemented to evaluate detection performance, decision quality, policy compliance, false mitigation, audit com-pleteness, and response efficiency. Results show that the proposed framework improves macro-F1, correct decision rate, gov-ernance compliance, and audit completeness compared with single-agent, centralized multi-agent, role-based multi-agent, and non-governed swarm baselines. The findings suggest that future autonomous security operation centers require not only stronger AI models but also architecture-level zero-trust governance, dynamic trust management, and human-agent co-governance.

K260379

Rule-Based Span-Graph Extraction for English and Filipino Code-Switched texts for Pharmacovigilance Reports

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Keywords: pharmacovigilance, NLP, constraint-aware decoding, rule-based information extraction, span graph extraction

Abstract:

Adverse drug reaction reporting remains challenging when patients describe medicine experiences through short, informal, and code-switched narratives. This study presents a lightweight rule-based span-graph extraction method for converting English and Filipino pharmacovigilance self-reports into structured adverse drug reaction case graphs.

The system uses language-aware preprocessing, cue-preserving normalization, bilingual rules, schema-guided span detection, constraint-aware graph assembly, confidence calibration, and selective prediction to support interpretable and auditable extraction without relying on large neural models or external drug lexicons. From 476 collected responses, 423 were valid, yielding an 88.87% valid response rate.

The narratives had a median length of 30 words, and a median code-switch ratio of 0.4315, confirming the compact and bilingual nature of the task. In the final calibration round, the model achieved 80.28% span micro-F1, 70.56% edge micro-F1, and 79.33% tuple accuracy, while reducing edge-level and graph-level violation rates to 10.51% and 6.32%, respectively. Selective prediction reached 91.50% accuracy at 27.00% coverage using a 0.90 confidence threshold.

These results show that rule-based bilingual span-graph extraction can provide a transparent, lightweight, and reviewer-assisted foundation for processing noisy code-switched adverse drug reaction reports.

K260380

Feasibility of UV-Activated Persulfate Oxidation as a Pretreatment for Biological Treatment of Spent Metal Cutting Fluid

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Keywords: UV-activated persulfate, Advanced oxidation process, Metal cutting waste fluid, Organic matter mineralization

Abstract:

Metal machining is an important part of Taiwan's manufacturing sector, where cutting fluids are widely used for lubrication, cooling, and corrosion prevention. However, wastewater containing cutting fluids may have a high organic content and contain complex, refractory organic additives, creating challenges for conventional wastewater treatment processes. This study evaluated ultraviolet-activated sodium persulfate (UV/PS) oxidation for the treatment of a fresh commercial cutting-fluid solution. The process was intended to mineralize refractory organic compounds or transform them into more biodegradable products prior to subsequent biological treatment. A Taguchi L9 orthogonal array was employed to evaluate three operating parameters, persulfate concentration, UV lamp power, and pH, each at three levels. The cutting-fluid solution had an initial total organic carbon (TOC) concentration of approximately 1,500 mg/L. The results indicated that the optimal operating conditions were 1 M persulfate, 30 W UV irradiation, and pH of 2. Analysis of variance showed that persulfate concentration was the dominant parameter, accounting for 97.8% of the variation in treatment performance. pH exerted a secondary influence, whereas UV lamp power had the smallest contribution. Under the optimal conditions, the predicted TOC removal after 3 h of treatment was 39%. A confirmation experiment achieved a comparable TOC removal of 42%, demonstrating good agreement with the predicted result. These findings demonstrated that UV/PS oxidation can partially mineralize the organic constituents of cutting fluids and may serve as a potential pretreatment process for wastewater containing cutting fluids before subsequent biological treatment.

K260383

Design and Computational Analysis of an Active-Temperature-Controlled Container Application to Air Transportation in Thermal Environment

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Keywords: Air Transportation, Active-Temperature-Controlled Container, Computational Analysis, Design

Abstract:

Based on the temperature under thermal cycling conditions, the air transportation temperature-controlled container established in this study effectively mitigates the impact of external heat loads on the internal loading. Under thermal cycling conditions, although the internal air temperature gradually rises to a maximum of approximately 34°C during the forced system shutdown due to external high temperatures and heat flux, the temperatures of the upper, middle, and lower loading layers consistently remain between 22.6°C and 23.6°C. These values are well within the target range of 24±2°C, demonstrating that the loading temperature does not fluctuate rapidly with the internal air temperature. In the extreme hot environments, the internal air temperature is visibly affected by external boundary conditions. Nevertheless, because the loading possesses a substantial heat capacity, and due to the synergistic effect of the container's multi-layer insulation structure and the active-temperature-controlled system, the temperature variation of the loading is relatively gradual and is successfully maintained within the target limits. Consequently, the material configuration of the aviation container exhibits excellent thermal insulation performance, while the active control further enhances loading temperature stability, ensuring safe transport conditions for temperature-sensitive goods during hot cycle in air transportation.

K260384

An Investigation of Laser Diodes Lighting Components Thermal Management Using Immersion Liquid

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Keywords: Dielectric Fluid, Immersion Liquid, Laser Diodes

Abstract:

This research explores the feasibility of using an isoparaffin-based EC-135 dielectric fluid for the immersion cooling and thermal management of laser diode lighting modules. We have developed a replaceable immersion cooling module that can be directly deployed as a thermal management unit, ensuring the surface and junction temperatures of the laser source are strictly maintained under 60°C. The system's performance is tested under various power outputs and dielectric fluid conditions to evaluate its temperature control capabilities. Experimental findings indicate that utilizing the enhanced heat transfer properties of the dielectric fluid provides a distinct advantage, effectively upgrading the overall cooling efficiency and thermal management of the laser diode lighting modules.

K260385

An Edge Vision-Based Walking Assistance and Information Prompting System for a Smart Guide Cane

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Keywords: Smart Blind Cane, Edge Computing, Visual Assistance, Tactile Paving Recognition, Hough Transform

Abstract:

Visually impaired individuals often face challenges such as difficulty in detecting forward obstacles, unintended deviations from their walking path, and limited access to critical environmental information in daily public spaces. For tactile paving recognition, the system captures ground images via a camera mounted at the front of the cane. The dominant direction of the guiding tactile paving strips is extracted through an image processing pipeline involving grayscale conversion, filtering, edge detection, and Hough transform line detection. Based on the deviation between the dominant direction of the paving and the centerline of the image, the system estimates the user's walking alignment error and delivers voice prompts—such as turn left, turn right, or go straight—to assist the user in walking steadily along the tactile paving. To bolster traveling safety, an ultrasonic sensor is employed to detect the distance to obstacles ahead, triggering an immediate voice warning when the distance falls below a pre-set safety threshold. Furthermore, the system utilizes the electronic compass to obtain the current heading angle, allowing users to maintain general orientation awareness, and employs the RFID reader module to recognize landmarks, converting the corresponding environmental information into voice announcements to provide intuitive, real-time auditory feedback.

This paper integrates image processing, distance sensing, orientation determination, RFID-based environmental landmark recognition, and voice output through a Raspberry Pi to construct a smart blind cane system. Compared to traditional reliance on standard white canes, this system provides tactile paving deviation prompts, obstacle warnings, and environmental information assistance. It successfully mitigates travel uncertainty for the visually impaired while enhancing both safety and convenience in public navigation.

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