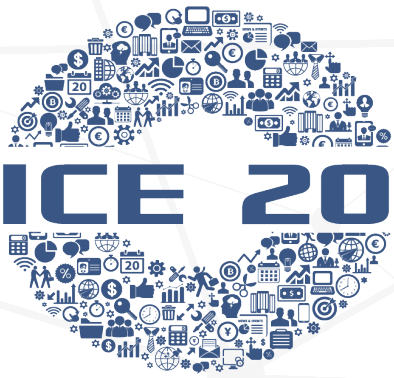

7th Eurasia Conference on IoT, Communication and Engineering 2025

14 - 16 November, 2025

National Formosa University, Yunlin, Taiwan

7th Eurasia Conference on IoT, Communication and Engineering 2025

(ECICE 2025)

Yunlin, Taiwan
November 14–16, 2025

Organized by:

Institute of Electrical and Electronics Engineers,
Tainan Section Sensors Council (IEEE TSSC)

College of Engineering, National Formosa University, Taiwan

Smart Machinery and Intelligent Manufacturing Research Center,
National Formosa University, Taiwan

Welcome

Welcome to the 7th Eurasia Conference on IoT, Communication and Engineering 2025 (ECICE 2025). This conference is the collaboration between Institute of Electrical and Electronics Engineers, Tainan Section Sensors Council (IEEE TSSC); College of Engineering, National Formosa University; Smart Machinery and Intelligent Manufacturing Research Center, National Formosa University to organize an interdisciplinary conference in the field of science and engineering technologists. ECICE 2025 provides a unified communication platform for researchers with IoT and Advanced Manufacturing topics. The booming economic development in Asia, particularly the leading manufacturing industries from auto-mobile, machinery, computer, communication, consumer product, flat panel display to semiconductor and micro/nano areas have attracted intense attention among universities, research institutions and many industrial corporations. This conference aims to provide a broad international forum for world researchers, engineers, and professionals working in the areas of IOT and manufacturing to discuss and exchange various scientific, technical and management aspects across the wide spectrum of the society. The theme of the conference is set as smart manufacturing, focusing on new and emerging technologies. Papers with innovative idea or research results in all aspects of advanced manufacture are encouraged to submit. This conference is must attentive towards strong interactions among researchers disseminating their high-quality research results.

ECICE 2025 received a total of 255 submissions, with 171 papers finally selected and registered for this conference. 11 countries and regions of participation include China, Colombia, Hong Kong, Indonesia, Japan, Malaysia, Pakistan, Taiwan, The Philippines, Turkey, and Vietnam. These papers on various topics are divided into 17 Regular Sessions. We are happy to say that it is a fine starting point for establishing an international network to facilitate future science and engineering technologists in the academic and industrial fields. I would like to express my sincere gratitude to the participants and committee members for making this event possible. I welcome you all to share in this conference, as an opportunity to make new unforgettable learning experiences and colleagues. Friends, welcome to ECICE 2025 and National Formosa University!

Prof. Chi-Ting Ho, Ph. D.
Department of Machine Design Engineering,
National Formosa University, Taiwan
Program Chairman of ECICE 2025
November 14th, 2025

Conference Topics

Regular

A. Internet & IOT technology
B. Communication Science & Engineering
C. Computer Science & Information Technology
D. Computational Science & Engineering
E. Electrical & Electronic Engineering
F. Mechanical & Automation Engineering
G. Advanced Machining and Forming Processes
H. Micro- and Nano-Fabrication
I. Surface Manufacturing Processes
J. Gears Manufacturing
K. Bio-medical Manufacturing
L. Precision Engineering Measurement
M. Robotics and Automation
N. Additive Manufacturing Technology
O. Smart Manufacturing Technology for Industry 4.0
P. Environmental Sustainability
Q. Others

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College of Engineering, National Formosa University, Taiwan

Smart Machinery and Intelligent Manufacturing Research Center, National Formosa University, Taiwan

International Institute of Knowledge Innovation and Invention (IIKII)

Sponsor

Molecular Diversity Preservation International (MDPI)

Sessions

Regular

A. Internet & IOT technology
B. Communication Science & Engineering
C. Computer Science & Information Technology
D. Computational Science & Engineering
E. Electrical & Electronic Engineering
F. Mechanical & Automation Engineering
G. Advanced Machining and Forming Processes
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K. Bio-medical Manufacturing
L. Precision Engineering Measurement
M. Robotics and Automation
N. Additive Manufacturing Technology
O. Smart Manufacturing Technology for Industry 4.0
P. Environmental Sustainability
Q. Others

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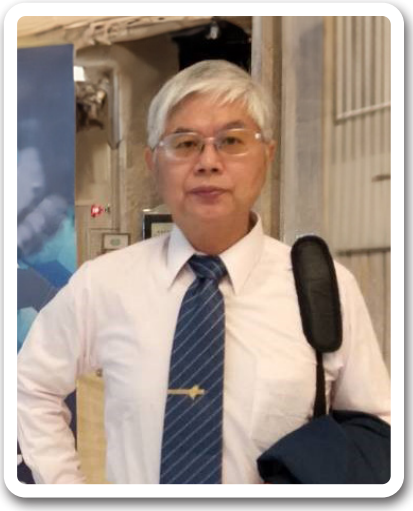

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- IEEE Tainan Section Sensors Council
- International Institute of Knowledge Innovation and Invention (IIKII), Korea

Keynote Speaker

Liang-Chia Chen, Ph. D.

Distinguished Professor,
Department of Mechanical Engineering,
National Taiwan University, Taiwan

Technical Advancements and Challenges in Precision Metrology and AOI for Advanced Semiconductor Packaging

As semiconductor devices continue to scale down, precision metrology has become indispensable for semiconductor manufacturing, valued for its non-invasive, high-precision, and rapid measurement capabilities. Its role is particularly critical in advanced processes such as automated optical inspection (AOI), where the demand for accurate characterization of 3D integrated circuit packaging is intensifying. These requirements pose significant challenges, especially for in-line process control. This talk will provide an overview of key metrology methods in semiconductor fabrication, including CD-SEM, X-ray and EUV scatterometry, optical critical dimension (OCD) metrology via optical reflectometry and scatterometry, AFM, advanced optical methods, white-light interferometry, and modern AI-AOI technologies. The discussion will highlight the inherent limitations of these techniques, recent advancements, and possible directions for innovation. The session will conclude with a forward-looking perspective on how optical metrology can evolve to meet the constraints of next-generation semiconductor technologies.

Keynote Speaker

Wei Gao, Ph. D.

Professor,
Precision Nanometrology Laboratory,
Department of Finemechanics,
Tohoku University, Japan

Manufacturing and Applications of Scale Gratings for Precision Motion Control

Precision motion control, which is a fundamental operation in manufacturing engineering, is supported by appropriate sensor technologies. This is especially true for ultra-precision positioning applications, such as ultra-precision measuring instruments, ultra-precision machining and semiconductor manufacturing machines. Optical encoders are the most widely used sensors for this purpose. An optical encoder used for ultra-precision positioning is generally composed of a scale grating as the measurement reference, an optical head for reading the scale graduations, and electronics for data-acquisition and counting. A scale grating consists of a surface on which a large number of equally-spaced line structures or variable-line-spacing grating structures are generated. Since the scale gratings are employed as the measurement references of the optical encoders, it is thus important to manufacture the scale gratings with a high accuracy over a large area. In this plenary speech, after a brief description of the nanomanufacturing technologies for master line scale gratings based on traditional dividing machines/ ruling engines and fast-tool-servo based diamond turning systems, the laser interference lithography system will be presented for both equally-spaced line structures and variable-line-spacing grating structures, followed by the fast calibration techniques and the applications in optical encoders.

Guidelines

1. Official Languages

   The official language of ECICE 2025 is English. All presentations including Q&A should be delivered in English.

2. Guideline for Participants

   2.1. Conference Venue

   National Formosa University, Taiwan
   (No. 64, Wunhua Rd., Huwei Township, Yunlin County 632, Taiwan)

   2.2. Registration

   Time of Registration:
   08:50~ 13:00, November 14, 2025 (UTC/GMT +8 Taipei)

   2.3. Conference Kit

   Conference kit, which contains final program and name badge, will be provided to participants during check-in at the Registration/Information Desk.

3. Guidelines for Presenters

   3.1. The presenters and session chairs are asked to keep to the paper sequence as shown in the Final Program. By following this predefined schedule, participants can switch between sessions without missing any particular papers of interest.

   3.2. The presentation time for each oral presenter is 10 minutes. The session chairs will allow the presenter 7 minutes for presentation and 3 minutes for discussion. Presentation time for each poster presenter is 60 minutes.

   3.3. It is required that the presentation language of ECICE 2025 papers is in English.

   3.4. Notebook PCs and LCD projectors will be available in every session room. Presenters are urged to prepare their files in MS PowerPoint format on a USB and copy the Conference into the PC at the session room before the session begins. Our session aids will assist the presenters to copy any relevant files. If you wish to use your own notebook PC, please be prepared to open the file before your presentation time.

   3.5. Please contact the Conference Secretary Desk, the session chairs, or any of the session aids if there are any special requests which might require special and unexpected attention.

Conference Agenda

Conference schedules are listed in Local Standard Time (GMT+8:00, Taipei)

Venue: National Formosa University, Yunlin, Taiwan **Language**: English

Main Conference		
Friday, November 14, 2025		
08:50	09:20	Welcoming Reception & Registration
09:20	09:40	Opening Ceremony
09:40	10:40	Keynote Speech 1
10:40	11:00	Coffee Break
11:00	12:00	Keynote Speech 2
12:00- 13:00 Lunch Break		
13:00	15:00	Oral & Poster Paper Presentation (In-person)
15:00	16:00	Coffee Break
15:00	17:00	Oral & Poster Paper Presentation (Remote)
18:00	20:00	Conference Banquet

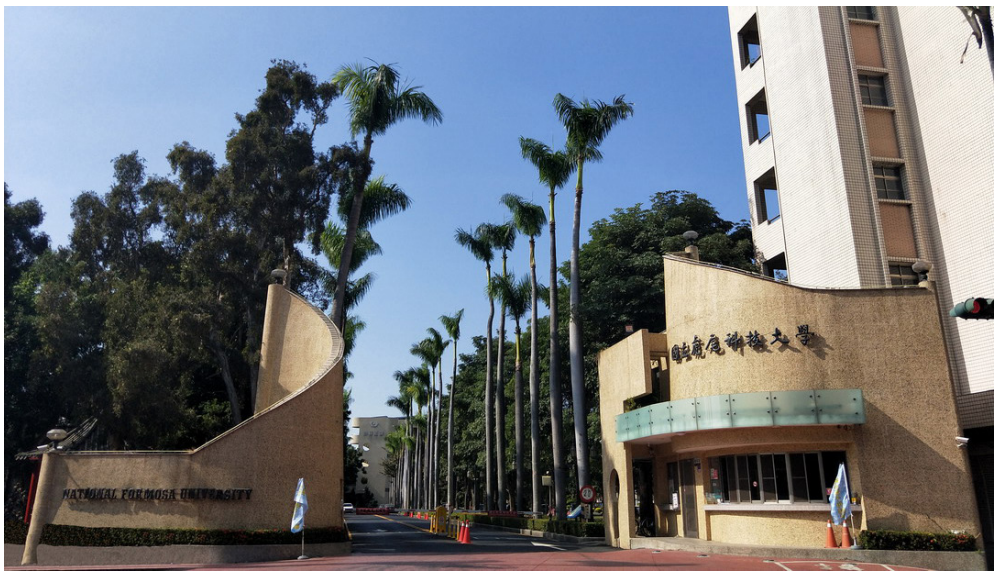
Main Conference		
Saturday, November 15, 2025		
08:30	17:30	Technical Visit & Communication

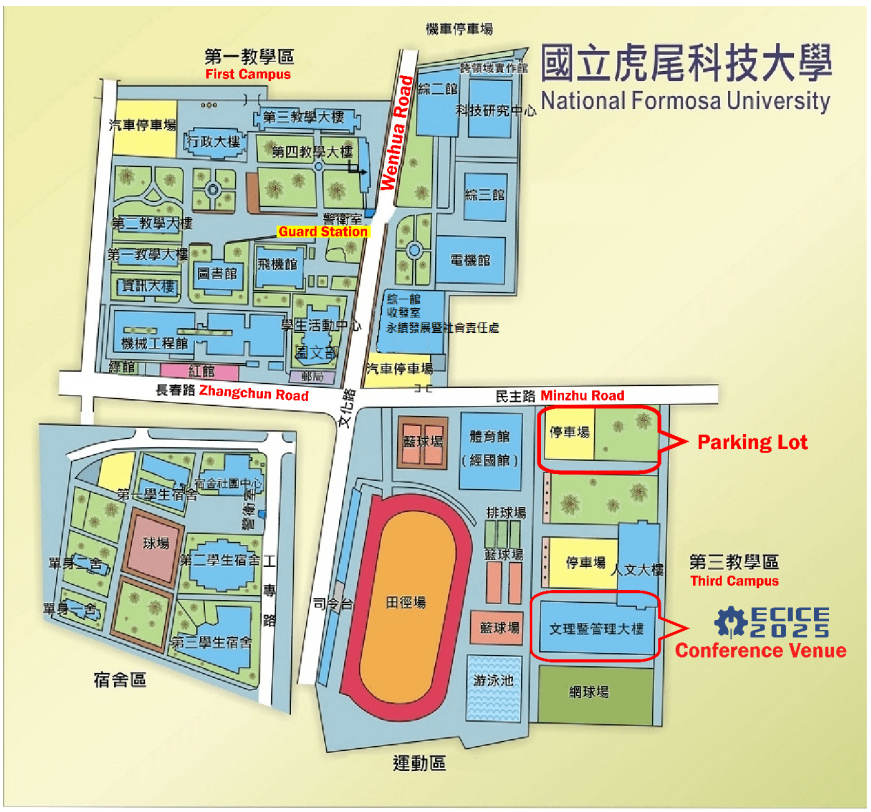
Main Conference		
Sunday, November 16, 2025		
08:30	17:30	Technical Visit & Communication & Closing Ceremony

Venue

Arts and Sciences and Management Building, Third Campus, National Formosa University

No. 64, Wunhua Rd., Huwei Township, Yunlin County 632, Taiwan





Oral Paper Schedule

Friday, November 14, 2025

Onsite Oral Paper Sessions
(National Formosa University, Yunlin, Taiwan)
UTC/GMT +8 hours

13:00—14:00	14:00—15:00	15:00—16:00	16:00—17:00
Session A			
A1	A2	A3	
T250058-C	T250080-B	T250099-A	T250137-A
T250118-C	T250007-A	T250103-A	T250162-A
T250128-C	T250016-A	T250111-A	
T250151-C	T250032-A	T250122-A	
Session B			
B1	B2	B3	
T250028-Q	T250073-D	T250215-D	T250031-C
T250082-Q	T250124-D	T250181-C	T250051-C
T250013-D	T250195-D	T250182-C	
T250025-D	T250214-D	T250232-C	
Session C			
C1	C2	C3	C4
T250040-O	T250136-O	T250056-F	T250086-F
T250045-O	T250140-O	T250063-F	T250139-F
T250100-O	T250154-O	T250074-F	T250257-F
T250129-O	T250155-O	T250085-F	T250258-F
Session D			
D1	D2	D3	
T250143-P	T250196-P	T250065-K	
T250156-P	T250197-P	T250199-K	
T250180-P	T250228-P	T250141-L	
T250194-P	T250233-P	T250036-M	

Online (Remote) Oral Paper Sessions
(ZOOM Meetings) UTC/GMT +8 hours

13:00—14:00	14:00—15:00	15:00—16:00	16:00—17:00
Session E			
E1	E2	E3	E4
T250108-A	T250236-A	T250009-C	T250044-C
T250198-A	T250191-B	T250021-C	T250048-C
T250209-A	T250004-C	T250022-C	T250078-C
T250235-A	T250008-C	T250037-C	T250088-C
Session F			
F1	F2	F3	F4
T250091-C	T250119-C	T250165-C	T250223-C
T250110-C	T250125-C	T250166-C	T250043-D
T250112-C	T250126-C	T250174-C	T250072-D
T250114-C	T250148-C	T250210-C	T250083-D
Session G			
G1	G2	G3	G4
T250135-D	T250034-E	T250158-E	T250172-E
T250219-D	T250089-E	T250161-E	T250175-E
T250010-E	T250123-E	T250164-E	T250202-E
T250011-E	T250134-E	T250171-E	T250212-E
Session H			
H1	H2	H3	
T250222-E	T250006-Q	T250026-P	T250247-P
T250256-F	T250070-Q	T250071-P	T250053-K
T250113-O	T250115-Q	T250183-P	
T250240-O	T250188-Q	T250211-P	

Poster Paper Schedule

Friday, November 14, 2025

Onsite Poster Paper Sessions

(National Formosa University, Yunlin, Taiwan) UTC/GMT +8 hours

13:00—14:00	14:00—15:00	15:00—16:00	16:00—17:00
T250015-A	T250029-C	T250035-P	T250106-Q
T250064-A	T250054-C	T250038-P	T250127-Q
T250077-A	T250055-C	T250145-P	T250152-Q
T250163-A	T250057-C	T250146-P	T250159-Q
T250081-B	T250094-C	T250147-P	T250169-Q
T250087-B	T250095-C	T250185-P	T250030-F
T250024-D	T250130-C	T250213-P	T250061-F
T250120-D	T250138-C	T250229-P	T250014-I
T250062-E	T250047-O	T250234-P	T250005-H
T250117-E	T250168-O	T250109-M	T250153-H

Online (Remote) Poster Paper Sessions

UTC/GMT +8 hours

13:00—14:00	14:00—15:00	15:00—16:00
T250079-A	T250084-D	T250101-E
T250033-B	T250189-D	T250170-E
T250090-C	T250190-D	T250220-P
T250203-C	T250192-D	T250144-Q
	T250193-D	

Paper Abstracts

https://www.ecice.asia/Abstract

Contact Us

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T250004

Challenges and Issues in Integrating Diverse Systems at Western Philippines University: Barriers and Solutions

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Keywords: system integration, higher education institution, data interoperability, factor analysis, educational information systems

Abstract:

With the need for higher education institutions to be more efficient and effective, they have become more dependent on integrated information systems; yet many struggle with system integration issues .This study investigates system integration challenges at Western Philippines University (WPU) using mixed-methods approach to identify barriers and propose evidence-based solutions.

A cross-sectional survey questionnaire was conducted using Google Form with a sample of 58 university stakeholders participated to measure eight challenges for integration against validated 5-point Likert scales. Students (n=23, 39.7%), administrative staff (n=18, 31.0%), faculty (n=10, 17.2%), IT staff (n=3, 5.2%) and faculty with administrative roles (n=3, 5.2%). Correlations between challenges were tested using a Pearson correlation, and factor analysis was used to find the dimensions underlying the challenges. Findings indicated all integration problems were rated as moderate level (M = 2.76-2.84, SD = 0.90-1.14). Bivariate correlation analyses revealed 28 significant associations between the challenges (all p .60). The most robust relationship was between double entry of data and absence of live synchronization ($r = 0.775$, $p < 0.01$) and accounted for 60% of the variance shared. Three key domains of challenges emerged from factor analysis: (1) Data Management and Synchronization, (2) System Performance and Access, and (3) Security & Human Factors. The results show that the issues of system integration in WPU are not mutually isolated but are interconnected, and it might be possible for focused change programs aimed at core data management problems to have significant effects through entire value chains. The data-driven three-factor model offers a useful guide for the prioritization of integration activities in other higher education settings. This study provides the first systematic statistical analysis of interdependencies between integration challenges within developing country higher education, which can form a basis for more informed targeting of resources and interventions.

T250005

Effect of Nb$_2$O$_5$ Catalyst on the Hydrogen Storage Properties and Kinetics of MgH$_2$

Yan-Ting Lin[1,a], Ching-Chang Cho[2,b] and Yun-Jane Chung[3,c]

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Keywords: MgH., Nb.O., high-energy ball milling, hydrogen absorption/desorption kinetics, solid-state hydrogen storage

Abstract:

In this study, 10 wt% of niobium pentoxide (Nb_2O_5) was incorporated into magnesium hydride (MgH_2), and composite hydrogen storage powders were prepared using high-energy ball milling. The milling process employed stainless steel balls with a ball-to-powder weight ratio of 20:1, operated continuously for 24 hours. Experimental results indicate that the addition of Nb_2O_5 as a catalyst effectively reduces the hydrogen desorption temperature to below 300°C. Under optimized ball milling conditions, the desorption temperature can be further lowered to approximately 280°C. However, at this lower operating temperature, the hydrogen desorption plateau pressure drops below 1 atm, which limits practical applications due to insufficient driving pressure. In addition, the pressure–composition–temperature (P–C–T) measurements were performed to analyze the thermodynamic behavior of the materials. The results show that the simple addition of 10 wt% Nb_2O_5 has minimal effect on the desorption plateau pressure and hysteresis. However, significant changes in hydrogen storage capacity and isotherm slope were observed after ball milling. These findings highlight the crucial role of mechanical processing in tuning both the kinetic and thermodynamic properties of MgH_2-based hydrogen storage materials doped with transition metal oxides.

T250006

CosmoPals: A Mixed-Methods Study on User Preferences and Digital Belonging in a Space-Inspired Social Networking Ecosystem

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Corresponding author: Shane Maryneth M. Solima, qsmsolima01@tip.edu.ph

Keywords: Space-themed application, Social Media, Social networking, Mobile application development, Compatibility-based matchmaking

Abstract:

This study explored how users engage withCosmoPals, a space-themed social mobile app for connecting with virtual companions, checking horoscopes, joining space events, playing games, and learning space trivia. A mixed-methods approach gathered survey and narrative data from151 participants inQuezon City. Quantitative analysis (descriptive stats, multivariate correlation, path analysis) and qualitative thematic analysis revealed three key themes: Horoscope and Astrology Engagement (HAE), Swiping and Messaging Preferences (SMP), and Space-Themed Exploration and Community (SEC). These elements were strongly connected, shaping user behavior and preferences. The findings can help improve digital spaces like CosmoPals to foster better online interaction and learning. The study also supports several UN Sustainable Development Goals by promoting inclusive, tech-driven communities.

T250007

AI-Enabled Smart Dustbin for Automated Hazardous E-Waste Separation

Min Xuan Soh[1,a], Hou Kit Mun[1,b], Hui Ziang Lee[1,c], Zhi Khai Ng[1,d] and Yan Chai Hum[1,e]

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Corresponding author: Hou Kit Mun, munhk@utar.edu.my

Keywords: Electronic waste, Smart dustbin, Artificial intelligence, Google Gemini, Internet of Things

Abstract:

Electronic waste (e-waste) is rising globally, yet most public bins cannot distinguish hazardous batteries and devices from ordinary recyclables. This research presents an AI-enabled smart dustbin that automatically identifies and segregates general waste, metals, and electronic or battery-based hazards while delivering real-time data to facility managers. The prototype combines a three-compartment mechanical design with an inductive sensor, Time-of-Flight proximity sensing, and an ESP32-CAM module. Images captured on deposit are sent via MQTT to a cloud server, where Google Gemini Flash classifies the item; servo-driven plates then route it to the appropriate compartment. A second ESP32 monitors compartment fill-levels with ultrasonic sensors, drives an OLED status display, and pushes capacity and alert data to a web dashboard. System testing on 23 diverse objects, with 10 repeated tests per object, achieved an overall classification accuracy of 93.5 % and an end-to-end cycle time of 4–6 s. Dual-channel notifications (email and Discord) ensure prompt response when hazardous items are detected or bins approach capacity, and remote power-cycling and analytics are available through an online dashboard. The touch-free lid, swift mechanical actuation, and compact 59 cm × 59 cm × 100 cm footprint make the dustbin suitable for campuses, offices, and shopping malls. By fusing AI vision, IoT connectivity, and ergonomic engineering, the solution demonstrates a scalable path toward safer, data-driven, and environmentally responsible e-waste management.

T250008

Yoga Practice Posture and Performance Feedback from Machine Vision

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Keywords: Machine Vision, Yoga Posture Classification, Performance Feedback, Convolutional Neural Network, Computer Vision System

Abstract:

In recent years, the yoga industry has witnessed rapid integration of technology, particularly through computer vision and machine learning, to enhance the practice experience. This study proposes a yoga posture detection and feedback system using a Raspberry Pi 5 based hardware setup and a combination of OpenCV, MediaPipe, and TensorFlow. The system captures image footage of practitioners performing five standard yoga poses and provides immediate, data-driven feedback to help correct misalignments. By employing Convolutional Neural Networks (CNNs) and extracting key joint landmarks and limb angles, the model delivers pose classification with high accuracy, validated through confusion matrix analysis. This low-cost, accessible system enables users to practice safely without direct instructor supervision, broadening access to effective and informed yoga training. The framework also opens future applications in physical therapy and athletic training, where form and alignment are critical.

T250009

Movie Review Score Classification using BERT

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Keywords: BERT, movie reviews, NLP, machine learning, raspberry pi

Abstract:

This paper presents a BERT-based approach for classifying movie reviews into multi-class score ratings. The model was trained on a public dataset and fine-tuned using preprocessing techniques, including stop word removal to optimize input length. It achieved a training accuracy of 77.96% and an evaluation accuracy of 71.34%, supporting a more nuanced understanding of audience sentiment. The trained model was successfully deployed on a Raspberry Pi 5 for efficient local inference, demonstrating the feasibility of transformer-based models on resource-constrained devices. This work contributes to enhancing real-time sentiment-driven recommendation systems and embedded NLP applications.

T250010

Enhanced Sensor-Based Automatic Fire Suppression System for Residential Kitchen Safety

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Keywords: Fire Suppression System, False Alarm Prevention, Sensor Integration, Smoke Sensors, Flame Detection

Abstract:
Fire outbreaks, whether caused naturally or unintentionally, pose serious threats to safety, especially in household environments such as kitchens. Common triggers include overheated personal devices, electrical malfunctions, and unattended cooking appliances. This study focuses on the development and enhancement of an automated fire suppression system designed specifically for residential kitchen settings. The system integrates multiple sensors—photoelectric, ionization, and flame detectors—paired with an Arduino microcontroller to ensure accurate detection and timely activation of a servo mechanism that triggers either a Class A or Class K fire extinguisher. Through controlled testing using both solid and liquid combustible materials, the study examined key variables, including sensor placement, height, and nozzle angle. Results from 15 trials per session revealed a correlation coefficient exceeding 0.90 between detection time and distance and an ANOVA significance level of less than 0.05, indicating that increased distance significantly affects response time. The percent error remained below 6.7% across all tests, with strong correlations above 0.8 between combustible material type and the corresponding extinguisher class. This research contributes to the advancement of intelligent fire suppression systems by enhancing detection accuracy, reducing false triggers, and optimizing efficient sensor configurations for residential safety.

T250011

Design of Hybrid Solar Powered Composter

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Keywords: composting, moisture content, juicing, heating, solar energy

Abstract:

Food waste is a serious worldwide problem that greatly contributes to resource inefficiency and degradation of the environment. But amidst the challenge is a phenomenal opportunity for sustainability: turning food waste into useful organic compost. Thus, the researchers come up with the idea of creating a composting machine that converts Food waste into organic compost matter with a process of decreasing the Moisture Content to fasten the time of composting. The researcher conducted two processes, one with the juicing process and without the juicing process. The results with the juicing process shows a great decrease of Moisture Content starting from 42% to approximately 32%-34%, while without juicing shows a decrease from 72% to 69%. Both processes are tested in the same time span. The researcher used a T-Test to determine if there is a significant difference in the means of two different sets of data, such as the Moisture Content of compost with and without the Juicing Process and . The P-value of each moisture sensors are 2.40□10^-78, 3.33x10^-78, 2.84x10^-75, and 1.465x10^-75, these P-value are lower than the significance level or alpha value of 0.05, therefore there is a significant difference between the means of the four comparison data. Overall, the researchers successfully achieved its objective and specific objective to design a hybrid solar-powered composter.

T250013

Pattern Identification System for Finger Vein and Knuckle print using CNN with CLAHE

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Keywords: Finger Vein, Convolutional Neural Network, Knuckle Print, Contrast Limited Adaptive Histogram Equalization, Biometrics

Abstract:
A pattern identification system is developed in this study to discern finger vein and knuckle print patterns. This system utilizes a Convolutional Neural Network (CNN) alongside Contrast Limited Adaptive Histogram Equalization (CLAHE). The system will use a Raspberry Pi camera module to capture high-quality finger photo images and implement multilayer feature extraction using a CNN model. The system provides a more accurate and reliable biometric security solution compared to traditional methods such as face and iris recognition. The system exhibits an accuracy rate of 91% for finger vein and 93% for knuckle print based on the results obtained.

T250014

Influence of Gas Tungsten Arc Welding (GTAW) Cladding Parameters on the Microstructure and Surface Hardness of TiC-Reinforced Composite Layers

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Keywords: Gas Tungsten Arc Welding (GTAW), TiC-reinforced composite, Surface hardness, Microstructure, Cladding parameters

Abstract:

This study investigates the influence of Gas Tungsten Arc Welding (GTAW) cladding parameters on the microstructure and surface hardness of TiC-reinforced composite layers on carbon steel substrates. To enhance the surface properties of structural components, TiC particles (10–30 μm) were cladded onto carbon steel using a controlled GTAW process. The microstructure, chemical composition, and hardness of the cladded layers were comprehensively characterized using optical microscopy (OM), scanning electron microscopy (SEM) with energy-dispersive X-ray spectroscopy (EDS), X-ray diffraction (XRD), and Rockwell and Vickers hardness tests. Experimental results demonstrate that the TiC-reinforced layers formed an excellent metallurgical bond with the substrate, exhibiting uniform dispersion of TiC particulates and a characteristic non-equilibrium dendritic microstructure. The incorporation of TiC significantly improved the surface hardness, increasing it from HRc 6.6 for the carbon steel substrate to a remarkable HRc 72 in the composite layer. Parametric analysis revealed that cladding current and speed exert the most significant effects on the resultant hardness, primarily by influencing the dilution depth, ferrite content, and solidification rate. These findings provide valuable insights for optimizing GTAW parameters to achieve high-performance TiC-reinforced composite layers for various engineering applications. While this work focuses on hardness, the tribological performance warrants further dedicated investigation.

T250015

Quantum-Resistant Encryption for IoT Communication in Critical Engineering Infrastructure

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Keywords: IoT Communication, Quantum, Engineering Infrastructure

Abstract:

The rapid proliferation of Internet of Things (IoT) devices across critical engineering infrastructure—including smart grids, intelligent transportation systems, and industrial control systems—has significantly enhanced operational efficiency and real-time decision-making capabilities. However, the increasing dependence on interconnected IoT communication networks has also introduced substantial cybersecurity risks. With the advent of quantum computing, traditional asymmetric cryptographic algorithms such as RSA, ECC, and DSA are rendered vulnerable due to Shor's and Grover's algorithms, threatening the foundational security of IoT-enabled systems. This paper investigates the design, implementation, and performance implications of quantum-resistant encryption schemes—also known as post-quantum cryptography (PQC)—for secure IoT communication within critical engineering applications. The study reviews and evaluates lattice-based, code-based, multivariate polynomial, and hash-based cryptographic primitives, focusing on their resource overhead, computational efficiency, and resilience to quantum attacks in constrained IoT environments. Furthermore, a hybrid encryption framework is proposed, combining NIST-recommended PQC algorithms (such as CRYSTALS-Kyber and Dilithium) with lightweight symmetric ciphers (e.g. PRESENT, SPECK) to achieve quantum-safe, end-to-end communication with minimal latency and power consumption. The framework is tested on a simulated IoT network embedded in a SCADA (Supervisory Control and Data Acquisition) system typical of smart water distribution infrastructure. Experimental results demonstrate the feasibility of quantum-resistant encryption protocols with acceptable trade-offs in processing time (sub-300 ms), memory footprint (below 50 KB), and energy consumption (<20 mJ per transaction). This research contributes a comprehensive roadmap for integrating PQC into future-proof, resilient communication architectures in engineering-critical IoT systems, supporting both current security needs and anticipated quantum-era threats.

T250016

Digital Twin and IoT Integration for Predictive Maintenance in Civil and Structural Engineering

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Keywords: Digital Twin, IoT, Predictive Maintenance

Abstract:

The increasing demand for resilient and sustainable infrastructure has catalyzed the adoption of advanced technologies in civil and structural engineering, particularly in the domain of maintenance and lifecycle management. Among these, the integration of Digital Twin (DT) systems with Internet of Things (IoT) technologies presents a transformative approach to predictive maintenance, offering real-time data acquisition, intelligent diagnostics, and proactive intervention strategies. This study presents a comprehensive framework for the deployment of DT-IoT platforms tailored to monitor the structural health of critical assets such as bridges, tunnels, dams, and high-rise buildings. The proposed architecture incorporates distributed IoT sensor networks for capturing multispectral data—including vibration, strain, displacement, corrosion, humidity, and temperature—which is synchronized with a high-fidelity digital replica of the physical infrastructure. The digital twin leverages finite element modeling (FEM), BIM integration, and machine learning algorithms for fault classification, degradation forecasting, and anomaly detection. A case study on a suspension bridge integrates real-time sensor feeds into a dynamic DT environment using MQTT and OPC-UA communication protocols, enabling cloud-edge hybrid analytics and digital feedback loops. Results indicate that the DT-IoT system achieved a 94% accuracy in crack propagation detection and a 27% reduction in unscheduled maintenance costs over a 12-month simulation period. The platform also supports life-cycle cost analysis, safety index estimation, and resilience benchmarking through AI-driven decision support. This research establishes the viability and scalability of Digital Twin-IoT synergy in achieving predictive, condition-based maintenance in structural engineering, promoting operational efficiency, asset longevity, and risk-informed asset management under Industry 4.0 and Infrastructure 5.0 paradigms.

T250021

Handheld Based Device Using Near-Infrared (NIR) for Textile Classification with Microplastic Detection

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Keywords: Near-Infrared, Textile Classification, Waste Management, Microplastic Detection, Linear Regression

Abstract:

Abstract— Textile waste management is a critical environmental challenge, particularly due to the complexity of sorting and recycling various types of fabrics. This study proposes the development of a handheld device utilizing Near-Infrared (NIR) spectroscopy for the classification and management of textile waste. The device integrates an NIR spectrometer with a Raspberry Pi 4 Model B microcontroller to create a portable, cost-effective solution for identifying and sorting textiles, including natural and synthetic fibers. Testing on 1,200 samples demonstrated 90.26% classification accuracy, with distinct spectral signatures captured for each fiber type. A single wavelength is adequate to distinguish different textiles; however, the Near-infrared (NIR) scanner faces challenges in detecting microplastics due to their complex composition. Overall, this research seeks to bridge the gap between advanced spectroscopic techniques and practical, portable solutions for microplastic detection.

T250022

Mussel Classification using CNN with MobileNet

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Keywords: Mussel Classification, MobileNet, Image Processing, Raspberry Pi, Aquaculture

Abstract:

The Philippines' mussel industry plays a vital role in coastal livelihoods and food security, yet accurate species identification remains labor-intensive. This study developed an image classification system using MobileNet on a Raspberry Pi 4 to automate the identification of Perna viridis, Modiolus philippinarum, and Mytella charruana. Trained on 900 images and tested on 180 unseen samples, the system achieved 100% accuracy for the first two species and 85% for Mytella charruana, with an overall accuracy of 95%. Results demonstrate MobileNet's effectiveness in fine-grained classification, offering a cost-efficient solution for aquaculture, biodiversity monitoring, and sustainable marine resource management.

T250024

FIR Digital Filter Implementation Using Quantum Computation and QR Decomposition

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Keywords: quantum computation, digital filter, FIR filter, QR decomposition, quantum circuit

Abstract:
In the field of digital signal processing, the finite impulse response (FIR) filter is a fundamental tool for processing discrete-time signals. This paper explores the implementation of FIR filters using quantum computation methods. The study is divided into two main tasks: In the first task, a quantum circuit for the FIR filter is designed using a normalized filter coefficient vector, QR decomposition, and the transpilation tools provided by IBM's Qiskit software. In the second task, each block of the input signal is normalized to a unit-norm vector, loaded into a quantum register, and processed by the FIR filter quantum circuit to produce an output state. Quantum measurement is then performed on the output state to obtain a histogram, from which the first-bin data is scaled to compute the output sample of the filter. Finally, signal filtering experiments using FIR mean filters are conducted to demonstrate the effectiveness of the proposed quantum computation approach.

T250025

Obstructive Sleep Apnea (OSA) Severity Classification using Tongue Ultrasound Images and YOLOv8 Algorithm

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Keywords: YOLOv8, Obstructive Sleep Apnea, Ultrasound, Tongue, Image Processing

Abstract:

Obstructive Sleep Apnea (OSA) is a widely recognized sleep disorder that can lead to serious health complications if left undiagnosed. Although polysomnography (PSG) remains the gold standard for diagnosing OSA, it is time-consuming, expensive, and not readily accessible. Machine learning (ML) has been increasingly applied in various medical imaging modalities; however, there remains a lack of research specifically on applying ML to ultrasound (US) imaging for OSA classification. Most prior studies on ML applications in medical imaging focus on X-rays, CT scans, and MRIs, leaving ultrasound as an underexplored area. This research explores the use of YOLOv8 algorithm and static tongue ultrasound images in the classification of OSA severity: Normal, Mild, Moderate, and Severe. A total of 280 ultrasound images were augmented to 838 images using brightness scaling, which enhanced the dataset's diversity and robustness, thus improving the training of the model. The system was tested on 60 test images, achieving an overall classification accuracy of 85%. Overall, the results demonstrate the feasibility and potential of using machine learning and ultrasound imaging for classifying the severity of Obstructive Sleep Apnea (OSA), suggesting potential assistance to clinicians in diagnosing and intervening in this condition.

T250026

BEMAX: A Leaf-Based Endangered Tree Classification System using Convolutional Neural Network in the Bohol Biodiversity Complex

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Keywords: Convolutional Neural Network, Leaf Image Classification, Endangered Species, Embedded Systems, Biodiversity Monitoring

Abstract:

Biodiversity monitoring in tropical regions remains a challenge due to limited infrastructure, insufficient localized data, and the impracticality of cloud-dependent tools. Existing plant classification systems are typically trained on temperate species and rely on internet connectivity, making them unsuitable for remote field environments. This study introduces BEMAX, a lightweight convolutional neural network system for the offline identification of endangered tree species in the Bohol Biodiversity Complex using leaf images. A custom dataset was curated using a Raspberry Pi camera, covering five endangered species along with an "unknown" category. The MobileNetV2-based model achieved 93.89% validation accuracy and 88.33% during field testing. The system was deployed on a Raspberry Pi 4 Model B with touchscreen and camera support for real-time, offline species identification. This system demonstrates embedded artificial intelligence for biodiversity assessment. It provides a replicable framework for conservation applications in data-scarce environments and supports sustainable development efforts focused on ecosystem protection and technological innovation.

T250028

Investigating Disparities in Thyroid Function Test and Ultrasound Screening Between Genders: A Comparative Analysis

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Keywords: Thyroid disorders, Thyroid function tests, Ultrasonography, Diagnosis, Correlation

Abstract:

Thyroid disorders are becoming increasingly common across all age groups. Ultrasonography (US) serves as an excellent imaging modality for assessing the thyroid gland due to its ease of use, affordability, non-invasive nature, and absence of ionizing radiation. It is employed to evaluate neck lumps and adjacent structures, offering a valuable means of identifying thyroid abnormalities and detecting non-palpable lesions. This complements findings from thyroid function tests (TFTs) to assess the prevalence of thyroid disorders, such as hypothyroidism and hyperthyroidism, in males and females. Additionally, to explore how variations in thyroid function testing and ultrasound imaging influence the diagnostic accuracy in both genders. This cross-sectional study involved 120 participants aged 11 years and older, with a focus on individuals presenting with symptoms. Participants underwent both thyroid ultrasound and TFTs. Standardized imaging protocols were used to collect ultrasound findings, which were then compared to TFT results for correlation and analysis. Findings revealed a significant positive correlation between TFT results and ultrasound findings (Pearson correlation coefficient=0.54, p=0.05). Among 60 patients with ultrasound reports, various thyroid pathologies were identified, including hyperthyroidism, hypothyroidism, and their subtypes. This study highlights the importance of integrating ultrasound and TFT results for diagnosing thyroid disorders. The observed positive correlation demonstrates that while TFTs provide a fundamental baseline for identifying conditions such as hyperthyroidism, hypothyroidism, and euthyroidism while ultrasound offers a comprehensive anatomical assessment of thyroid abnormalities, considering factors such as echogenicity, texture, nodularity, symmetry, and size respectively.

T250029

Sandstorm Image Reconstruction by Adaptive Prior, Selective Enhancement, and Sky Detection

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Keywords: sandstorm image, sky detection, color correction, adaptive dark channel prior, contrast enhancement

Abstract:
In sandstorm environments, a large number of suspended particles in the air absorb and scatter light, causing strong color bias, low contrast, and blurred details in images. These degradations reduce the reliability of computer vision applications in surveillance systems, intelligent transportation systems, unmanned aerial vehicle (UAV) monitoring, and outdoor autonomous driving systems. This paper proposes a complete sandstorm image enhancement method that combines sky detection, color correction, contrast enhancement, and adaptive dark channel prior (ADCP) dehazing. The Lab color space is used to correct the color bias. The L channel is enhanced using normalized gamma correction and contrast limited adaptive histogram equalization (CLAHE) to improve brightness and contrast. Then, the sky region is detected to avoid over-processing. It helps to preserve the natural appearance of the sky region. Finally, the ADCP is applied to non-sky regions for further dehazing. Experiments show that the proposed method provides better subjective and objective performance compared to other algorithms.

T250030

Characteristics of Heat Dissipation from a Block Heat Source Module in a Three-Dimensional Cabinet to Ambient Natural Convective Air Stream

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Keywords: 3-D cabinet, Heat source module, Cooling performance, Numerical simulation, Experiment

Abstract:

A numerical analysis is performed to investigate the conjugate conduction and natural convection for a block heat source module in a three-dimensional cabinet filled and surrounded by air. The effects of Rayleigh number Ra, module position C1, ratio of block to air thermal conductivities Kbf, and ratio of board to air thermal conductivities Kpf on the heat dissipation characteristics of the module are rigorously examined. Moreover, great efforts are carried out to explore the influence of thermal interaction between the air streams inside and outside the cabinet. The computation domain covers the cabinet and the surrounding area, so that the temperature and velocity fields of the cabinet and surrounding area are solved simultaneously. To complement the numerical analysis, an experimental system is set up to measure the surface temperatures of block heat source. The measured data are in good agreement with the numerical predictions. Comparing the results for cases with and without thermal interaction between the air steams inside and outside the cabinet, the difference in hot spot temperature of module is 22 – 32 % for 10e5 $\leqq$ Ra $\leqq$ 10e7, 10 $\leqq$ Kbf = Kpf $\leqq$ 100 and 0.1 $\leqq$ C1 $\leqq$ 0.2. The maximum reduction in the hot spot temperature can be up to 63% as the Kbf = Kpf = 10 increase to Kbf = Kpf = 100. A movement of the module from C1 = 0.1 to C1 = 0.2 reduces the hot spot temperature about 17 % as Ra = 10e5.

T250031

Binocular Stereo Vision Disparity Estimation Based on Dinov2 with Multi-Scale Attention Fusion

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Keywords: stereo matching, disparity estimation, DINOv2, attention fusion, multi-level feature integration

Abstract:

This work presents a stereo vision framework designed to improve disparity estimation in occluded and boundary regions, targeting autonomous driving scenarios. The proposed architecture combines frozen DINOv2 features with a modular three-stage attention fusion strategy, which consists of bottom-up semantic propagation, top-down detail enhancement, and cross-view attention mechanisms. These stages jointly enforce semantic consistency, structural integrity, and accurate correspondence modeling. The fused features are then processed by an IGEV-based disparity estimation module for multi-stage regression and iterative refinement. A three-phase training pipeline is employed, including pretraining on SceneFlow, fine-tuning on Virtual KITTI, and adaptation to KITTI and ETH3D datasets. The model achieves an Out-Noc error o 7.45% on KITTI2012 and a D1-all error of 4.10% on KITTI2015. Beyond quantitative performance, the proposed method produces visually superior disparity maps. The enhancements of boundary sharpness, occlusion completion, and structural coherence demonstrate the strong potential of the proposed algorithm for real-world deployment in dynamic and complex environments.

T250032

A System Architecture Design: Integrating Random Forest, Natural Language Processing, and Internet of Things to Predict Technical Carnapping in the Philippines

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Keywords: Random Forest Algorithm, Internet of Things, Car Anti-theft System, Natural Language Processing

Abstract:

Technical carnapping, or rent-tangay, is a new deceptive scheme of stealing a car by virtue of a rental contract. Typical car anti-theft systems can only provide the location and status of the car. This means that by the time the vehicle is stolen, it is often too late. Even with the use of technology, this makes it hard for car owners and operators to prevent this new illegal scheme. This study features an architecture design for a car anti-theft system that integrates the use of natural language processing (NLP), random forest (RF) model, and internet of things (IoT) in predicting technical carnapping or rent-tangay in the Philippines. It highlights three major components, which are the black box or the hardware module, the mobile application, and the website application. The black box is responsible for gathering data inputs, including geographical location, recorded audio, and sensor outputs. The NLP pipeline is responsible for mining and processing text-based data from the audio recording. Whereas the RF model is responsible for scoring all of the inputs and using them to predict technical carnapping. The model developed in the study scored 100% in recall, 96.30% in accuracy, and 85.71% in F1 score. This implies the success and effectiveness of the design in predicting technical carnapping. This achievement significantly contributes to the body of work that focuses on developing security systems for cars, especially by effectively and efficiently implementing NLP and machine learning to the system. The study pushes the technological boundaries that can be explored in designing and developing car security systems.

T250033

Deployable Conical Spiral Antenna for Small Satellite Applications

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Keywords: spiral antenna, satellite, CubeSat, deployable

Abstract:

We propose an S-band conical spiral antenna on a stretchable substrate to significantly reduce its packaging volume, making it a compact payload for small satellites, particularly in CubeSat applications. In contrast to the conventional rigid conical design, the proposed conical spiral antenna is imprinted on a membrane-like substrate, so the entire antenna is able to be folded as a silicone collapsible travel mug for outdoor travel. For deployment, the collapsed antenna is spread open through an outward extension movement of a rigid PCB-based matching circuit attached to the apex of the conical structure. The developed spiral antenna is targeted to operate over a wide band of frequencies between 3 and 4 GHz with a return loss greater than 10 dB. Meanwhile, the antenna features highly directional, circularly-polarized radiation poised for satellite-to-ground communications. Indeed, the proposed antenna configuration could greatly alleviate space constraints for electrically large antenna deployment in small-satellite applications. The effectiveness of the proposed antenna designs alongside experimental verification will be presented at the conference.

T250034

Development of Static and Dynamic Sensor Node Energy Level Model for Different Wireless Communication Technologies

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Keywords: Wireless Sensor Networks, Node Energy Forecasting, LSTM, Wireless Technology, Deep Learning

Abstract:

WSN node energy forecasting is an important factor that contributes to improving network efficiency, extending network lifespan, and providing energy management strategies. In this study, a deep-learning-based WSN node energy forecasting model based on LSTM and stacked-LSTM was developed across differen wireless communication technologies in both static and dynamic WSN setups. The performance of the deep-learning-based models was compared with traditional forecasting techniques such as exponential smoothing and Prophet. The results showed the superiority of LSTM and stacked-LSTM in terms of the RMSE an MAE, having consistently lower values compared with the traditional forecasting techniques. Furthermore, the results also show that the models perform best with LoRa technology. The deep learning based model also demonstrates its ability to perform better in both the WSN static and dynamic scenarios. These results demonstrate the potential of deep-learning based models in WSN node energy management that can result in a more optimal energy efficiency and prolong the network lifetime. Future research can explore hybrid approaches to further improve the prediction performance of deep learning-based models by combining their strengths with statistical or traditional forecasting techniques.

T250035

AI–ESG Strategic Coupling under Climate Risk: Redesigning Corporate Business Models for Sustainability and Resilience

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Keywords: climate risk, artificial intelligence (AI), ESG governance, business model redesign, Triple Helix

Abstract:

This study adopts a qualitative case study approach (Yin, 2018), incorporating policy and document analysis, and selects representative AI-adopting enterprises in Taiwan and the European Union, with transformative significance in the electronics manufacturing, smart electric vehicle, and green energy sectors. Using thematic analysis (Braun & Clarke, 2006), the study identifies core themes including "AI–ESG strategic coupling models," "logic of business model redesign," and "institutional coordination mechanisms in Triple Helix interactions."First, AI technologies not only enhance the monitoring of environmental and social performance but also enable data-driven ESG decision-making and predictive governance. Second, the reconstruction of sustainable business models relies on cross-sectoral platform building and institutional embeddedness, such as carbon footprint transparency, responsible supply chain governance, and green innovation incentive mechanisms. Third, Triple Helix interactions accelerate the formation of resilient governance systems, acting as key mediating structures for aligning localized innovation policies with global sustainability standards.This study contributes to the academic discourse by integrating the interaction mechanisms between AI and ESG governance, addressing a gap in existing literature regarding the co-evolution of institutional structures and technological drivers in business model transformation. For policy and industry practice, it offers a strategic coupling model and institutional adaptation insights, providing theoretical and practical guidance for achieving net-zero transitions and advancing regional innovation systems.

T250036

Maze Navigating Robot using Lucas-Kanade Optical Flow with Coarse-to-Fine Method

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Keywords: robot navigation, Lucas-Kanade optical flow, Coarse-to-fine flow method, Simple Linear Regression, Decision Tree

Abstract:

This study investigates the application of the Lucas-Kanade Optical Flow method combined with a Coarse-to-Fine approach for robot navigation. While Lucas-Kanade is widely used for flow estimation and tracking, its utilization in robot navigation remains limited. Using a Raspberry Pi 5 (8GB) and a Logitech webcam, a mobile robot was developed that processes optical flow vectors to guide navigation decisions aimed at exiting a maze. Unlike most maze-navigation research that relies on sensor fusion, this study focuses solely on computer vision to achieve collision-free navigation. The Coarse-to-Fine method effectively addresses the challenge of processing large motions inherent in Lucas-Kanade, resulting in an 80% success rate and 67% recovery rate. Simple Linear Regression revealed a negative correlation between optical flow magnitude and the robot's distance to the nearest obstacle, indicating that closer obstacles correspond to higher flow magnitudes. These findings highlight the potential of low-cost, vision-based autonomous navigation systems that eliminate the need for complex sensor arrays, making them suitable for cost-sensitive applications. The demonstrated effectiveness of the Coarse-to-Fine Lucas-Kanade method in handling large motion suggests its broader applicability in real-time robotic navigation, including autonomous vehicles and service robots operating in challenging or resource-limited environments.

T250037

SMART CAP: SPECIES AND GENDER CLASSIFICATION OF BUTTERFLIES IN THE PHILIPPINES USING YOLOv8 AND SVM

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Keywords: Philippine Butterflies, Species Classification, Gender Classification, YOLOv8, SVM

Abstract:
The rich diversity of butterflies in the Philippines poses challenges in accurately classifying species and gender. This study introduces a smart cap system designed to classify both the gender and species of butterflies, focusing specifically on Idea Leuconoe, Papilio Lowi, and Papilio Demoleus. The system employs a Raspberry Pi 3 with a camera module for image acquisition, and an Arduino Nano to control an Organic Light-Emitting Diode (OLED) display for real-time output. The classification framework utilizes a hybrid approach combining You Only Look Once, version 8 (YOLOv8) for object detection with Support Vector Machine (SVM) for species and gender classification. The dataset comprised 500 images per gender for each species, augmented to increase variability and improve robustness. Model performance was evaluated using confusion matrices, precision-recall analysis, and F1-confidence curves, achieving an overall classification accuracy of 96.5%, a mean average precision (mAP) exceeding 90%, an average precision of 95%, and an average recall of 94%. This hybrid YOLOv8-SVM approach demonstrates strong potential for ecological monitoring and field research by enabling accurate, real-time, and portable butterfly classification. The system may help biodiversity assessment, conservation efforts, and community-based environmental monitoring, especially in resource-limited or remote environments, by facilitating rapid and reliable species and gender identification.

T250038

Reinstitutionalizing ESG Labor Governance in the Era of AI: A Multi-Level Comparative Study of Smart Manufacturing and Traditional Supply Chains through the Triple Helix and MLP Lenses

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Keywords: Artificial Intelligence , ESG Labor Governance, Triple Helix, Socio-Technical Transitions , Smart Manufacturing, Sustainable Transition

Abstract:

Amid the global Net Zero transition and the evolving landscape of digital labor, Artificial Intelligence (AI) is fundamentally reshaping the labor governance mechanisms embedded within corporate Environmental, Social, and Governance (ESG) frameworks. Sustainable transitions entail not only technological innovation but also institutional evolution and value reconfiguration (Geels et al., 2020), with AI increasingly functioning as an institutional intermediary within the government–industry–university Triple Helix system (Cai & Etzkowitz, 2020). Existing scholarship predominantly focuses on smart manufacturing or ESG disclosure, while systematic investigations into the reinstitutionalization of "AI × ESG × labor governance" remain limited. This study employs a qualitative multiple-case research design (Yin, 2018), integrating policy and documentary analysis to compare leading smart manufacturing enterprises and traditional supply chain firms in Taiwan. Guided by the Multi-Level Perspective (MLP) of socio-technical transitions and the Triple Helix framework, thematic analysis was conducted following Braun and Clarke (2021). The findings reveal that: (1) AI has shifted from being a tool for operational efficiency to an institutional intermediary for managerial regulation and risk control; (2) smart manufacturing firms adopt a "collaborative governance" model, whereas traditional industries rely on "internal re-regulation"; and (3) the degree of institutional coupling and the robustness of data governance ethics critically shape governance model transitions and legitimacy construction. Theoretically, this research extends the digital governance discourse within the "Social" dimension of ESG; practically, it offers policy- and strategy-oriented recommendations for embedding AI into labor governance in ways that balance technological efficiency, ethical legitimacy, and institutional resilience.

T250040

Auto-tuning Integrating CMP Hierarchical Reinforcement Learning Control Based on Optimal Manufacturing Efficiency

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Keywords: Semiconductor Manufacturing Efficiency, Hierarchical Reinforcement Learning, CMP, Artificial Intelligence

Abstract:

The application of artificial intelligence (AI) to the chemical-mechanical planarization (CMP) process, such as the integration of lot-to-lot and wafer-to-wafer CMP hierarchical reinforcement learning (iHRL) algorithm, is proven to reduce CMP rework rate and is to enhance significant manufacturing efficiency. In this study, the auto-tuning algorithm of the iHRL CMP reinforcement learning controller is proposed based on the optimized object of manufacturing efficiency. All of combination of incoming lot combination during full CMP pad life is under study. The iHRL CMP control is used to deal with low manufacturing efficiency of the semiconductor run-to-run EWMA control due to wafer-to-wafer removal rate decay and lot-to-lot pattern density shift with reinforcement leaning. In the other hand, the manufacturing efficiency prediction function of iHRL is an important index to adjust the run-to-run EWMA control parameters to gain the best control performance. The reinforcement learning auto-tuning CMP simulation shows more than 10% in the rework rate and an increase of more than 30% in manufacturing efficiency.

T250043

Implementation of a Deep Belief Network with Sensor Correction Algorithm to Predict Weather on a Raspberry Pi

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Keywords: Deep Belief Networks, Weather Prediction, Raspberry Pi

Abstract:
Weather is an essential part of life, as it can affect the feasibility of activities planned out for the rest of the day. Weather has therefore proven itself to be an essential phenomenon that must be predicted or at least approximated to plan activities effectively and mitigate the effects of various problems caused by sudden changes in weather conditions. Existing systems on weather condition predictions make use of Deep Learning Frameworks such as Recurrent Neural Networks and Long Short Term Memory Networks. The use of these Deep Learning Frameworks often requires large amounts of computational resources to create a complex model that is enough to learn Weather Patterns. These complex models also suffer from the problem of Vanishing Gradients due to the complexity of the models making the layers of the model closer to the inputs update less compared to the ones closer to the output. This study proposes the use of Deep Belief Networks to address the problem of Vanishing Gradient for these different Deep Learning Architectures. Historical Data would be obtained from the Philippine Atmospheric Geophysical and Astronomical Services Administration and would be used to train the Deep Belief Network. Ground Level Sensor Data would be utilized to provide real-time data which would first be normalized based on the historical data, then used as inputs to the Deep Belief Networks to predict the Weather Condition. The resulting multiclass classification accuracy is 80%. The researchers therefore also recommend using a larger dataset for better performance.

T250044

The Effect of Focal Length Variations on CNN-Based Fabric Classifications

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Keywords: fabric classification, convolutional neural network, Raspberry Pi, MobileNetV2, ResNet50

Abstract:

This study investigated the impact of image capture distance on the performance of convolutional neural networks (CNNs) in classifying fabrics. Unlike previous works that rely solely on digital zoom and data augmentation to simulate multi-scale variations, this re-search explores the use of physically captured images at far, mid-range, and near focal lengths using a camera with an attached varifocal lens. Fabric samples from three categories Cotton, Linen, and Silk were imaged under consistent lighting to create an image dataset with a total of 1350 images used to train CNN models via transfer learning, with MobileNetV2 and ResNet50 as the baseline architectures. Classification performance was evaluated separately on each focal subset and on their combined dataset to test the trained model generalization capability. Results showed an absolute accuracy gain of 20.57 in percentage points with MobileNetV2 and 9.78 for ResNet50 while performing with an improved accuracy at 98.42% for MobileNetV2 and ResNet50 at 96.30%.

T250045

A Control-Loop–Based PPE Compliance System Enhanced by Image Processing Techniques

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Keywords: IIoT, OPC, PLC, YOLO Real-time object detection, PPE Compliance

Abstract:

This paper introduces a Python-integrated industrial safety system that unifies real-time helmet compliance detection with direct machine actuation in a feedback-controlled framework. The proposed Python application functions as middleware, coordinating the end-to-end pipeline from YOLOv8-based computer vision inference to industrial automation by converting AI detection outputs into OPC UA messages for PLCs. The framework supports configurable safety policies defined by polygonal work zones and authorized helmet colors, applies persistence filtering to reduce false triggers, and ensures deterministic conversion of probabilistic AI outputs into Boolean PLC control signals. Experimental validation confirms reliable, low-latency actuation with a clear architectural separation between vision processing, Python-based policy enforcement, and PLC-driven deterministic control.

T250047

Structural Optimization and Modal Analysis of the Ram Component in a 5-Axis CNC Machine Tool

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Keywords: Structural optimization, modal analysis, dynamic performance, finite element analysis, vibration, precision.

Abstract:

This study presents the structural optimization and modal analysis of a Ram component in a 5-axis CNC machine tool. The Ram, which supports the spindle, strongly influences the machine's dynamic behavior. Finite element techniques were applied to optimize the geometry for a higher stiffness-to-mass ratio and reduced vibration errors. Modal analysis was used to determine the natural frequencies and mode shapes of the optimized design. Results show improved dynamic performance, minimizing the risk of resonance. Optimization also reduced material usage, lowering manufacturing costs and enhancing energy efficiency. The work advances precision, structural reliability, and cost-effective design in modern multi-axis machine tools.

T250048

Neocaridina (Cherry Shrimp) Gender Identification using YOLOv9

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Keywords: Object Detection, YOLOv9, Feature Extraction, Cherry Shrimp Gender, Image Processing

Abstract:
Cherry shrimp (Neocaridina davidi) are popular ornamental freshwater species known for their bright colors and ability to thrive in a variety of tank environments. However, due to their small size and the subtle differences between male and female cherry shrimp, it can be challenging to determine their gender. A YOLOv9 object identification model and a Raspberry Pi 4-based system are used in this study to infer and classify the gender of cherry shrimp. A graphical user interface (GUI) facilitates image collection, classification, and displays the results. This can be achieved through the following objectives: (1) develop a Raspberry Pi 4-based device with a camera module that captures images of cherry shrimp; (2) integrate a DynamicDet architecture with PGI and GELAN to classify the gender of a Cherry shrimp; and (3) evaluate the performance of the model using a confusion matrix to measure the accuracy of the gender classification. A confusion matrix was used to assess the collected data, and the system achieved an accuracy of 85.00%. The researchers suggest expanding the dataset to include more color variations, focusing on adding more robust male shrimp datasets, enabling the device to function without an enclosure, and updating the technology for faster inference

T250051

UAV aerial photography combined with BIM applied in transportation landscape planning research

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Keywords: UAV, point could, Metashape, Revit, BIM

Abstract:
For road planning and landscape design, data collection focuses on existing conditions, particularly for non-new construction projects, as existing data can influence subsequent planning. Beyond traditional surveying methods, data collection for large-scale street region DEM can be obtained using aerial photography from unmanned aerial vehicles (UAVs). The point clouds captured from these aerial photos can then be used to create spatial models for subsequent street landscape and road planning. In this study, the aerial data was first modeled using Metashape software, and then a BIM-based design for the road, landscape, and related facilities was created using AutoDesk Revit. This enabled rapid and accurate design results, and the resulting BIM model could be applied to related mapping applications to establish a basic database for regional public works.

T250053

Contactless Footprint Acquisition and Automated Identification Using Convolutional Neural Network

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Keywords: Contactless Biometric System, Footprint Recognition, Convolutional Neural Network, Machine Learning, Image Preprocessing

Abstract:
Biometric systems are widely used in security and forensic applications. Conventionally, contact-based footprint scanners require physical contact, which presents significant limitations. These devices raise hygiene concerns and are impractical in field conditions such as forensic investigations or disaster victim identification, where quick and non-invasive methods are essential. To address these challenges, a contactless footprint acquisition and identification system was developed using image processing techniques and a Convolutional Neural Network (CNN) based on the VGG-16 architecture. The system employs a Raspberry Pi 4, a Logitech C922 camera, and a ring light to capture footprints without direct surface contact. Captured images are processed with Contrast Limited Adaptive Histogram Equalization (CLAHE) to improve contrast and mean thresholding to generate binary images for clearer feature extraction.
System performance was evaluated using a multiclass confusion matrix. The CNN correctly classified 158 of 160 test images, achieving an accuracy of 98.75%. This result demonstrates higher accuracy than earlier studies that used older CNN models such as AlexNet and LeNet-5, which performed with fewer subjects and lower accuracy rates. The developed system shows potential for biometric security, forensic investigations, and disaster response, where contactless and reliable identification is required. Future research can expand the dataset with more diverse footprints, test performance under varied conditions, and extend the approach to other contactless biometrics such as palmprints or ears.

T250054

Skill Classification of Youth Table Tennis Players Using Sensor Fusion and the Random Forest Algorithm

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Keywords: Six-Axis Sensor, Table Tennis, Random forest

Abstract:

This study addresses the issue of inaccurate results in traditional table tennis player classification, which is often influenced by subjective judgment and environmental factors, by proposing a youth table tennis player classification system based on sensor fusion and the random forest algorithm. The system utilizes an embedded intelligent table tennis racket equipped with an ICM20948 nine-axis sensor and a wireless transmission module to capture real-time acceleration and angular velocity data during players' strokes, while synchronously employing a camera with OpenPose to extract joint angle variations. A total of 40 players' stroke data were collected. Due to the limited sample size of top-tier players, the Synthetic Minority Over-sampling Technique (SMOTE) was applied, resulting in a final dataset of 360 records. Multiple key motion indicators were then computed and stored in a dedicated database. Experimental results showed that the proposed system, powered by the random forest algorithm, achieved a classification accuracy of 91.3%, making it a valuable reference for coaches and referees in conducting objective player classification. Future work will focus on expanding the dataset of domestic high-performance athletes and integrating precise sports science resources to further enhance the system's performance and algorithmic models, thereby promoting the scientific selection of national team players and advancing the intelligent development of table tennis.

T250055

Millimeter wave radar and MR virtual reality system for agility analysis

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Keywords: Millimeter-Wave Radar, UWB Radar, Mixed Reality, TABLE TENNIS

Abstract:

This study proposes an agility assessment system that integrates Millimeter-Wave (MMW) radar, Ultra-Wideband (UWB) ranging, and Mixed Reality (MR) technologies to quantify athlete performance with high accuracy. The system leverages the precise motion-tracking capability of MMW radar and the real-time visualization of MR to ensure reliable operation under low-light and multi-object occlusion conditions, enabling measurement of mobility, reaction time, and movement distance. To address the limitation of player identification in doubles testing, a one-to-one UWB configuration was adopted, in which base stations were paired with wearable tags to distinguish individual athletes; UWB was not required in single-player tests.The experimental protocol comprised three specialized agility tests—Table Tennis Agility Test I (TTAT I), Table Tennis Doubles Agility Test II (TTAT II), and the Agility T-Test (ATT)conducted with more than 80 table tennis players of varying technical levels (80% male, 20% female). Each athlete completed two sets of two trials to ensure data stability. Results showed that MMW radar accurately captured displacement trajectories, movement speed, and reaction time, achieving an average measurement error below 10% and an overall classification accuracy of 91%, confirming the system's reliability and consistency.In addition to local storage and real-time MR display, the system supports cloud-based data upload for graphical analysis and enables MR visualization to be mirrored on computer screens, allowing coaches to monitor performance in real time and provide immediate feedback. By combining the environmental adaptability of MMW radar, the real-time visualization of MR, UWB-assisted identity recognition, and cloud-based data management, the proposed system demonstrates strong potential for professional sports training, technical diagnostics, and strategy optimization, while delivering accurate and timely data support for sports science applications.

T250056

FREQUENCY AND QUALITY FACTOR ANALYSIS OF LOSS FACTOR ADDITION TO HIGH FREQUENCY AT-CUT QUARTZ RESONATORS WITH FEMTOSECOND LASER DRILLING ELECTRODE AND INVERTED ETCHING

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Keywords: Quartz Oscillators and Resonators, Q factor

Abstract:

In recent years, with the advancement of computing and transmission technologies, there has been a growing demand for quartz oscillators and resonators, whose performance is evaluated by the quality coefficient (FoM). High-frequency, miniaturized fabrication is the design goal, and process optimization and innovative design methods need to be emphasized. Based on the 1978 IEEE standard definition, this study retains the old design parameters of AT-cut quartz crystal sheet, and focuses on analyzing the structural loss factor, dielectric loss factor, frequency, admittance, quality factor, and error value, and increases the fundamental frequency design from 76.8 MHz to 96 MHz. In this study, COMSOL Metaphysics is used to simulate and analyze the quartz resonator by introducing the femtosecond laser quartz microvia machining technique from the literature, improving the electrode and inverted wet etching process, and incorporating the structural loss factor and dielectric loss factor into the quartz resonator model to observe the changes of the quality factor, the percentage of the quality factor error, and the values of the eigen- frequency and the error of the frequency. We analyze the trend of loss factor, frequency value and error value, and analyze the process advantages and disadvantages of femtosecond laser drilling electrodes, coated electrodes, inverted wet etching, inverted dry etching, and single-side and double-side etching to provide a reference for the design of future process components.

T250057

Low-resolution Script Recognition for Chinese Characters with Similar Radicals Based on Local Relations and Global Statistical Features

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Keywords: Chinese characters, similar radicals, low-resolution images, script verification, feature extraction

Abstract:
Chinese handwritten character recognition is challenging due to structural similarities among visually similar radicals and limited available training data, especially in the low-resolution case. In this work, a multi-dimensional feature fusion method combining histogram of oriented gradients (HOG), Hu moments, Zernike moments, local binary patterns (LBP), gray-level co-occurrence matrix (GLCM), and stroke-based descriptors is proposed. Region-specific segmentation strategies enable fine-grained feature extraction and recursive feature elimination with cross-validation (RFECV) effectively reduces feature redundancy. Experiments demonstrate that the proposed algorithm has superior recognition performance compared to existing, including deep learning-based methods, especially under data-constrained or low-resolution scenarios, highlighting the effectiveness and practicality of the proposed approach.

T250058

Development of Honey Grading System using Computer Vision and Convolutional Neural Network

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Keywords: Honey, Grading Honey Color, Convolutional Neural Network, Computer Vision, Raspberry pi

Abstract:

This study developed a prototype for grading various classes of honey using computer vision, convolutional neural network (CNN), and Raspberry Pi. The honey was categorized into three classes such as Light Amber, Medium Amber, and Dark Amber. A total of 900 training images were manually collected, in which for each class there is a total of 300 training images. These data were split into training and validation using an 80/20 ratio. Furthermore, the study employed the pre-trained model of MobileNetV2 architecture to facilitate the transfer learning and utilize its feature extraction capabilities. Then the model was fine-tuned and trained using the collected dataset on the Google Colab platform and achieved 98.09% and 96.5% training and validation accuracy, respectively. The final model was integrated to the user interface developed using Flask, OpenCV, and TensorFlow Lite frameworks and was deployed using the Raspberry Pi. This way, the prototype allows for realtime image capture and prediction using the captured images. During testing, the prototype were evaluated using 90 testing images, in which the prototype yielded a 91.1% testing accuracy rate. On the other hand, despite the highly satisfactory result of the model testing, future improvements are needed to the model to differentiate better visually similar classes. Overall, the developed prototype demonstrated the feasibility of deploying it in a real-world scenario for honey grading using edge device like the Raspberry pi.

T250061

Aerodynamic Analysis and Design of a Hybrid-Electric VTOL Fixed-Wing UAV

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Keywords: UAV, Aerodynamics, VTOL

Abstract:

This study presents the design of a vertical take-off and landing (VTOL) fixed-wing unmanned aerial vehicle (UAV) optimized for long-endurance missions. The UAV is designed with a maximum take-off weight under 60 kg, including a 6 kg payload, and aims to achieve a range exceeding 800 km and an endurance of more than 8 hours. To support reconnaissance and surveillance operations, the platform integrates optical imaging devices and sensors, enabling rapid area search capabilities.

The design methodology begins with mission-based sizing to estimate aerodynamic, propulsion, and fuel requirements, followed by iterative component design and analysis. Numerical simulations are conducted on the completed aircraft model to evaluate aerodynamic and performance characteristics. The wing design considers airfoil selection, aspect ratio, taper ratio, and wingtip configuration, while fuselage studies emphasize nose geometry to balance internal volume and drag. Four tail configurations are analyzed to assess stability and aerodynamic performance. The VTOL quadrotor subsystem is designed to provide 120 kg of lift (safety factor of 2) with a 20-minute hovering capability, achieved by selecting commercially available motors, propellers, and battery capacity.

The final configuration employs the MH139 airfoil with a 4° incidence angle and an H-tail layout, powered by a SAITO FG-100TS four-stroke gasoline engine. Simulation results indicate that at 1000 m altitude and 30 m/s flight speed, the UAV generates 730 N of lift, sufficient to sustain its maximum take-off weight. Performance analysis shows a range exceeding 1000 km and an endurance of at least 9 hours, both surpassing the mission requirements. The derived flight envelope reveals a stall speed of 20 m/s at sea level, a maximum speed of 40.84 m/s, and a service ceiling above 5000 m.

T250062

Research on Efficiency Improvement of Wireless Power Supply Track System

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Keywords: WPT, Efficiency, valley-fill filter

Abstract:

Wireless Power Transfer (WPT) is a contactless method of transmitting electrical energy with significant application potential in consumer electronics, medical devices, transportation, and industrial automation. In industrial automation, the use of WPT technology in AGVs is particularly noteworthy. Traditional AGVs rely on batteries or wired power systems, which increase charging time and maintenance costs while reducing operational efficiency due to battery lifespan limitations. AGVs equipped with WPT technology can continuously receive stable power during operation, avoiding downtime caused by frequent charging and reducing battery usage, thereby lowering environmental impacts during production and disposal processes. The WPT systems typically include a filter circuit composed of inductors or capacitors after the rectifier circuit to convert electrical energy into stable DC power for the load. However, the induced voltage or current waveform at the pick-up end becomes a square wave after passing through the filter circuit, affecting the overall system efficiency.

This paper proposed methods for improving the overall efficiency of wireless power supply track system. By improving the waveform before rectification at the pick-up end, the circuit structure of the pick-up end of the wireless power transfer system can be modified, such as using a valley- fill filter or directly removing the LC filter, which can improve the transmission efficiency of the system. Through theoretical analysis and discussion using two methods — valley-fill filter circuits or directly removing the filter circuits. Finally, hardware experiments have verified the feasibility of the proposed method.

T250063

Numerical Study and Optimization of Energy-Efficient Electro-Thermal De-Icing for UAVs

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Keywords: Unmanned aerial vehicles, Electro-thermal de-icing, Energy efficiency, Ice accretion

Abstract:

UAVs flying high are highly vulnerable to ice accretion, which reduces lift, increases drag, and can severely compromise flight safety. While manned aircraft often employ robust de-icing systems, these solutions are unsuitable for UAVs due to weight limits, and power consumption constraints. This study examines the energy conservation characteristics of electro-thermal de-icing systems to balance reliable anti-icing performance and efficient energy use. The system is modeled as a multilayer composite structure consisting of an skin, insulation layers, a heating strip, a protective layer, and an ice coating. Numerical simulations were carried out under unsteady, incompressible flow conditions at 25,000 feet and Mach 0.15.

This research introduces an electro-thermal de-icing concept designed to minimize ice buildup while optimizing power efficiency. An altitude-dependent heating strategy is proposed in which the first cycle raises the wing surface temperature above 273 K before cooling, and subsequent cycles regulate the flux to maintain the surface near 273 K within a ±5 K margin. Regression analysis of simulation data yielded two empirical formulas to calculate the required heat flux at different altitudes. This approach eliminates the need for onboard icing sensors, as the appropriate flux value can be programmed directly to sustain effective de-icing.

Parametric analyses evaluated the roles of heat flux, heating and cooling durations, and heating strip length under both static and airflow conditions. Results showed that higher heat flux and longer heating cycles shorten de-icing time but increase residual heating and energy demand, while longer cooling intervals and shorter strips conserve power but extend the time required to remove ice. The inclusion of airflow significantly altered surface temperature dynamics, lowering peak values and modifying de-icing times, which highlights the importance of simulating realistic flight environments. An optimized heating model was developed that integrates altitude-based empirical flux formulas, providing a practical and systematic framework for the design of energy-efficient electro-thermal de-icing systems.

T250064

Bridging Finite Element Analysis and Deep Learning Using Graph Neural Networks

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Keywords: Finite Element Analysis (FEA), Surrogate Modeling, Graph Neural Networks(GNN), Data Representation, Physics-informed AI

Abstract:

In modern engineering, rigorous mathematical methods are widely adopted to simulate various problems, thereby capturing system characteristics and assisting engineers in design optimization. Among these approaches, Finite Element Analysis(FEA)is the most mature and extensively applied tool, capable of accurately describing the complex interactions among structures, materials, and boundary conditions. However, the substantial computational cost and time consumption of FEA remain significant challenges, particularly for large-scale or nonlinear problems. With the rapid development of artificial intelligence(AI), surrogate models have emerged as a promising solution. By using boundary conditions as inputs and simulation results as labels, deep learning models can be trained to replace conventional numerical procedures, thus greatly improving computational efficiency.

In this context, this study focuses on the integration of FEA and deep learning, with particular emphasis on the impact of data representation. Since deep learning methods typically rely on specific data structures, inappropriate transformations may lead to information loss or even misrepresentation of the original characteristics. To address this issue, we experimented with multiple data formats and ultimately adopted graph-based representation. The topological nature of nodes and edges can naturally correspond to FEA meshes, while preserving structural relationships during neural network message passing. Our preliminary results demonstrate that Graph Neural Networks(GNN)can effectively learn and reproduce FEA data, while maintaining flexibility to handle varying topologies and feature dimensions across different samples.

In summary, employing graph-based data as a bridge between FEA and deep learning, and training models with GNNs, not only shows strong potential to serve as physics-informed surrogate models but also lays the foundation for building AI systems with mechanical understanding. This direction is expected to accelerate engineering simulations toward higher efficiency and intelligence, while fostering rapid adoption and innovation across disciplines.

T250065

Data-Driven Financial Insights: Analyzing Financial Perfor-mance in the Medical Manufacturing Firms Using Machine Learning

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Keywords: machine learning, financial performance, random forest, importance feature, intangible assets

Abstract:

In the medical manufacturing industry, where companies' competitive advantage is frequently driven by high research and development (R&D) intensity and intangible assets, understanding the determinants of profitability is an urgent issue. Old models tend to focus on sales and revenue growth while neglecting the importance of intangi-ble assets and R&D as strategic drivers. This study is intended to find the key financial drivers of Profit Before Interest, Taxes, Depreciation and Amortization (EBITDA) in the leading 34 listed medical manufacturing companies in the year 2020-2024 through machine learning. Six financial variables were investigated: research and development (RnD), total net sales, total assets, total intangible assets, total debt to total equity, and total debt to total capital. Six machine learning classifiers have been used namely se-quential minimal optimisation (SMO), logistic regression, random forest, J48 decision tree, multilayer perceptron, and Naive Bayes. Of these models, random forest gave the highest accuracy. Furthermore, feature importance analysis reveals that, although net sales continues to be the most important predictor, intangible assets and R&D ex-penditure are also important determinants of profitability, which indicates the im-portance of knowledge and innovation in the profitability.. These insights offer a more comprehensive perspective for both researchers and policymakers, highlighting the value of advanced analytics in financial decision-making within the medical manu-facturing sector.

T250070

Comparative Analysis of Combustion Characteristics and Pollutant Formation in Radiant Tubes with Different Structural Designs

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Keywords: Staged combustion, NOx emissions, CFD

Abstract:

This study investigates the combustion characteristics, thermal distribution, and NO_x formation of two radiant tube designs—conventional and staged combustion—under air–fuel ratios of 1:10 and 1:11. A three-dimensional numerical model was developed in ANSYS Fluent to compare flame temperature, wall temperature gradients, and pollutant emissions. The results reveal that flame temperature is the dominant factor in NO_x formation. The conventional tube, with flame temperatures around 1800 °C, shows decreasing NO_x emissions as the air–fuel ratio increases (corresponding to lower flame temperatures). In contrast, the staged combustion tube exhibits flame temperatures exceeding 1900 °C, where the thermal mechanism dominates, leading to a sharp increase in NO_x emissions far above the conventional design. These findings highlight that in staged combustion systems, inadequate consideration of flame temperature and mixing characteristics may cause NO_x control to fail or even reverse.

T250071

Adoption of ESG Principles in Taiwan Manufacturing: Developing an ESG Assessment Framework through Modified Delphi Method.

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Keywords: ESG model, Delphi method, Instrument development, Manufacturing

Abstract:

While the positive outcomes of Environmental, Social, and Governance (ESG) principles are well-documented in broader literature, their specific application within the manufacturing sector remains underexplored. This study addresses this gap by utilizing a modified Delphi technique to develop a tailored evaluation tool for ESG implementation in manufacturing firms. The research engaged a panel of academic and industry experts in a multi-round process to identify, refine, and validate critical ESG factors and performance indicators. The outcome is a structured framework designed to assist manufacturers in integrating sustainable practices, aligning with global standards, and comprehensively assessing environmental impact, social responsibility, and governance policies. The study also examines the specific challenges and opportunities associated with ESG adoption, offering practical insights for industry leaders and policymakers. By providing a validated assessment tool, this research aims to support manufacturing organizations in enhancing their sustainability strategies, complying with evolving regulations, and securing a long-term competitive advantage in a market increasingly driven by sustainability concerns.

The developed framework demonstrated outstanding content validity, supported by a scale-level content validity index (S-CVI/Ave) of 0.974 and a universal agreement index (S-CVI/UA) of 0.845. Furthermore, al item-level content validity indexes (I-CVIs) ranged from 0.80 to 1.00, confirming the robustness of each individual indicator within the tool.

T250072

Fusarium Disease Identification on Pineapple using CNN with False-Prediction Interpretability using LIME

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Keywords: Fusarium disease, Convolutional Neural Networks (CNNs), Raspberry Pi, Local Interpretable Model-Agnostic Explanations (LIME)

Abstract:
This study addresses the challenge of identifying Fusarium disease in pineapples. Due to the disease's subtle, often internal symptoms, manual identification methods are prone to human error and are time-consuming. This research develops an automated Fusarium infection identification system for pineapple leaves and fruit using Convolutional Neural Networks (CNNs). The system uses a two-input CNN model to process images of leaves and fruits and is implemented with a Raspberry Pi 5 and an HQ Camera for image input. To build a reliable dataset, healthy pineapples were inoculated with isolated Fusarium cultures to capture the infection progression every day for 15 days. The images were also augmented with Gaussian blur, geometric transformation, brightness and saturation adjustment, etc., resulting in 1500 augmented image pairs along with non-infected pineapples for training. To ensure transparency in the model's predictions, the study integrates Local Interpretable Model-Agnostic Explanations (LIME) to clarify the model's decision-making process and to explain misclassifications. The system was evaluated using a confusion matrix and achieved an overall accuracy of 89.61%, with 77 image pairs for infected and 77 for non-infected image pairs used for testing.

T250073

Classification of Guava Leaf Disease using SVM and YOLOv8

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Keywords: YOLOv8, SVM, Guava Leaf Disease, Image Classification, Accuracy Rate

Abstract:

Guava is very popular in the provinces of the Philippines serving as one of the fruits that gives various health benefits as well as its leaves which are used for traditional medicine that helps in aiding wounds, stomach disorders, pain, and more. This study focuses on the classification of guava leaf disease using Support Vector Machine (SVM) and You Only Look Once version 8 (YOLOv8). Raspberry Pi 4 Model B controls the image preprocessing and the program that uses the trained SVM and YOLOv8 models. The SVM model is responsible for image classification while YOLOv8 processes the bounding boxes and image identification. The study uses a Raspberry Pi Camera V2 for capturing the leaves that will be used for testing the said model. The dataset includes four categories: Algal Leaf Spot, Bacterial Blight, Cercospora Leaf Spot, and Healthy Leaf. The creation of the prototype is successful within the scope of the study. The SVM model achieved an accuracy of 90.83% but with occasional misclassifications, particularly in classifying as Cercospora Leaf Spot. YOLOv8 demonstrated a superior performance supported by mean Average Precision values with a mAP@50 score of 99.35%, and a mAP50-95 score of 84.84%. Both models are then combined for the classification and detection of the guava leaf diseases. With its very low error rate, the system can accurately classify guava leaf diseases.

T250074

Design analysis and health diagnosis technology on dual-axis roller cam rotating worktable

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Keywords: Dual-axis rotary table, Finite element analysis, Experimental modal analysis, Positioning accuracy, Predictive maintenance

Abstract:
The increasing demand for high-precision machining in aerospace and advanced manufacturing underscores the critical role of dual-axis roller cam rotary tables in achieving dynamic stability and angular accuracy. This study develops a design and diagnostic framework integrating finite element analysis (FEA), experimental modal analysis (EMA), VDI3441-based validation, and intelligent predictive diagnosis. Simulations revealed structural weak points and natural frequencies from low-order deformations to localized high-frequency modes, validated by EMA. Accuracy tests showed indexing precision of 11.6–19.8 arcsec and repeatability within 2.2 arcsec, meeting multi-axis machining requirements. Comparison of dual rotary axes (C1, C2) showed a persistent 2.5-fold disparity even after compensation, with best results at low speed (Pa ≈ 3.5″, A ≈ 6–8″, P ≈ 8.6″), while high-speed operation degraded performance (Pa ≈ 9.2″, A ≈ 10–11″, P ≈ 11.7″). Synchronized motion achieved stable low-speed accuracy but amplified error at high speed, indicating low-speed synchronization suits precision machining, while high-speed is acceptable only for rough tasks. To enable health monitoring, a Predictive Diagnosis Performance System (PDPS) was implemented using Principal Component Analysis (PCA) with Gaussian Mixture Models (GMM). The PCA GMM achieved 93.5% classification accuracy with AUC >0.92, outperforming FFT and Wavelet methods, and showed robustness across spindle speeds and load conditions. Overall, the optimized design improves rigidity and accuracy while enabling real-time fault detection and predictive maintenance, offering a systematic solution for intelligent, sustainable, high-precision multi-axis machining.

T250077

Construction and Verification of an Innovative Sensing-fingerprint Keycap System for Notebook Applications

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Keywords: Fingerprint image quality, NFIQ 2, Sensing Fingerprint Keycap, Notebook

Abstract:
Although low-quality fingerprints have been approved and verified successfully in fingerprint verification competitions (FVC), the efforts to determine methods to improve fingerprint quality are ongoing. Additionally, low-computation-complexity enhancement algorithms are required for actual industrial applications. The main core operations are performed and easy parallel implementation is achieved owing to the autoencoder's architecture, which is composed of convolutional, polling and residual layers. This paper presents a low-cost enhancement method to improve low-quality fingerprint images based on the autoencoder's architecture. The experimental results indicate that the enhancement of the image quality score and recognition rate are higher when our proposed method is used, yielding an approximate average improvement of 2 units for images stored in the public databases (DBs) FVC2000 DB2, FVC2002 DB3, and FVC2004 DB2.Moreover, Eight template fingerprint frames are required to achieve a recognition rate of 99.28% according to our implementation, by simple fingerprint recognition algorithm of SourceAFIS fingerprint matcher. Following the quantification of the fingerprint image in this framework, the open database Fingerprint Verification Competition 2002 database 3 was also used as a benchmark for fingerprint image assessment comparisons. Findings show that the resulting fingerprint image quality assessed based on the National Institute of Standards and Technology fingerprint image quality 2 score is very close to that of images available in Fingerprint Verification Competition 2002 database 3.

T250078

Real-time Classification of Guinea Pig Using YOLOv9-small and Raspberry Pi 5

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Keywords: YOLOv9-small, Raspberry Pi 5, Hailo-8L, real-time classification, guinea pig breeds

Abstract:

This study developed a real-time guinea pig breed classification system utilizing the YOLOv9-small model deployed on a Raspberry Pi 5 with a Raspberry Pi Camera Module 3 and Hailo-8L AI accelerator. The system was designed to classify three guinea pig breeds: Abyssinian, American, and Peruvian. A dataset of 4,500 images was compiled from both online and locally gathered samples. The model was trained and validated using this dataset with a 70:20:10 split for training, validation, and testing to ensure reliable performance. After training, the model was converted into a format optimized for the Hailo-8L accelerator and deployed on the Raspberry Pi 5 for real-time inference. Testing was conducted on live samples of the three breeds and an additional species, the hamster, which served as the unknown class. A total of 600 frame blocks were spliced from the video input for evaluation, and results were analyzed using a multi-class confusion matrix. The system achieved an overall accuracy of 89%, with individual accuracies of 94.67% for Abyssinian, 94.33% for American, 98.67% for Peruvian, and 90.33% for the unknown class. Misclassifications primarily occurred among short-haired breeds. The findings demonstrate the feasibility of deploying YOLOv9-small on embedded devices for accurate and real-time animal classification.

T250079

Real-Time Granular Audio Processing using Raspberry Pi and DSP algorithms

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Keywords: real-time processing, granular synthesis, Raspberry Pi, digital audio, digital signal processing

Abstract:

Recent developments in low-cost computing platforms have enabled new possibilities for real-time digital audio signal processing. In particular, the Raspberry Pi single-board computer provides an affordable system capable of performing audio processing tasks that previously required more capable hardware. This paper investigates the applicability of the Raspberry Pi for real-time granular synthesis, a technique that manipulates audio signals by modifying and rearranging short segments of the signal, known as grains. An accessible system for real-time granular synthesis is developed using the Raspberry Pi's capabilities and efficient audio processing algorithms. The system's performance is benchmarked on the basis of processing latency, audio output quality and computational demands to determine the capabilities and feasibility of the platform for real-time granular audio applications. Results show that the Raspberry Pi is capable of achieving sub 20ms latency for typical signals and sampling rates up to 48kHz. Perceptual evaluation of audio output quality indicates minimal artifacts or noise compared to offline rendering. Measurements of CPU utilization demonstrate the effects of various grain parameters on computational load. These findings suggest promising opportunities to leverage affordable platforms like the Raspberry Pi for creative real-time granular synthesis projects across diverse fields.

T250080

Calibrated SFT-CNN-LSTM: A Dually Supervised Approach for Dynamic MIMO-OFDM Channel Estimation

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Keywords: MIMO-OFDM, Channel Estimation, Deep Learning, Long Short-Term Memory, Gate Calibration

Abstract:

Accurate channel state information (CSI) acquisition remains a key challenge for coherent demodulation in MIMO-OFDM systems, particularly in millimeter-wave networks with rapid temporal variations. While conventional estimators such as LS and MMSE are still widely used, they degrade under fast fading due to their reliance on static assumptions or prior statistics. Recent deep learning approaches (CNNs, LSTMs, transformers) show promise, but in our experiments they either overlook temporal correlations, or require very large datasets, and all saturate at high SNR due to their unconstrained architecture degenerating into a trivial copying mechanism. To address these limitations, we present a sequence-aware estimator based on Selective Feature Transformation with Long Short-Term Memory (SFT-LSTM). Our contributions are three-fold: first, an SFT module for adaptive spatial refinement, second, a dynamic gating mechanism that fuses noisy and denoised features conditioned on SNR, finally, a Gate Calibration Loss (GCL) enforcing SNR-consistent gating across noise regimes. This design can explicitly prevent this degeneration by adaptively fusing or bypassing denoising operations, and enhancing robustness against temporal dynamics and channel variations. Simulations on time-varying MIMO-OFDM channels (Nt=32, Nr=16, Nc=64) show that SFT-LSTM consistently achieves lower NMSE than both classical and DL baselines; for example, at 0 dB it reaches about 0.12, compared with 0.56 for MMSE and 0.61 for CNN, and it maintains robustness over longer sequences. Although all methods converge near 10^{-4} at high SNRs, SFT-LSTM preserves a clear advantage in the low-to-medium regime, suggesting its potential as a robust sequence-aware CSI estimator for dynamic mmWave MIMO-OFDM systems.

T250081

Temporal-Aware SFT-CNN-LSTM for Antenna Selection and Hybrid Beamforming in Time-Varying mmWave MIMO Systems

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Keywords: mmWave MIMO, Hybrid Beamforming, Deep Learning, Spectral Efficiency, Temporal Modeling

Abstract:

Millimeter-wave (mmWave) multiple-input multiple-output (MIMO) systems rely on efficient antenna selection and hybrid beamforming (HB) to reduce hardware cost while maintaining high spectral efficiency (SE). In this work, we propose SFT-LSTM, a temporal-aware deep learning framework that integrates selective feature transformation (SFT), convolutional neural networks (CNNs), and long short-term memory (LSTM) to jointly address antenna selection and HB in time-varying channels. By modeling sequences of ten consecutive channel states, the network captures temporal dependencies more effectively than conventional approaches. The system adopts a 16×16 MIMO configuration with four RF chains per side and eight selected receive antennas, a setting widely used in mmWave experiments because it is large enough to reflect realistic beamforming and spatial multiplexing behaviors while remaining computationally tractable. Four RF chains strike a cost–performance balance typical of hybrid architectures, and selecting half of the receive antennas mirrors practical energy- and complexity-constrained scenarios where intelligent subset selection is critical. This configuration aligns with common array sizes at 28–60 GHz and allows the network to focus on algorithmic gains rather than excessive simulation burden. Experimental results show that SFT-LSTM consistently outperforms classical methods such as simultaneous orthogonal matching pursuit (SOMP) and alternating minimization (AltMin); for single- and dual-stream cases (Ns = 1, 2), it nearly matches the singular value decomposition (SVD) benchmark, achieving 1–1.5 bit/s/Hz gain over plain LSTM and 3–5 bit/s/Hz over SOMP in the low-to-medium SNR regime, while remaining competitive for multi-stream transmission.

T250082

Educational Psychology, English, and STEM Training: A Qualitative Study of Aviation College Students

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Keywords: STEM education, educational psychology, motivation, learning anxiety, emotional regulation

Abstract:

STEM education plays an essential role in the professional training of aviation college students, particularly in avionics and related engineering fields. Aviation education requires not only a solid foundation in mathematics, science, and engineering but also the development of problem-solving ability, resilience, and sound judgment in complex and high-risk environments. Additionally, English proficiency in aviation professional training is especially critical. Aviation students must master aviation and technical English to meet the International Civil Aviation Organization (ICAO) standards for standardized communication and obtain professional certifications. However, students often face challenges such as low motivation, heightened anxiety, and reduced self-efficacy during STEM training.

This study is grounded in educational psychology and collects aviation students' shared experiences from social media platforms. Qualitative methods, including semantic, thematic, and content analysis, are applied to examine: (1) the role of learning motivation and self-efficacy in STEM development; (2) the influence of course-related and English learning anxiety on students' emotional regulation and learning processes; and (3) how educational psychology interventions can mitigate anxiety and enhance professional adaptation.

The expected findings will reveal the dynamic interaction between students' psychological processes and STEM training, highlighting the challenges and regulatory role of English anxiety in professional education. The study contributes by proposing a psychology-informed support model specifically designed for aviation education. This model integrates English proficiency with professional knowledge, fosters motivation and emotional regulation, and strengthens students' international competence. Ultimately, the research offers concrete strategies for supporting the cultivation of aviation professionals who are not only technically skilled but also psychologically prepared and proficient in English.

T250083

Development of an Augmented Sungka Board using Fuzzy Logic and Heuristic Search

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Keywords: Sungka, Fuzzy Logic, Heuristic Evaluation, Rule-Based System, Data Structures and Algorithm

Abstract:

This study presents the development of an augmented Sungka board that integrates traditional Filipino gameplay with modern sensor technology and artificial intelligence. The system uses load cell sensors beneath each hole to detect marble movements, enabling automated score tracking and move validation. A Raspberry Pi 4 serves as the central processing unit, managing sensor inputs and outputting the number of marbles through the attached LED displays for feedback. The core innovation lies in a rule-based move selection algorithm that combines fuzzy logic with heuristic search to evaluate game states and suggest optimal moves. Since the algorithm operates in constant time O(1), it is suitable for real time gameplay application. Performance evaluation across 10,000 simulated games demonstrates the algorithm's effectiveness, achieving win rates of 84.9% against random opponents, 77.7% against greedy strategies, and 56.3% against sophisticated exact-match policies. Statistical analysis reveals consistent performance with narrow confidence intervals, confirming the reliability of the fuzzy inference system. The algorithm maintains balanced gameplay in self-play scenarios, indicating internal consistency and fairness. This fusion of traditional culture with intelligent technology offers a novel approach to cultural preservation while engaging in modern audiences. The system provides educational value through strategic feedback without disrupting the authentic Sungka experience, demonstrating how traditional games can be enhanced while preserving their cultural essence.

T250084

YOLO-Based Bitter Melon Size Classification Enhanced by Harris Corner Detection and Douglas-Peucker Algorithm

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Keywords: YOLOv8, Object Detection, Bitter Melon Classification, Harris Corner Detection, Douglas-Peucker Algorithm

Abstract:

Accurate size classification remains a persistent challenge for agricultural products with irregular morphology, such as bitter melon (Momordica charantia). Proper grading is essential for fair pricing, efficient packaging, and compliance with ASEAN and Philippine National Standards, yet traditional manual sorting often results in inconsistencies. To address this, the present study introduces an automated classification framework built on the YOLOv8 model. The system integrates Harris Corner Detection to enhance feature extraction and the Douglas-Peucker algorithm to simplify contour representations, thereby reducing noise and improving shape analysis. A dataset of Ampalaya images was trained and processed to detect and categorize fruit sizes, with evaluation conducted through a confusion matrix. Experimental results showed an overall classification accuracy of 93.75%, demonstrating that the combined approach effectively balances precision with computational efficiency. Beyond improving classification accuracy, the findings highlight the broader potential of combining deep learning and contour-based methods to advance agricultural automation, optimize post harvest workflows, and strengthen competitiveness in both local and international markets.

T250085

Numerical Investigation of Supersonic Flows over a Missile Released from the F-16 Wing with Altitude Variation

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Keywords: supersonic, missile, wing, altitude, thrust

Abstract:

In this article, the commercial software CFD FASTRAN is used to study the supersonic flows over a missile released from the F-16 wing with altitude variation and 8G thrust. Three-dimensional unsteady Euler equations and six degree of freedom (6-DOF) rigid body motion equations are solved in the Cartesian coordinate. The Chimera grid system is used and the information of multiple blocks is calculated separately. Grid communication among multiple blocks is automatically implemented to obtain calculated results by coupling flow fields between a store and a wing and 6-DOF rigid-body motion equation. To evaluate the accuracy of the present calculation, the calculated store instantaneous trajectory of center of gravity of store, velocity, angles of roll and angular rate are compared with those of experimental data. The results are in good agreement with the experimental data. Store separation at 1000m, 6000m and 11600m is employed to investigate the trajectory of a store. In addition, the 8G thrust is added to analyze the physical variation of the store. As the altitude increases and an 8G thrust is applied when releasing the missile, the forward displacement in the X-axis gradually increases; in the Y-axis, the minimum wingtip displacement gradually increases; in the Z-axis, the downward displacement gradually decreases.

T250086

Inspection for Solder Joint Defects in Voltage Regulator ICs of Automotive Charging Applications

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Keywords: Solder Joint Defects, YOLO, classification

Abstract:

Rapid and accurate identification of solder joint defects is crucial in car charger production lines. This study employs the YOLO classification method to automatically screen IC solder joints, classifying them into four categories: cold solder, low solder, misalignment, and normal. The training accuracy for the samples is 0.975 (406 samples). The model achieved an average accuracy of 0.987 on an independent test set of 2,715 factory-verified normal samples across confidence thresholds from 0.5 to 0.9. It can quickly identify solder joints that may contain defects, with an average processing time of 26.9 milliseconds per image, facilitating manual review. These results demonstrate the feasibility of using the model as an auxiliary tool to reduce manual inspection workload, improve efficiency, and shorten the production cycle.

T250087

A Study of Time-Sensitive Networking and Time Scheduling Mechanisms for 5G Networks

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Keywords: 5G, TSN, PTP, GCL

Abstract:

With the rapid development of 5G communication technology, 5G networks are designed to achieve three major objectives: higher bandwidth, support for a greater number of connected devices, and lower latency. It is necessary to meet the requirements of the three primary 5G application scenarios: Enhanced Mobile Broadband (eMBB), Massive Machine-Type Communications (mMTC), and Ultra-Reliable and Low Latency Communications (uRLLC). To meet the stringent requirements for time synchronization and low latency, 5G is being integrated with Ethernet-based Time-Sensitive Networking (TSN) technologies. TSN plays ar important role in achieving time determinism in uRLLC scenarios and ensures low-latency and high-reliability Ethernet communication through the transmission of time signals that are also known as the Precision Time Protocol (PTP). This paper investigates the application of TSN technology in the IEEI 802.1Qbv standard and evaluates its transmission delay performance. By modifying the Gate Control List (GCL) to accommodate varying network traffic, it helps to guarantee low-latency transmission for high-priority traffic. We propose two GCL configurations for TSN that incorporate TAS to achieve efficient traffic scheduling.

T250088

Deep Learning-Based Identification of Invasive Aquatic Plant Species Using ResNet-50

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Keywords: Invasive Aquatic Plants, CNN, Raspberry Pi 5, ResNet-50, Object Detection

Abstract:

Aquatic plant species, when removed from their natural habitats, become invasive and disrupt ecosystems. It is vital to detect and remove them at an early stage to prevent damage to an ecosystem. This study aims to create a system that uses a CNN with a ResNet-50 architecture, tuned through transfer learning, to identify three invasive aquatic plants in the Philippines: Water Hyacinth, Water Lettuce/Cabbage, and Water Thyme. This study focuses on these species, addressing a gap left by prior research that largely focused on single species and different architectures. The system is deployed on a Raspberry Pi 5 equipped with a camera module. It captures images either manually or at set intervals, applies the trained model for object detection, and, if a target species is present, highlights it with a bounding box and class label. Confirmed detections are stored for further observation and monitoring. The tuned ResNet-50 model has an overall accuracy of 86.78% on the validation set and 86.08% on an initial testing set. At a confidence threshold of 75%, the precision and recall are 80.1% precision, and 44.35% on the validation set, and 81.82% precision, and 39.87% recall on an initial testing set. The system has been able to identify bought samples of the specified species with more successful detections than failures.

T250089

Smart IoT-Enabled Non-Invasive Blood Glucose Monitoring System with Android Application and Cloud Logging

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Keywords: Non-invasive glucose monitoring, near-infrared spectroscopy, IoT, diabetes, digital signal processing

Abstract:

This study presents a non-invasive blood glucose monitoring system using near-infrared spectroscopy and an Arduino platform. Reflected signals from NIR-focused emissions towards a user's finger are captured via an infrared-tuned photodiode, digitally processed, and displayed on an Android-based application with logging, reminders, and cloud synchronization. Calibrated testing with 20 participants (10 diabetics, 10 non-diabetics) revealed that in measurement of diabetics, the non-fasting readings showed high average accuracy (99.89%). Non-diabetic trials also demonstrated strong measurement acuity (92.18%), with improved accuracy in non-fasting measurements. The device demonstrates feasibility for affordable, porta-ble, and cloud-connected smart non-invasive glucose tracking.

T250090

Enhancing Syntax Mastery through Repetitive Practice in a Duolingo-Like Programming System

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Keywords: Programming Education, Gamification, Syntax Mastery

Abstract:

This study aims to reduce beginners' frustration in learning programming by empha-sizing repetitive practice to master syntax. Inspired by Duolingo, the system divides exercises into short units with gradually unlocked challenges and immediate feedback. Gamification elements such as points, streaks, and badges enhance engagement and motivation. Learners can practice in fragmented time, consolidate skills, and build confidence, while developing problem-solving and logical thinking abilities, promoting programming as an accessible and essential component of digital literacy.

T250091

Detection of Jailbreak Attacks in Large Language Models Using Perplexity Analysis Technique

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Keywords: jailbreak attack, generative AI,, cross-modal obfuscation, cross-modal obfuscation, multi-agent systems

Abstract:

Jailbreak attacks (JA) are a type of adversarial attack involving specially crafted inputs designed to deceive machine learning models and trigger unintended behaviors. The emergence of JA reveals a critical vulnerability in Generative AI (GEN AI) systems, where attackers exploit this weakness to bypass security safeguards and induce the model to generate inappropriate or harmful content. Such attacks not only compromise the ethical boundaries of the model but also pose serious societal concerns regarding the overall safety and trustworthiness of GEN AI technologies. This study aims to propose a novel defense framework that combines language model perplexity with Multi-Agent Systems (MAS) to enhance the detection and mitigation of jailbreak attacks. The goal is to strengthen the robustness of large language model (LLM) applications while safeguarding user privacy and interests. The proposed approach adopts a query-based attack methodology, whereby jailbreak prompts are generated directly through the target LLM to probe its vulnerabilities. The defense mechanism leverages the model's perplexity score to identify anomalous prompts and incorporates MAS-based detection agents to improve resilience against diverse and cross-modal obfuscation inputs. To validate the proposed system, a comprehensive JA evaluation benchmark will be established, including metrics such as Detection Rate, False Positive Rate, Defense Pass Rate (DPR) Benign Pass Rate (BPR), Generated Response Quality (GRQ), and Response Time. Through iterative testin and refinement, this research seeks to elevate the security posture of large language models and ensure the responsible deployment of GEN AI technologies

T250094

Gateway Discovery and Congestion Mitigation in Multi-domain Cooperative SDN

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Keywords: Software Defined Networking (SDN), Multi- domain SDN (MDS), Congestion Mitigation

Abstract:
Software-Defined Networking (SDN) simplifies network management through centralized control. However, in Multi-Domain SDN (MDS) environments, each domain is managed by an independent controller and requires collaboration via inter-domain links. When certain paths become congested and no alternative routes exist within a domain, inter-domain traffic distribution becomes an effective solution, where gateway discovery and selection play a critical role. This study proposes an automated gateway discovery mechanism. Specifically, the controller is treated as a routing-capable entity and serves as the default gateway for its managed hosts. A Gateway Advertisement Protocol (GADP) is designed to enable the controller to broadcast its domain information (including IP, Media Access Control (MAC) address, and domain identifiers) to switches. When switches in other domains receive external GADP messages, their controllers can recognize the switch as a gateway and learn the corresponding external domain information. Furthermore, during inter-domain transmission, the proposed method can automatically select a gateway based on congestion status and path distance to achieve efficient traffic distribution. Simulation results demonstrate that the proposed method effectively improves the efficiency and scalability of inter-domain congestion mitigation.

T250095

A Zero-Trust Framework Integrating EDR, SDP and SDN for Dynamic Network Access Control

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Keywords: Software-Defined Networking, Software-Defined Perimeter, Endpoint Detection and Response, zero-trust

Abstract:

This paper proposes a network-protection zero-trust architecture that integrates Endpoint Detection and Response (EDR), Software-Defined Perimeter (SDP), and Software-Defined Networking (SDN). Th architecture employs a centralized SDN controller together with the EDR framework to continuously verify access requests and enforce network connection policies (e.g., permit or block). As remote and work-from-home scenarios proliferate, traditional perimeter-based access controls have become increasingly inadequate. Our framework first performs identity verification via Single Packet Authorization (SPA), then evaluates endpoint risk based on EDR logs and risk scores, allowing the SDN controller to direct network devices to enforce least-privilege controls according to the verification results. When the endpoint EDR continuously detects anomalies and issues alerts, the controller immediately re-assesses the device's trust level. A prototype environment has been implemented and basic network endpoint access-control tests were conducted; results demonstrate that the proposed architecture achieves the intended zero-trust protection functions.

T250099

Specific Emitter Identification with Few-Shot Learning for Dynamic IoT Environments

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Keywords: IoT Security, Specific Emitter Identification (SEI), Radio Fingerprinting, Few-Shot Learning

Abstract:

With the rapid proliferation of the Internet of Things (IoT) and wireless communications, ensuring device identification and secure connectivity under highly variable conditions has become a critical challenge. Specific Emitter Identification (SEI) leverages subtle hardware-induced imperfections in radio signals as unique device fingerprints, offering tamper-resistant and hard-to-forge authentication. However, SEI in real-world scenarios faces significant challenges: transmission environment effects (such as noise, multipath, and interference) distort feature distributions and destabilize decision boundaries, while limited labeled data makes traditional deep learning approaches requiring large datasets and long training difficult to generalize. To address these issues, this study aims to disentangle device-specific features (hardware fingerprints) from transmission environment effects, thereby reducing environmental interference in classification. Furthermore, we propose a new few-shot learning approach that enables fast convergence with limited annotations while maintaining robustness under dynamic conditions. The overall goal is to establish a reproducible, comparable, and reliable SEI framework that performs effectively in scarce data and high-variability scenarios, paving the way for practical deployment in IoT and industrial applications.

T250100

Assessment of Multivariate Methods for Packing Safety in Intelligent Systems

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Keywords: smart warehousing, container loading problem, packing safety, evolutionary algorithm, decision-making

Abstract:

In Industry 4.0, warehousing and logistics efficiency within the supply chain has be-come a key factor influencing product costs. However, achieving higher transportation efficiency requires robust packing safety measures. No single factor now dictates transport safety; it depends on multiple variables, including materials, weight, dimensions, volume, cargo contents, etc. This study proposes a practical framework that integrates various factors affecting packing safety in three-dimensional multi-container packing problems, enabling intelligent warehousing systems to make quick safety-related decisions. A two-stage approach is introduced: the first stage uses pattern matching to generate a feasible load template rapidly; the second stage applies fuzzy logic with multiple inputs and an evolutionary algorithm to improve the safety coefficient, ensuring compliance with transportation standards. This framework emphasizes real-time decision-making over seeking the optimal objective compared to previous studies. It can incorporate multiple parameters simultaneously based on an understandable safety rating and support real-time working environments. Experimental results demonstrate that the framework's advantages grow with increased product diversity. An average container loaded with large quantities can be completed within seconds on a consumer computer, with utilization surpassing 75 percent.

T250101

Design of CMOS Differential Ring Voltage-Controlled Oscillator with Controllable Current Source

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Keywords: voltage-controlled oscillator, cascode differential amplifier, oscillation frequency, CMOS technology

Abstract:

We propose a novel design of a voltage-controlled oscillator (VCO) based on a cascode differential amplifier constructed with complementary metal–oxide–semiconductor (CMOS) transistors and active loads. At the output of this differential amplifier, three cascaded CMOS inverter stages are connected, forming a structure similar to that of a ring oscillator. Cascode differential amplifiers offer the advantages of high output impedance and high voltage gain for small signals. They also have a high common-mode rejection ratio and can improve phase noise. While cascading increases circuit complexity, it allows multiple amplifier stages to share bias current, improving current efficiency. Two controllable current sources are incorporated, and by appropriately switching them on and off, the differential amplifier can be biased with currents of 0.5 mA, 1 mA, or 1.5 mA. We used standard 0.18 μm CMOS technology from TSMC to design this VCO circuit. By properly designing the MOS device's (W/L) ratio, we can generate output oscillation waveforms of varying frequencies at varying supply voltages. Under a supply voltage variation from 1.4 V to 1.8 V, the corresponding oscillation frequency ranges achieved at these three bias currents are 484 MHz–2.03 GHz, 778 MHz–2.12 GHz, and 917 MHz–2.21 GHz, respectively. At a supply voltage of 1.8 V and a bias current of 0.5 mA, the power consumption of the circuit is 1.15 mW.

T250103

Exploring Healthcare Providers' Acceptance and Adoption of Digital Health Technologies

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Keywords: Healthcare Providers, Digital Health Technologies, Data Analytics, Digital Social Innovations

Abstract:

The fast growth of digital health technologies has the potential to change the healthcare delivery industry. However, their success depends on how well healthcare providers accept and adopt these innovations. This research looks into the factors that shape providers' attitudes and behaviors towards digital health technologies, focusing on big data analytics, digital social innovation, and values for society's well-being. By reviewing existing literature and possible studies, the work aims to identify barriers and facilitators to adoption, offering insights for strategies to integrate digital health solutions into clinical practice. The ultimate goal is to better understand how to use digital tools to improve patient outcomes and streamline healthcare systems.

Healthcare companies must develop a multifaceted strategy that is centered on provider demands in order to expedite the implementation of digital health technology. Instead of merely increasing administrative labor, training has to be personalized, practical, and show how technologies like big data analytics enhance clinical operations and patient results. To reduce disturbance and enhance its usability, digital solutions must be smoothly incorporated into current Electronic Health Records (EHRs) with an intuitive, user-centered design. Health care organizations may use digital social innovation to motivate providers by clearly articulating the innovations' social worth, presenting them as instruments for attaining health equity and societal well-being, and including providers as co-creators to ensure relevance and promote ownership. Establishing firm technical support and transparently communicating data security protocols will build the necessary trust and confidence to fully integrate these tools into everyday clinical practice.

T250106

Analysis and testing of night image positioning system

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Keywords: Image positioning system, Autonomous Vehicles, Adaptive Driving Beam

Abstract:
This study presents an image-based positioning system and evaluates its performance under nighttime conditions. The system combines GPS, IMU, and camera input to deter-mine position. Tests were conducted under three lighting scenarios: daylight lamp, low beam, and high beam. Results show that both daylight lamp and high-beam conditions improved positioning accuracy by up to 82%, demonstrating strong adaptability to vary-ing lighting conditions. Additionally, the difference in correction percentage between low-beam and high-beam conditions was approximately 19.6%. The system's robust per-formance suggests strong potential for integration into Adaptive Driving Beam (ADB) systems, contributing to intelligent lighting control and improved safety in autonomous driving and advanced driver-assistance applications.

T250108

Simulated Fall Detection using a Semi-Supervised Machine Learning Method

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Keywords: fall detection, human activity recognition, multimodality, optical flow, sensor data

Abstract:

This study proposes a multimodal strategy for fall detection within the broader domain of human activity recognition. A fine-tuned I3D model, trained on optical flow data derived from video inputs, achieves 92.70% accuracy in classifying fall-related events. Simultaneously, a CNN-BiLSTM model incorporating attention mechanisms processes time-series sensor data, contributing to an ensemble performance of 97.87%. The integration of visual and sensor modalities illustrates a promising direction for developing reliable, real-time fall detection systems applicable in healthcare and assisted living environments.

T250109

Automated HMI Display Verification using Robotic Arms and Transformer Models: A Comparative Study of ViT and DETR

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Keywords: DETR, Vision Transformer, Robotic Arm, HMI, Verification and Validation

Abstract:

One of the fundamental functions of image recognition is the analysis of visual content within a single image. In scenarios involving overlapping objects, specialized algorithmic models can be employed to ensure reliable differentiation.

This study employs an industrial robotic arm equipped with a camera, in conjunction with image recognition techniques, to verify the correctness of Human-Machine Interface (HMI) display functions. The robotic arm performs automated random presses on the touchscreen HMI, and the images captured after each press are analyzed by image recognition models to identify the displayed content. Based on predefined element combinations, the system determines the corresponding page and thereby validates the correctness of the HMI display functions.

Two Transformer-based models, Vision Transformer (ViT) and DEtection TRansformer (DETR), were used in this study. Experimental results show that the training time for fine-tuning the DETR model was 5.8 hours, whereas the Vision Transformer model required less than 5 hours. In terms of frames per second (FPS) for image recognition in HMI display verification, the Vision Transformer achieved 7.69 FPS (0.13 sec), while DETR achieved 1.62 FPS (0.62 sec). A total of 10,000 randomized press tests were conducted using the robotic arm to conform to HMI verification requirements. DETR achieved 99.98% accuracy in verifying HMI display functions, while Vision Transformer achieved 98.78%, both of which are considered effective and satisfactory.

The main contribution of this study is to demonstrate the effectiveness of Transformer-based models in image recognition tasks with small-scale, multi-object combinations. Moreover, integrating image recognition with robotic arm control provides a practical and effective approach for verifying the correctness of HMI display functions.

T250110

Image Classification of Asiatic Parakeet Using YOLOv5 and ResNet-50

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Keywords: Computer Vision, Object Detection, Image Classification, Asiatic Parakeet

Abstract:
Parakeets exhibit many similar traits across species, with only subtle differences in features and coloration used for classification, which can complicate detection and identification for birdwatchers, breeders, and researchers. Traditional classification methods rely on observation, while more expensive options involve DNA sampling. This study develops a bird classification system aimed at identifying Asiatic parakeets by combining YOLOv5 for detection with ResNet-50 for the classification of four specific species: Alexandrine, Moustached, Plum-headed, and Indian-ringnecked parakeets. Using a Raspberry Pi 4B and a Raspberry Pi Camera housed in a customized enclosure to capture images of the birds, the evaluation indicated an overall accuracy of 95.05% through a multi-class confusion matrix, demonstrating the effectiveness of the system as a reliable tool for avian identification and research.

T250111

A Design of Duplexing SIW Slot Array Antenna for IoT Radar Sensing Applications

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Keywords: SIW, duplexing antenna, 24-GHz ISM band, frequency-scanning, leaky wave

Abstract:
A dual-port duplexing substrate integrated waveguide (SIW) slot array antenna is proposed for the 24-GHz Industrial Scientific Medical (ISM) band, Internet of Things (IoT) platform, and Internet of Radars (IoR applications. The slot array antenna is designed following the electric field and mode distribution of SIW at the central frequency. The design consists of a duplexing array antenna with a transition and microstrip line-fed structure to accomplish 30-dB isolation between the ports, and the maximum realized gain of 11 dBi in the simulation and measurement results. In particular, the leaky-wave characteristic and frequency-scanning capability are described in this research.

T250112

Fake News Detection by Graph Neural Network and Large Language Model

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Keywords: Misinformation, Fake News Detection, Large Language Model, Graph Neural Network, TextGCN

Abstract:

The rapid proliferation of misinformation and disinformation on social and public media poses a significant threat to society, and has intensified the need for automatic and reliable fake news detection systems. Various machine learning approaches have been explored in extensive research. Recent advances in Large Language Model (LLM) such as GPT (Generative Pre-trained Transformers) and LLaMA (Large Languag Model Meta AI), have demonstrated significant potential in capturing nuanced linguistic and semantic patterns. However, LLMs are prone to hallucinations and less suited for factual reasoning. Graph Neural Network (GNN)—particularly models like TextGCN—provide a framework for representing textual data as graph structures, thereby leveraging inter-document and word co-occurrence relationships. This paper explores the synergy between LLMs and GNN-based architectures for robust, explainable, and generalizable fake news detection. Extensive experiments conducted on two datasets demonstrate the advantages of the proposed model over the baselines.

T250113

A Case Study on a Cooling Tower Decision Support Web System

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Keywords: Artificial Intelligence, Long Short-Term Memory, Reinforcement Learning, Decision Support System, Smart Manufacturing

Abstract:

Conventional cooling tower operations often rely on operator experience for fan control, lacking precise decision support and real-time monitoring. This makes it challenging to maintain water temperature within an optimal range, thereby affecting industrial efficiency. Using a case study, this research integrates a Long Short-Term Memory (LSTM) model for temperature prediction with a Reinforcement Learning (RL) model to develop a web-based decision support system for cooling tower operations. The LSTM predicts return water temperature trends for the next 15 minutes. This prediction, along with environmental conditions and historical data, is fed into the RL model. Through a reward mechanism, the model receives higher scores when the predicted temperature is close to 30.5°C, and a lower score otherwise, enabling it to learn the optimal fan control strategy. Based on the evaluation results, the system automatically determines the optimal action—turning the fan on, off, or maintaining its state—and provides specific operation suggestions via a web interface.

This system is designed with a layered architecture, comprising modules such as a real-time monitoring dashboard, historical data query, and Artificial Intelligence (AI) model management. Through visual elements like temperature trend charts, fan status indicators, and a decision suggestion interface, it provides operators with real-time water temperature status, predicted temperature trends, and specific operational recommendations. The system has been deployed and is running in an actual manufacturing factory, where the AI model outputs decisions every 15 minutes, assisting operators in adjusting fan control. This has stabilized the outlet water temperature within the target range of 30-31°C, thereby enhancing cooling efficiency.

This study demonstrates the practical application of AI technology in a manufacturing control scenario and establishes aweb-based decision support system, offering a practical example for smart manufacturing transformation within an Industrial IoT environment.

T250114

Computer Vision-Based Tennis Ball Tracking Using YOLO for Training Analytics

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Keywords: Computer Vision, YOLO, Object Tracking, Tennis Training, Sports Analytics

Abstract:
Tennis is an exceptionally fast-paced sport where the ability to deliver precise returns to an opponent's weak zones is decisive for competitive success. Although wall practice has long been regarded as a fundamental training method, reliably capturing and ana-lyzing the spatial distribution of impact points during high-speed rallies remains a formidable challenge, even for elite players. Prior computer vision research has largely concentrated on in-match tracking scenarios, while dedicated solutions for wall practice, a critical yet understudied training environment, are still limited. To address this gap, we present an AI-driven wall practice analytics framework that integrates advanced computer vision techniques to extract coordinate-based distributions of ball impacts and, through temporal statistical modeling, quantify players' endurance, placement preci-sion, and return consistency. Specifically, a two-stage detection pipeline is employed: YOLOv12 and MobileNetV2 collaboratively generate candidate bounding boxes of the tennis ball, which are then stabilized using a Kalman filter with a predict–update mechanism to ensure robust tracking under high-speed trajectories and intermittent occlusions. Building on the reconstructed trajectories, a novel wall impact detection module automatically identifies returns within predefined target zones, computes hit-rate metrics, and visualizes impact distributions. By transforming unstructured high-speed ball motion into actionable training analytics, the proposed system delivers objective, quantitative feedback that empowers athletes to refine placement accuracy, sustain endurance, and enhance consistency during autonomous wall practice sessions. This work highlights the potential of integrating deep learning and statistical tracking models to advance sports analytics, offering a scalable solution that can be extended beyond tennis to other fast-moving ball sports and performance assessment domains.

T250115

Remarks on the Application of Multi–Layer Extreme Learning Machines to Tracking Control of an Autonomous Unmanned Vehicle

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Keywords: Neural networks, Extreme learning machines, Control, Autonomous unmanned vehicle

Abstract:
Neural networks (NNs) integrating deep learning techniques have become a standard tool for solving real–world problems across various domains. However, increasing the size of datasets to improve accuracy increases the complexity of the model parameters, raising the computational, memory and energy consumption requirements. To address these issues, considerable attention has been focused on developing lightweight network architectures, including extreme learning machines (ELMs) and echo state networks. Owing to their compact architectures and rapid training, these networks have been successfully applied to nonlinear and temporal data processing in many applications. In the control engineering domain, NNs have become popular and powerful approaches for system identification and control. However, they are sometimes challenged under the aforementioned constraints. Therefore, ELMs are considered a promising alternative for effectively handling the dynamic relationships in data related to the control of nonlinear systems. This study investigates the applicability of multi–layer ELMs (MLELMs), which comprise stacked hidden layers tuned via an autoencoder, to control systems. A practical MLELM–based controller was designed for the control of autonomous unmanned vehicles, specifically an unmanned surface vehicle (USV). In particular, the control objective was that the USV followed the reference trajectory while preserving its attitude. This study adopted a dual–loop control architecture that implements position control in the outer loop to generate the desired forces based on the reference trajectory while executing attitude control in the inner loop to produce the desired torques, where the control functions within each loop were approximated by separate MLELMs. The performance of the MLELM–based controller was evaluated through computational experiments on a mathematical model of the USV. Simulation results demonstrated that the MLELM–based controller achieved the control objectives with adequate performance, confirming the feasibility of applying MLELMs to control systems.

T250117

Effects of using low-toxic green binary antisolvents on the crystallization of perovskite films

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Keywords: perovskite solar cell, green antisolvent, MAPbI3, methyl acetate, isopropanol alcohol

Abstract:
Perovskite solar cells are currently a highly promising research area, attracting significant attention due to their high photoelectric conversion efficiency and low manufacturing costs. The quality of thin film crystallization is crucial for the performance of perovskite solar cells. In the one-step spin-coating method, the choice of antisolvent plays a crucial role in the perovskite solar cell fabrication process. However, mainstream antisolvents are generally highly toxic and pose environmental risks, necessitating the development of low-toxic, environmentally friendly, and green antisolvents. To this end, this study investigated the effects of a low-toxic binary antisolvent methyl acetate and isopropanol on the crystallization quality of perovskite thin films and the performance of perovskite solar cells by adjusting the mixing ratio.

This study utilized field-emission scanning electron microscopy (FE-SEM), X-ray diffractometry (XRD) atomic force microscopy (AFM), ultraviolet-visible spectroscopy (UV-Vis), and a quantum efficiency (QE) measurement system to measure and analyze the thin film properties and perovskite solar cell performance. The research results show that when the methyl acetate mixed with isopropyl alcohol reaches 50 vol%, the perovskite film performs optimally, an average grain size of 340 nm, a surface roughness reduced to 20.3 nm, an increased light absorption rate of 4.134, and a photoelectric conversion efficiency of 4.56%, which maintains 0.44% efficiency after 504 hours. Conversely, when the isopropyl alcohol ratio is increased to 65 vol%, the film quality and efficiency decrease significantly.

Combined with these research results, a 50 vol% mixture of methyl acetate and isopropyl alcohol effectively improves the crystallinity and surface flatness of the perovskite film, light absorption, and cell stability, providing important insights for the development of environmentally friendly, green, and low-toxic perovskite solar cells.

T250118

Nose Detection Based on Quadratic Curve Fitting with Geometric–Photometric–Structural Scoring

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Keywords: quadratic curve fitting, YCbCr color space analysis, multi-threshold Canny edge detection, histogram projection, geometric–photometric–structural scoring

Abstract:

This work presents an edge-based and curve-based rule-driven nose-detection framework designed to improve the reliability of face detection. The proposed method combines quadratic curve fitting with a calibrated scoring mechanism that fuses geometric, photometric, and structural information into a unified model. These stages jointly enforce symmetry consistency, reliable tip position, and clear wing boundaries. Candidate face regions are first refined by skin filtering and ellipse validation, from which a mid-lower facial ROI is framed for nasal candidate extraction. We further incorporate EyeMap/MouthMap to restrict the ROI to the region below the eyes, above the mouth, and between the two eyes. When a mouth is detected, this ROI refinement supersedes the Cr-channel trimming; otherwise, we fall back to the Cr-channel horizontal projection to detect dominant mouth peaks and trim the lower-lip band, thereby suppressing lip interference. A multi-threshold Canny procedure with histogram projection is employed to collect multiple nose rectangles by selecting various vertical and horizontal peaks under three adaptive threshold scales. Within each rectangle, edge contours are quadratically fitted and categorized into U-shape (nasal base), N-shape (nostril rim), and C-shape (nasal wings), enabling rule-based selection of the base, wings, and nostrils. The fused features are then processed by a calibrated geometric–photometric–structural scoring module that uses YCbCr contrasts and red/black penalties to suppress lip and eye confounders. Experiments on diverse faces and lighting conditions show accurate and stable nose localization, with notably reliable wing fitting and nasal-base detection, improving the accuracy of face detection.

T250119

Detection and Segmentation of Surface Corrosion in Steel-based Hand Tools Using YOLOv8

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Keywords: Computer Vision, Instance Segmentation, YOLOv8-seg, Raspberry Pi 5, Corrosion Segmentation

Abstract:

Corrosion in steel hand tools over time leads to material degradation and poses potential safety risks to users. Current methods to evaluate corrosion requires visual inspection of an inspector, but this mode of corrosion detection can be resource and time extensive, subjective or inspector dependent. Computer vision offers an efficient approach to monitor corrosion in tools; however, existing systems remain limited in performing instance segmentation on non-uniform surfaces and smaller objects such as hand tools. This study aims to develop a YOLOv8-based system capable of detecting and segmenting corrosion in steel hand tools. The model is trained with a dataset that consists of hand-tools annotated and its corrosion (if present) annotated, this allows the model to solely focus on finding the corrosion within the tool area. The system integrates a Raspberry Pi 5 with a camera module and a controlled lighting environment to enhance feature extraction of corroded regions. Results on the detection of hand tools and their corrosion show a bounding-box F1-score of 62.95 and a segmentation mask F1-score of 59.1. The model particularly struggles with the smaller areas of corrosion present in the tools and due to the nature of most corrosion in hand tools this becomes a common occurrence.

T250120

Parameters Determination of QAOA Using Layerwise Grid Search Method

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Keywords: quantum computation, quantum approximate optimization algorithm, grid search

Abstract:

The quantum approximate optimization algorithm (QAOA) is an efficient method for solving combinatorial optimization problems in quantum computing. These problems involve finding the best solution from a finite set of possibilities. At its core, QAOA uses an ansatz circuit composed of alternating unitary operators—the mixing and problem Hamiltonians—that are controlled by a set of parameters. The goal is to find the optimal parameters so that the final quantum state of the circuit encodes the problem's solution. While this parameter optimization is often handled by classical optimizers like COBYLA and Nelder-Mead, these methods frequently get stuck in local extrema. This paper proposes a layerwise grid search (LGS) method as an alternative. Since a full grid search is too time-consuming, the LGS method is designed to significantly reduce the search time while still finding a good solution. To demonstrate its effectiveness, we present experimental results on the max-cut problem, comparing the performance of our LGS method against conventional classical optimizers.

T250122

DNS-Inspired Synchronization Strategies for Efficient MQTT Resource Discovery

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Keywords: MQTT, Internet of Things, Resource Discovery, Hierarchical Architecture, Resource Management

Abstract:

In the Internet of Things (IoT), automatic resource discovery (RD) is essential for system scalability. The existing MQTT-RD framework relies on full-mesh synchronization among peer RD entities, which ensures consistency but leads to rapidly increasing communication overhead and maintenance complexity as the number of nodes grows. This weakness restricts its scalability and stability in large-scale IoT deployments.

To address this problem, we propose a Root-managed hierarchical MQTT-RD architecture. In this design, RD entities are organized into layers by region, and these RD entities are organized as a hierarchical relation. Each RD entity is responsible for reporting its RD data to its upper-layer entity, and the root RD entity manages and synchronizes the whole-system RD data to all the other RD entities. Inspired by Domain Name Service (DNS) design principle, we apply the data cache and version control mechanisms to further improve the system performance.

Preliminary theoretical analysis suggests that this architecture effectively reduces communication load and enhances scalability. By integrating DNS-inspired synchronization strategies, the proposed Root-managed hierarchical RD provides a new design direction for MQTT-based IoT resource management and shows potential value in balancing efficiency, scalability, and resilience.

T250123

Real-Time Classification of Tobacco Leaf Diseases on Raspberry Pi 5 with YOLOv8n and DCNN

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Keywords: real-time systems, agricultural technology, neural networks, tobacco

Abstract:

The accurate and timely detection of leaf diseases is essential in helping farmers take necessary corrective actions to prevent disease spread that can lead to significant crop losses, reduced yield, and economic losses. A real-time Raspberry Pi 5-based prototype classification of tobacco leaf diseases using YOLOv8n and a Deep Convolutional Neural Network (DCNN) was developed to assist farmers with their crop disease identification. The calibration was performed by adjusting the camera mounting height and the lux level to achieve the system's optimal performance. It was further evaluated using 24 fresh tobacco leaves upon identifying the system's optimal setting. Under optimal settings, the prototype achieved an overall accuracy of 93%, with per-class accuracies of 100% for frogeye classification, 100% for TMV classification, 94% for wildfire classification, and 78% for healthy leaves.

T250124

Classification of Dark Condiment Sauces through Electronic Nose using Support Vector Machine

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Keywords: Electronic Nose, Support Vector Machine, Volatile Organic Compounds, Machine Learning, Condiments

Abstract:

Condiment sauces such as soy sauce, fish sauce, oyster sauce, and Worcestershire sauce play a vital role in culinary practices and cultural identity, particularly in the Philippines. These sauces are distinguished by their unique volatile organic compound profiles, which define their aroma and flavor. With the growing demand for these condiment products, there is an increasing need for accurate and efficient methods to classify them, ensuring product authenticity and strengthening quality control. However, conventional approaches such as sensory evaluation and laboratory-based chemical analysis are often expensive, time-consuming, and subjective. To address this limitation, this study proposes the use of an electronic nose (e-nose) system integrated with a Support Vector Machine (SVM) classifier for the classification of dark condiment sauces. The system consists of an array of MQ-series gas sensors connected to an Arduino Mega 2560 for analog-to-digital conversion, with a Raspberry Pi 5 serving as the primary processing unit. Sensor data undergo preprocessing steps, including standardization and dimensionality reduction through Principal Component Analysis (PCA), before being classified using SVM. A total of 120 samples, consisting of 40 readings per condiment type, were used for training and testing, while 60 additional samples—15 per class—were reserved for validation. The e-nose system achieved a 95% classification performance, as evaluated using a confusion matrix and overall accuracy metrics. These findings demonstrate the potential of the e-nose combined with SVM as a low-cost, portable, and reliable tool for condiment classification. The system offers practical applications in quality control and product authentication. Future work may extend its capabilities toward spoilage detection, the integration of different gas sensors, and the classification of a wider variety of condiment sauces.

T250125

Automatic Transliteration of Baybayin Transliterated Rizal Poems to Latin Text Using Kraken

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Keywords: Baybayin, Kraken, optical character recognition, transliteration, Raspberry Pi 5

Abstract:

This study introduces an automatic transliteration system that uses the Kraken OCR framework to convert Baybayin, a Philippine national script, into its equivalent Latin script. The system was implemented on a Raspberry Pi 5 with a Raspberry Pi Camera Module 3 for image capture and a document binarization program for preprocessing. The objective is to provide an image recognition system that utilizes the Kraken framework for the recognition and transliteration of Baybayin transliterated Dr. Rizal's manuscripts. The dataset consists of binarized images of Baybayin symbols, words, and sentences paired with their corresponding ground truths, divided into 80% for training, 10% for validation, and 10% for testing. Model training was performed using convolutional recurrent neural networks and multiple training epochs to optimize character and word recognition accuracy. The evaluation achieved a validation character accuracy of 98.1% and a validation word accuracy of 87.8%. The system further attained 25.5% word error rate (WER), 98.5% word detection rate, and a 77.2% ROUGE-1 score. The challenges encountered during development included the adjustments in the controlled environment, such as sufficient lighting and proper horizontal orientation (deskewing) of papers. For future research, exploring hybrid OCR-NLP approaches for contextual correction and applying augmentation and script variety are recommended to further enhance accuracy.

T250126

Image Colorization of Fruits and Vegetables using Convolutional Kolmogorov-Arnold Networks (CKAN)

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Keywords: Image Colorization, Convolutional Kolmogorov-Arnold Network, Kolmogorov-Arnold Network, Structural Similarity Index, Mean Squared Error

Abstract:
Image colorization transforms monochrome images into full-colored versions, which improves image restoration in fields such as art, history, and medicine. There are current AI models like CNNs and GANs that have made this possible; however, they often have limitations in generalization and interpretability. This study explores the application of the Convolutional Kolmogorov-Arnold Network, a new neural architecture that adds a convolutional layer to the Kolmogorov-Arnold Network for colorizing greyscale images of fruits and vegetables. A dataset of different variations of fruits and vegetables was used, and the model's performance was evaluated using the Structural Similarity Index (SSIM) and Mean Squared Error (MSE) After testing the model, the results showed that the CKAN colorized images achieved the desired outcome, consistently having a high SSIM score (~0.9) and a low MSE score (<100.0). This confirms CKAN's potential for effective image colorization and highlights its possible applications in other computer vision tasks.

T250127

Correlation Analysis between Preparation Movements and Smash Performance in Badminton Using YOLO Algorithm and Sensor Data

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Keywords: Badminton, Smash, YOLO algorithm, Motion analysis, IMU sensors

Abstract:

The smash is one of the most decisive offensive techniques in badminton, with its preparation and execution speed being critical to match outcomes. This study applied the You Only Look Once (YOLO) algorithm in combination with inertial measurement unit (IMU) sensors to analyze the relationship between players' preparatory movements and smash speed. High-speed video recording was synchronized with five IMU sensors placed on the right shoulder, elbow, wrist, hip, and knee to capture kinematic data during the smash. YOLO was employed to detect key joint positions and shuttle trajectories, while IMU data provided instantaneous acceleration for regression analysis. Four collegiate players participated, each performing 15 smash trials. Results showed that YOLO-based motion recognition, combined with IMU data, achieved an overall accuracy of over 93% in analyzing key movements and shuttle speed. These findings highlight the reliability and practical potential of the proposed system, which can serve as a valuable tool for professional training, coaching assistance, and skill development in physical education contexts.

T250128

A Personalized Topwear Recommendation System Integrating Image and Textual Features

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Keywords: AI Similarity Search, Deep Learning, E-commerce Applications, Multimodal Feature Fusion, Personalized Fashion Recommendation

Abstract:

In recent years, personalized fashion recommendation systems have gained significant attention due to the rapid growth of e-commerce and the demand for tailored user experiences. This study presents a personalized topwear recommendation system that integrates both image and textual features to enhance recommendation accuracy and relevance. The proposed system is designed to understand user preferences not only based on visual patterns in clothing images but also on semantic cues derived from textual descriptions or user-provided prompts.

To achieve this, the system first extracts visual features from topwear images using a pre-trained deep learning model, generating high-dimensional embeddings that capture key visual characteristics such as color, texture, and style. Simultaneously, semantic features are obtained by encoding text prompts or clothing-related descriptions into semantic vectors using a language model. The core of the system lies in the weighted fusion of two vectors: (1) the average visual embedding derived from the user's historical click records and (2) the semantic embedding generated from relevant textual prompts. This fusion enables the system to balance between what users have interacted with visually and what they express semantically.

To support fast and scalable retrieval, the system employs FAISS (Facebook AI Similarity Search) to index the entire topwear image database in the fused vector space. During inference, the system computes the user's fused preference vector and retrieves the most similar items from the FAISS index, offering personalized and context-aware topwear recommendations.

Experimental results demonstrate that integrating visual and textual features yields improved retrieval precision compared to using either modality alone. The system showcases strong potential in fashion e-commerce applications, enabling more intelligent and user-centric recommendation experiences.

T250129

Phased Strategies for Advancing Digital Transformation in the Manufacturing Industry

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Keywords: Digital transformation, Smart manufacturing, VSM, IoT, Artificial intelligence

Abstract:

This study explores phased strategies for digital transformation in manufacturing, divided into short-, medium-, and long-term stages. It focuses on three key dimensions: automated parameter collection, process optimization, and intelligent equipment upgrades. The progression moves from production data visualization and prediction to production transparency and process digitalization, and finally to equipment networking and system adaptability. Research methods include SME case studies, value stream mapping, and data analysis to validate improvements. The study proposes a practical transformation framework that supports manufacturers in gradually advancing through different stages toward smart manufacturing.

T250130

Pitch Type Prediction through Image Analysis

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Keywords: Baseball Training, Deep Learning, Image Analysis, Motion Recognition, Pitching Mechanics

Abstract:

With the rapid advancement of science and technology, many aspects of life have improved, and sports have also benefited, particularly baseball, where the integration of data analysis has become indispensable. In recent years, big data has become a mainstream tool, enabling teams to identify pitchers' tendencies, uncover patterns, and make strategic decisions with greater accuracy. Statistical models, performance metrics, and tracking systems have transformed how players are evaluated and strategies developed. Yet, despite these innovations, opponents still rely heavily on visual observation—scrutinizing pitchers' movements and subtle cues—to detect weaknesses that can be exploited.

Traditionally, flaws in pitching mechanics are recognized only by experienced coaches, catchers, or scouts, and even then, issues may not always be detected accurately or in time, limiting corrective training. To address these challenges, this study proposes a method combining image analysis with deep learning to automatically evaluate a pitcher's delivery posture. By leveraging computer vision and machine learning, the system assists coaches and catchers in detecting biomechanical issues more reliably, enhancing the precision and efficiency of pitching instruction.

This study uses game footage of MLB pitcher Max Scherzer from 2015 to 2020 as the dataset. The wind-up phase of each pitch is segmented and divided into frames for analysis. Pose estimation captures joint movements and body angles, and the extracted features are processed through deep learning models to classify delivery patterns and detect irregularities. This approach is expected to provide insights for correcting flaws and preventing habits that may hinder performance or increase injury risk.

Ultimately, this research demonstrates how combining image-based motion analysis with deep learning can bring innovation to pitcher training. The framework offers a scientific, data-driven tool to complement coaching expertise, improve training quality, and provide competitive advantages in future competitions.

T250134

SCOW+: A SCOW-Based Tunable Photonic Structure for Spectral Control and Transmission Response Simulation

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Keywords: SCOW, optical waveguide, ring resonators, all-pass filter

Abstract:
We propose a novel SCOW+ (Self-Coupled Optical Waveguide with All-Pass Filter) architecture that enhances spectral control in integrated photonic circuits. Derived from the foundational SCOW platform, SCOW+ introduces a tunable ring resonator coupled with an all-pass filter to achieve sharp, periodic transmission dips with adjustable free spectral range (FSR) and extinction ratio. This hybrid configuration supports multifunctional behavior, enabling the device to operate as a narrowband filter, modulator, or sensor depending on the tuning parameters. The SCOW+ structure leverages self-coupling and phase interference to induce coupled-resonator-induced transparency (CRIT), offering fine control over spectral features. Using frequency-domain simulations, we validate the spectral response, tunability, and compact footprint of SCOW+, Simulation results confirm that by adjusting ring length and coupling coefficient, the device exhibits flexible tuning capabilities and dynamic reconfiguration of its transmission profile. SCOW+ achieves enhanced spectral shaping without significantly increasing device size. Its modularity and compatibility with standard fabrication processes underscore its potential for scalable integration in silicon photonics platforms. This work highlights the versatility of SCOW-derived architectures and opens pathways for compact, tunable photonic components in next-generation integrated systems.

T250135

Continuous-Layer Modeling of Speech Dynamics with NODE-Conv-TasNet for Speech Enhancement

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Keywords: Speech Enhancement, Neural Ordinary Differential Equations (NODEs), Temporal Convolutional Networks (TCN)

Abstract:

Speech enhancement remains a critical challenge in audio signal processing, particularly in noisy real-world environments where intelligibility and perceptual quality degrade rapidly. Conv-TasNet has achieved notable success in time-domain speech processing; however, its reliance on discrete temporal convolutional networks (TCNs) constrains its capacity to represent the continuous evolution of speech signals. To address this limitation, this paper introduces an enhanced architecture that integrates Neural Ordinary Differential Equations (NODEs) into the Conv-TasNet separation module, enabling continuous-depth modeling of latent speech dynamics through adaptive ODE solvers. Three NODE variants of increasing capacity small, medium, and large were developed and systematically evaluated under multiple solver tolerances to investigate trade-offs between computational efficiency and enhancement quality. Experiments were conducted on noisy Mandarin speech mixed with CHiME4 and QUT-NOISE environments across a range o signal-to-noise ratios, reflecting both controlled and challenging real-world acoustic conditions. The results demonstrate that NODE-Conv-TasNet consistently outperforms the baseline across several objective measures, including scale-invariant signal-to-noise ratio improvement (SI-SNRi), perceptual evaluation of speech quality (PESQ), and short-time objective intelligibility (STOI). In particular, the large NODE configuration achieved notable performance gains, delivering improvements in intelligibility and perceptual quality across both seen and unseen noise types. Moreover, the adaptive solver enabled flexible control over inference time, highlighting a pathway to balance accuracy and efficiency. These findings emphasize the potential of continuous-depth neural architectures to advance speech enhancement research and demonstrate their suitability for practical deployment in real-time, resource-aware communication systems and high-fidelity industrial applications.

T250136

Virtual–Physical Two-Stage Deep Learning for CNC Lathe Energy Consumption Prediction Without Trial Cuts

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Keywords: Energy Consumption, Bi-LSTM, BPNN, Dry-run

Abstract:

This study addresses the challenge of predicting energy consumption in CNC lathe machining, an essential issue in smart manufacturing and energy management. Conventional approaches typically estimate energy only after machining, which leads to costly trial cuts and uncertainty in electricity planning.

We propose a two-stage prediction framework integrating Bidirectional Long Short-Term Memory (Bi-LSTM) and Backpropagation Neural Networks (BPNN). Stage 1 establishes a baseline model using CAM simulation parameters and dry-run energy data. Stage 2 incorporates actual cutting energy consumption while taking CNC machining parameters and predicted dry-run values as inputs to create a virtual energy model that more faithfully represents real cutting processes.

Experimental results show that prediction errors can be maintained within ±5% on the same machine type. With only spindle speed, feed rate, cutting depth, and CAM-generated runtime and path information, the framework can directly predict cutting energy consumption without trial machining. This work contributes to reducing material waste, lowering modeling costs, and enabling more reliable energy management and process optimization in smart manufacturing.

T250137

Performance Analysis of Hammer Throwers Using IMU and Internet of Things (IoT) Integration

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Keywords: Track & Field, Sport Technology, Sport Science, Throw Item

Abstract:

Introduction:

Hammer throw is a complex sport requiring strength, refined technique, and precise coordination. Traditional technique evaluation primarily relies on video observation and subjective judgment by coaches. This study integrates Internet of Things (IoT) technology with Inertial Measurement Units (IMUs) to provide a more objective, real-time, and data-driven performance analysis platform for hammer throw athletes and coaches.

Methodology:

This study utilizes IMUs (Xsens, Netherlands) placed on three key joints of the lower limbs: the hip, knee, and ankle. These sensors collect tri-axial acceleration and angular velocity during hammer throw actions. The data is wirelessly transmitted via an IoT network to a central computer for three-dimensional dynamic analysis. Key motion metrics such as rotational angular speed, segmental coordination, and joint acceleration patterns are extracted to evaluate the correlation between throwing technique and achieved distance.

Experimental Results:

Two collegiate hammer throw athletes each performed 10 throwing trials. Results indicate that the IMU system offers superior precision in capturing angular velocity and acceleration dynamics during rapid rotation phases when compared to traditional video analysis. The system achieved an accuracy rate of 93.5% in identifying performance differences and technical deviations. Notably, it successfully revealed micro-level motion variations that were otherwise unobservable in frame-by-frame video reviews.

Conclusion:

Traditional technique improvement depends heavily on coach experience, with limited objective support. By integrating IMUs with an IoT framework, this study provides athletes with scientific and quantifiable feedback for technical optimization. The system allows real-time monitoring, data-driven adjustments, and progress tracking. The proposed approach enhances communication between coaches and athletes and holds promise for further development, including AI-assisted training recommendations. It represents a practical and innovative direction for applying smart technology in sports science.

T250138

Challenges and Strategies in Enterprise Adoption of Artificial Intelligence

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Keywords: AI adoption, enterprise strategy, technical challenges

Abstract:

With the rapid advancement of artificial intelligence (AI) technologies, enterprises are actively exploring ways to integrate AI into their operations and decision-making processes. However, the adoption of AI often entails significant investment risks, technical implementation difficulties, and compliance pressures. Determining the necessity of adoption under limited resources and developing feasible strategies has thus become a critical issue. This study aims to identify the major challenges enterprises encounter when adopting AI and to propose corresponding strategies that can help reduce risks and enhance implementation outcomes.

This research employs a qualitative approach, collecting insights from 10 industry experts through interviews and conducting content analysis. The process included data collection, transcription, coding of key themes, and cross-case comparison, which ultimately led to the construction of a three-stage framework —covering the early, middle, and later phases of AI adoption—linking specific challenges to corresponding strategies.

The findings reveal that early-stage challenges lie in the dual uncertainties of demand validation and technical feasibility; middle-stage difficulties involve data quality, model adaptation, and system integration; while late-stage concerns focus on performance monitoring, long-term maintenance, and regulatory compliance. This study recommends that enterprises establish demand verification and technical review mechanisms during the early stage, strengthen cross-departmental collaboration and data management in the middle stage, and implement continuous monitoring and compliance governance in the later stage. The proposed three-stage framework serves both as a practical guide for enterprises adopting AI projects and as a foundation for future academic inquiry and validation.

T250139

A YOLO-Based Deep Learning Framework for Assembly Process Recognition in 3D Printers

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Keywords: Assembly Process, Image Recognition, YOLO, Transfer learning

Abstract:

During equipment assembly and maintenance, ensuring the correct number of parts are installed in the proper sequence is critical. Conventional aids that rely on manual expertise or static documentation are often inefficient, particularly for novice training and on-site troubleshooting, resulting in longer cycle times and higher rework costs. To address this issue, we propose a deep learning–based intelligent assembly assistance and alert system. A consumer-grade 3D printer serves as the application testbed. The assembly procedure is decomposed into ten steps, and a YOLO-based visual recognition model is trained for each step.

This study compares the performance of three instance segmentation models—YOLOv5, YOLOv8, and YOLOv11—for the task of component recognition during the 3D printer assembly. A two-stage training strategy was adopted: the YOLO models were first initialized with official pre-trained weights for foundational training on a custom dataset. Subsequently, using these weights as a starting point, transfer learning was employed by freezing layers and fine-tuning hyperparameters. Model robustness and accuracy were ultimately evaluated based on mAP scores, recall, and precision.

The experimental results demonstrate that YOLOv11 achieved an average improvement of 4-5% in mAP50-95 score compared to YOLOv5 and YOLOv8. The application of transfer learning further enhanced this performance by 5.38%, significantly increasing the accuracy and reliability of component recognition. This achievement not only validates the substantial benefits of systematic model selection and transfer learning strategies but also establishes a solid technical foundation for the development of high-efficacy intelligent manufacturing assistance systems.

T250140

Optuna-Driven Hyperparameter Tuning in Deep Learning Architectures for Linear-Axis Thermal Error Prediction

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Keywords: thermal displacement, LSTM, Bi-LSTM, GRU, Optuna

Abstract:

The primary sources of thermal error in machine tools are spindle, linear-axis, and rotary-axis errors. Conventional detection methods rely on eddy current probes or interferometers. Since 2023, our team employed a non-contact dual-laser optical system (LASER R-TEST) to measure thermally induced displacements and analyze the correlation between temperature rise and displacement. We subsequently applied machine learning and transfer learning to develop thermal error models. However, the results showed that prediction accuracy under complex conditions still needed further improvement.

Based on this type of approach, this study integrates three deep learning architectures GRU, LSTM, and Bi-LSTM with the Optuna hyperparameter optimization framework. By minimizing the loss function, the optimal parameter configurations are automatically identified, while Early Stopping is employed to prevent overfitting and ensure model stability across different working conditions. Experimental validation shows that the maximum residual error on the X-axis is within 6 μm with an RMSE below 1 μm, and the Y-axis residual is within 11 μm with an RMSE under 2 μm. These results confirm that the improved model achieves excellent prediction accuracy under varying conditions, significantly outperforming previous approaches.

The adoption of hyperparameter optimization not only enhances prediction accuracy of machine tool thermal errors but also reduces the time required for parameter tuning, while exhibiting strong potential for real-time compensation. This provides a comprehensive and practical solution for thermal error control in precision machining. Future work will integrate additional sensor data and machine operating parameters to further improve model generalization, with the ultimate goal of advancing toward smart manufacturing and integrated automated control systems, thereby enhancing machining stability and production efficiency.

T250141

Development of a BPNN-Based Analysis for Positioning-Induced Geometric Errors (PIGEs) in Five-Axis Machine Tools

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Keywords: Error compensation, BPNN, PIGEs, rotary axis error, concentricity error

Abstract:

With the growing demand for high-precision machining and smart manufacturing, geometric accuracy control of five-axis machine tools has become a critical research topic. Current approaches can be broadly categorized into two methods , one based on spatial coordinate matrix methods, and the other leveraging artificial intelligence (AI) techniques. While most studies achieve accurate results in the forward kinematic solution, challenges remain in the inverse solution process due to error coupling and complex mathematical derivations.

A modeling method based on a Backpropagation Neural Network (BPNN) with transfer learning is proposed, where simulated data are utilized for pre-training and the model is adapted to limited real data through transfer learning during fine-tuning. The trained model is capable of identifying and compensating for eight geometric error components of the rotary axes in five-axis machine tools. This approach reduces the need for extensive real-world measurements, effectively bridging the gap between virtual and real environments, and ensuring strong generalization even under limited data conditions.

Experimental results show that the proposed method maintains high-precision error compensation with significantly reduced real data requirements. The effectiveness of the approach is verified in accordance with ISO 10791–6, focusing on the identification and compensation of positioning-induced geometric errors (PIGEs). Advantages in efficiency, accuracy, and reduced human intervention are demonstrated, providing a feasible solution for intelligent accuracy control in next-generation CNC machine tools.

T250143

Optimizing Compact Centrifugal Impellers for Wearable Cooling: A CFD Study of Blade Count Effects

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Keywords: Centrifugal impeller, Wearable cooling devices, Computational fluid dynamics (CFD), Blade count optimization, Personal thermal management systems (PTMS)

Abstract:

Portable personal thermal management systems (PTMS), such as neck-mounted fans, are gaining prominence as localized, hands-free cooling solutions in response to increasing global temperatures. The centrifugal impeller is a critical component governing airflow performance; however, systematic studies on compact impellers designed for wearable applications remain limited compared with their industrial-scale counterparts. This work presents a comparative investigation of forward-curved centrifugal impellers with diameters below 50 mm, focusing on three blade counts (30, 28, and 24) derived from benchmarking of commercial devices. A baseline impeller–volute assembly was reverse-engineered through 3D scanning and CAD reconstruction, followed by blade-count modifications under consistent geometric constraints. Computational fluid dynamics (CFD) simulations in ANSYS Fluent were employed to evaluate velocity fields, pressure distributions, and volumetric flow rates. The results demonstrate that blade number strongly influences airflow characteristics, revealing clear trade-offs between velocity magnitude and overall efficiency. These insights advance the design optimization of compact impellers for wearable cooling devices and contribute to the development of more effective and reliable PTMS technologies.

T250144

Real-Time Face Detection Based on FPGA

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Keywords: FPGA (Field Programmable Gate Array)、Real-time Face Detection、Skin Tone Masking、LBP (Local Binary Pattern)、Centroid-based Algorithm.

Abstract:

This study designs a real-time face detection system using an FPGA (Field Programmable Gate Array). In the research, the OV7670 image sensor is adopted for image acquisition, and Verilog is used to develop the hardware modules. The overall architecture consists of three parts: image capture, feature processing, and face localization, with all functions implemented in hardware to ensure system efficiency.

The detection method in this work uses three approaches. The first is skin color detection, which filters out non-face regions based on skin color to reduce background interference in face detection. The second is the LBP (Local Binary Pattern) binarization method, which extracts facial features and emphasizes facial details. LBP highlights edges and texture details, improving the reliability of face localization. The third is the Centroid-based algorithm, which calculates the center coordinates of the face, making it possible to position a red box around the face according to the coordinates.

After the first two steps, the binarized image is used for computation to determine the facial region, and the center point of the face is obtained. Finally, the detection result is output through the VGA interface to the computer screen, showing the designed outcome. All algorithms are implemented in the FPGA, avoiding the delay problems of software processing, thereby achieving the goal of real-time operation.

T250145

Study on Sodium Copper Chlorophyllin Dye-Sensitized Solar Cells Using Gel-Electrolytes

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Keywords: gel electrolytes, PVDF-HFP, PEO, sodium copper chlorophyllin, dye-sensitized solar cells

Abstract:

Abstract—This study investigates the photovoltaic performance and long-term stability of dye-sensitized solar cells (DSSCs) fabricated using sodium copper chlorophyllin (SCC) as a natural dye combined with a gel-type electrolyte. To address the common volatility and leakage issues of conventional liquid electrolytes, a gel electrolyte composed of poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP) and polyethylene oxide (PEO) in a 3:2 weight ratio was prepared. UV–Vis spectroscopy showed that 1 wt% SCC exhibited the strongest and most distinct absorption peak, indicating optimal photon absorption and electron excitation capability; thus, it was selected as the optimal dye concentration. As the gel electrolyte is solid at room temperature, it was heated to approximately 70°C to become flowable for injection and encapsulation.

Three concentrations of gel electrolyte—5%, 10%, and 15% by weight—were compared. After 14 days of I–V measurements, the devices demonstrated excellent durability, with only 2% and 4% reductions in power conversion efficiency for the 10% and 15% samples, respectively. Additionally, both the short-circuit current density (Jsc) and fill factor (F.F.) were improved, indicating that the gel structure facilitates enhanced charge transport and separation. Based on these results, 10% and 15% gel electrolyte concentrations were selected as optimal conditions, as they provided superior stability and efficiency compared to the 5% sample, balancing both ionic conductivity and mechanical integrity of the gel for long-term device performance. Electrochemical impedance spectroscopy further confirmed reduced internal resistance and stable interfacial properties.

Overall, combining 1 wt% SCC with 10% or 15% PVDF-HFP/PEO gel electrolyte improved efficiency durability, and stability, providing a low-cost, eco-friendly approach for sustainable solar energy applications.

T250146

Effects of Incorporating Highly Diluted Carbon Nanotubes into TiO2 Layered Structures on the Performance of Dye-Sensitized Solar Cells

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Keywords: DSSCs, CNT, TiO2, Screen Printing Method

Abstract:

Abstract—This study investigates the effects of carbon nanotube (CNT) doping concentration and interlaced multilayer structures on the photovoltaic performance of dye-sensitized solar cells (DSSCs). Different CNT concentrations were introduced into TiO_2 photoanodes to investigate their role in optimizing electron transport and device efficiency.

The experimental results reveal that an optimal CNT concentration of 0.01 wt% achieves a power conversion efficiency (PCE) of 4.32% and a short-circuit current density (Jsc) of 10.03 mA/cm². At this concentration, CNTs are well dispersed and highly conductive, enabling efficient electron transport, lowering interfacial resistance, and suppressing electron–electrolyte recombination. In contrast, excessive CNT loading leads to aggregation and pore blockage, which increase internal resistance and deteriorate device performance.

Based on the optimal concentration, CNT/TiO_2 multilayer structures were fabricated, among which the interlaced configuration (FTO–CNT/TiO2–TiO2–CNT/TiO2–TiO2) exhibited the best photovoltaic properties, achieving Jsc = 10.31 mA/cm², fill factor = 62.35%, and PCE = 4.42%. UV-Vis and IPCE analyses confirmed stronger light absorption across the 400–700 nm visible range, especially in the 550–700 nm region. Furthermore, electrochemical impedance spectroscopy (EIS) revealed lower resistances and longer electron lifetimes for the F group, indicating that the interlaced multilayer design significantly enhances charge transport, suppresses recombination, and improves overall DSSC efficiency.

T250147

Exploring the Impact of Carboxylic Combining Copper Chlorophyllin Sodium on Dye-Sensitized Solar Cells

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Keywords: DSSCs, Copper Chlorophyllin Sodium, Carboxylic, TiO., doctor blade method

Abstract:

Dye-sensitized solar cells (DSSCs) are considered a promising low-cost alternative to conventional photovoltaic devices ; however, their performance is often limited by the stability and absorption ability of natural dyes. In this study, we investigate the effect of incorporating acetic acid and citric acid, two carboxyl-containing materials, into copper chlorophyllin sodium dye to improve DSSC performance. Titanium dioxide (TiO_2) thin films were prepared using the doctor blade method, and the dye solutions were modified with the two acids. The results revealed that photovoltaic conversion efficiency increased by 10.5% and 14.0% with the addition of acetic acid and citric acid, respectively. After seven days of operation, the short-circuit current remained higher than the unmodified dye , although the fill factor showed a decline. Moreover, citric acid demonstrated superior stability compared to acetic acid. These results suggest that carboxylic modification of copper chlorophyllin sodium dye represents a feasible strategy for improving the efficiency and stability of natural dye-sensitized devices, thereby advancing their practical application potential.

T250148

Adaptive Phishing Detection and Mitigation System Using Huawei MindRLHF

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Keywords: Phishing Detection, Reinforcement Learning with Human Feedback (RLHF), Huawei Mindspore, Cybersecurity, Email Security

Abstract:

Phishing remains a persistent cybersecurity threat that leverages deception to bypass traditional defenses. This study presents a phishing detection system that integrates baseline supervised learning with reinforcement learning through human feedback (RLHF) to improve adaptability against evolving attack strategies. Implemented on Huawei MindSpore and deployed on Raspberry Pi hardware, the system was evaluated using a dataset of 135,325 email samples consisting of both phishing and legitimate messages. The baseline supervised model established reliable detection performance, while the RLHF-enhanced model achieved improved adaptability, reaching 96.8% accuracy with balanced precision and recall. A multi-component reward function was designed to incorporate correct classification, human agreement, confidence matching, and consistency, enabling the model to refine its decision boundaries beyond automated optimization. Real-time monitoring and feedback were facilitated through a hardware-integrated LCD interface. Results confirm that RLHF not only enhances phishing detection accuracy but also reduces false positives and false negatives, making the approach suitable for practical deployment. The findings highlight the potential of human-centered reinforcement learning to strengthen the resilience and scalability of phishing mitigation systems against emerging cyber threats.

T250151

Visual scaffolding instruction strategy to enhance students' programming learning outcomes

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Keywords: visual thinking, flowchart, programming, learning motivation

Abstract:

In the digital age, computational thinking is considered a crucial thinking skill. Learning computer programming can help students develop computational thinking. This study designs a learning method based on cognitive development to guide students in programming. This teaching approach takes a "visual" approach; visualizing programming concept and how to program.Using scaffolding instruction strategy, we shift from visual support for learning programming concepts to support for learning programming implementation. Through visualization and flowcharts of programming language and example programs, this method teaches students to construct the connection between program and visual, then can analyze program logic, and enter the field of programming design. This study primarily focuses on enhancing student motivation and examine teaching outcomes related to motivation and learning outcomes. Results from this method demonstrat significant improvements in student motivation and academic achievement. Among the motivation of students, confidence and attention are most effective. Furthermore, the visualization approach is shown to help students focus their attention, reduce course difficulty, and enhance the effectiveness of learning. In summary, this visual scaffolding learning strategy can enhance students' motivation to learn programming and improve their academic performance.

T250152

AI-Based Video Analysis of Forearm Pass Sequence in Volleyball

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Keywords: Volleyball, AI-Based Video, Forearm Pass

Abstract:

The forearm pass sequence is a fundamental volleyball skill, essential for defense and serve reception. This technique requires precise coordination between posture and timing to ensure accurate ball redirection. With the rapid development of artificial intelligence and computer vision, video analysis methods—such as pose estimation and object tracking—have become feasible tools in sports training. These technologies can objectively capture key postural and dynamic information during athletic movements, assisting coaches and athletes in performance analysis.

In this study, we propose an AI-assisted motion analysis system using one high-speed camera and a laptop, positioned diagonally behind the athlete to record the execution of consecutive forearm passes. Ideal form includes: (a) fully extended arms, pressed-down wrists, a 90-degree angle between arms and torso, and forward-leaning posture at the start, (b) contact with the ball just behind the wrist joint, and (c) synchronization of body weight shift with the ball's motion rhythm. We employ the YOLO algorithm to detect the volleyball and extract joint positions—shoulders, elbows, wrists, hips, knees, and ankles—to evaluate conformity with the three aforementioned criteria.

Five female collegiate athletes participated in the experiment, each performing 10 trials. The analyzed results were compared with manual frame-by-frame video inspection. The system achieved an accuracy rate exceeding 95% in assessing movement correctness, indicating high reliability. This method provides practical feedback for both elite athletes and novice learners. It is especially suitable for physical education settings, where real-time guidance and correction can greatly enhance skill acquisition. Future applications include expansion to other sports techniques and integration into intelligent sports training platforms, contributing to the digital transformation of physical education and athletic development.

T250153

WSI/LSMO Bilayer Thin Films Studied by Laser Scanning Spectroscopy

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Keywords: 2D materials, heterostructures, nonlinear spectroscopy, time-resolved spectroscopy, laser scanning spectroscopy

Abstract:

Two-dimensional materials have been extensively studied in recent years, particularly for their remarkable optoelectronic properties that emerge when stacked at different twist angles, already showing the potential for optoelectronic device applications. Similar phenomena can be anticipated when two-dimensional materials are stacked on strongly correlated oxides. In this work, we investigate the case of WS_2 stacked on $La_{0.3}Sr_{0.7}MnO_3$, where we recently observed angle-dependent second-harmonic generation (SHG) polarization effects, reminiscent of those found in twisted WS_2/WS_2 systems. Using Raman spectroscopy and time-resolved pump–probe measurements, we explore the underlying interactions between WS_2 and $La_{0.3}Sr_{0.7}MnO_3$. In the time-resolved spectra, we observe the expected excitonic response of WS_2 upon absorption of 620 nm excitation, which provides further opportunities to probe the interfacial coupling between WS_2 and $La_{0.3}Sr_{0.7}MnO_3$. In addition, given the large volume of data, we develop reliable Python-based automated methods for laser spectroscopy analysis.

T250154

Design an Intelligent Notification Mechanisms and Workflow for a Legacy PLC system

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Keywords: PLC, n8n, smart manufacturing alarm system

Abstract:

In traditional manufacturing environments, the reporting of machine abnormalities or production line conditions often relies on manual inspections or a single monitoring system for recording. However, these methods are prone to delayed responses and insufficient information delivery, which can easily lead to untimely maintenance, thereby affecting production efficiency and line stability.

To address this issue, this study proposes a real-time alarm and data management framework, integrating the workflow automation platform n8n with Programmable Logic Controllers (PLCs). The system acquires data via the RS-485 industrial communication interface using standard protocols, and stores the collected status information in a SQL Server database for management. Finally, it employs messaging software APIs as the alert channel to achieve automated, traceable, and real-time abnormality notifications.

This framework features low cost, rapid deployment, cross-platform integration, and high flexibility. Its operational flow is as follows: when the PLC detects an abnormality or when monitored values exceed thresholds, the data is transmitted to the host computer via RS-485 communication and immediately written into the database. n8n then periodically reads the database records to perform logical judgment and workflow control, triggering notifications through messaging software and sending messages containing event time and machine information to maintenance personnel. Meanwhile, the database continuously preserves complete historical records, supporting trend analysis, report generation, and decision-making assistance, thereby providing a long-term foundation for monitoring and production line optimization.

T250155

Applying Model Context Protocol for Offline Small Language Models in Industrial Data Management

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Keywords: Model Context Protocol (MCP), Small Language Models (SLMs), Offline Industrial AI, Manufacturing Data Management, Smart Factory / Industry 4.0

Abstract:

In recent years, Large Language Models (LLMs) have shown strong capabilities in contextual reasoning and knowledge retrieval. However, their application in industrial domains is hin-dered by concerns over data security, reliance on cloud infrastructure, and high operational costs. To address these challenges, this study explores the use of the Model Context Protocol (MCP) as a middleware framework that enables the deployment of offline-operable Small Language Models (SLMs) for manufacturing data processing. MCP standardizes interactions between het-erogeneous shop-floor data sources—such as sensors, Manufacturing Execution Systems (MES), and time-series databases—and language models, allowing secure and structured access without exposing proprietary infrastructure. With MCP, SLMs can perform local computation to provide contextualized summaries, anomaly detection, and performance analytics while maintaining low computational requirements and full data locality. This eliminates dependency on cloud-based LLMs and mitigates associated risks. The paper further discusses the implementa-tion of MCP in factory environments, its integration with industrial data pipelines (MQTT, OPC-UA, MES), and evaluates its benefits in terms of security, cost-effectiveness, and real-time decision support. Results demonstrate that the proposed approach offers a feasible and practical pathway for deploying intelligent assistants in manufacturing without reliance on large-scale external AI services.

T250156

Mediating Pathways to Organizational Sustainability: An Examination of Green Human Capital, Employee Environmental Awareness, and Sustainable Innovation

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Keywords: Green Human Capital, Organizational Sustainability, Employee Environmental Awareness, Sustainable Innovation

Abstract:

The increasing global environmental challenges, including climate change, resource depletion, and pollution, demand a thoughtful shift in organizational and management practices towards sustainability. Stakeholder demands for corporate accountability emphasize the importance of environmental and social performance in long-term success and competitive advantages, surpassing purely financial metrics. Human capital is a crucial asset in today's business landscape, as employees drive green initiatives, innovation, and sustainable practices within organizations.

This study explores the interaction between the Green Human Capital, Employee Environmental Awareness, and Sustainable Innovation in enhancing Organizational Performance and Organizational Sustainability.The primary objective of this study is to determine the mediating role of Employee Environmental Awareness in the relationship between Green Human Capital and Organizational Performance, and to determine the mediating role of Sustainable Innovation in the relationship between Green Human Capital and Organizational Performance.

A quantitative research design was employed in this study, utilizing a cross-sectional survey approach to collect self-reported data from a diverse sample of employees. Data collected using validated scales for all constructs. Structural Equation Modeling (SEM) will be utilized for data analysis, given its robustness in assessing complex causal relationships and multiple pathways simultaneously using the SMARTPLS 4.

The findings of the study reveal SI is a crucial conduit from GHC to OP. Businesses can use the expertise of their people to create innovative, environmentally friendly goods, services, and procedures that enhance both financial and environmental results by aggressively encouraging and rewarding sustainable innovation. The study model shows a direct link from the organizational performance (OP) to organizational sustainability (OS). In making sustainable practices profitable and efficient, companies must ensure that the environmental efforts in their institutions are financially viable and scalable, safeguarding a more sustainable future.

T250158

Determining the Freshness of Milkfish (Chanos chanos) using Electronic Nose

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Keywords: KNN Algorithm, Electronic Nose, Gas Sensors, Milkfish

Abstract:

Milkfish (Chanos chanos), a widely consumed fish in the Philippines, is highly perishable, and conventional freshness assessments based on physical and olfactory inspection are often subjective and unreliable. To address this, this study introduces an electronic nose system designed for the objective classification of milkfish freshness based on spoilage-related gas emissions, namely methane, ammonia, hydrogen sulfide, and trimethylamine. The system integrates MQ-series and TGS gas sensors with an Arduino Nano and a Raspberry Pi 5 for data acquisition and signal processing. The k-Nearest Neighbor (k-NN) algorithm was used for classification, and its performance was evaluated using a confusion matrix. Data was gathered from 100 samples, consisting of 50 fresh and 50 spoiled fish. The evaluation demonstrated a peak classification accuracy of 92% for k-values between 1 and 15, confirming the system's reliability. These findings indicate the system's potential as a practical, low-cost, and efficient tool to enhance consumer safety and quality assurance in the fish supply chain.

T250159

Surface rejuvenation model for transient convection-diffusion problem

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Keywords: Surface rejuvenation model, Deposition velocity, Particle deposition

Abstract:

A previous paper gave an account of the surface rejyvenation model of calculating the deposition velocity of neutral and/or precharged particles from dilute turbulent flowing suspensions to adjoining surface. The purpose of this work is not intended to promote a new tool for predicting particle deposition, but to gain more physical knowledge on the interaction between individual transport mechanisms that dominate the particle deposition process.

T250161

Automated IoT-based Water Quality Monitoring and Control with Fuzzy Logic for Intensive Aquaculture of Oreochromis niloticus

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Keywords: Internet of Things (IoT), Fuzzy Logic, Water Quality Monitoring, Automated Control System, Intensive Aquaculture

Abstract:

The BFAR Tilapia Industry Roadmap (2022–2025) highlights the need for engineering and technological innovations to enhance aquaculture in the Philippines. Unlike previous IoT aquaculture studies, which often monitored or controlled only selected parameters but not all critical water quality factors in a single integrated system, this study uniquely applies fuzzy logic–based decision-making for dynamic adjustment of tilapia culture conditions. An automated IoT-based monitoring and control system was developed for the intensive aquaculture of Oreochromis niloticus, integrating sensors for ammonia, dissolved oxygen (DO), total dissolved solids (TDS), turbidity, temperature, pH, and time/date to provide real-time monitoring. A fuzzy logic algorithm manages aeration, filtration, water replacement, and temperature regulation to maintain optimal conditions. The system is connected to an IoT framework, allowing remote access through a web-based interface that displays parameter values, system status, and overall water quality. Experimental evaluation compared the proposed system with a conventional aquaculture setup. Results demonstrate that the automated IoT prototype provides precise monitoring and adaptive control of water parameters, leading to improved consistency and greater dependability of the aquaculture environment. Furthermore, experimental results indicate reduced fish mortality and enhanced growth performance under the proposed system. By combining automation, IoT connectivity, and fuzzy logic, the developed prototype offers an innovative and practical solution for fish farmers, promoting efficiency, sustainability, and productivity in Tilapia aquaculture.

T250162

Design and Implementation of an Intelligent Embedded System for Green-Energy Power Monitoring and Remote Control

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Keywords: Smart power monitoring, embedded systems, mesh networks, remote monitoring, energy management.

Abstract:

This study details the design and implementation of an intelligent green-energy power monitoring and remote-control system utilizing an embedded microcontroller. The system integrates power parameter measurement, environmental sensing, mesh-network communication, and cloud synchronization functionalities. A Microchip PIC18 microcontroller serves as the central processing unit, acquiring real-time voltage and current data, which are subsequently converted and processed via the on-chip analog-to-digital converter and computational modules to derive instantaneous power values. Sensor data are transmitted through UART to a primary wireless module and aggregated with temperature and humidity data from additional nodes within a mesh-network framework. The consolidated data are then synchronized with a cloud platform to facilitate remote visualization and multi-point monitoring. Furthermore, the system supports real-time display via an OLED screen and physical key controls, offering both local and remote user interfaces. Experimental evaluations indicate that the system maintains data stability and achieves a low packet-loss rate under diverse wireless interference conditions. Owing to its high scalability and low power consumption, the system is suitable for applications in smart-home environments, industrial power monitoring, and renewable energy management. The proposed architecture underscores the potential of embedded systems to deliver cost-effective and reliable power-monitoring solutions, thereby advancing energy conservation, carbon footprint reduction, and the digitalization of energy management.

T250163

Designing a Novel Language and Implementing Speech Recognition with Teachable Machines

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Keywords: Language learning apps, Google Teachable Machine, similar sounding words

Abstract:

Accurately assessing pronunciation remains one of the most formidable challenges in language acquisition. Predominantly, current mainstream online learning platforms depend on automatic speech recognition (ASR) systems based on Hidden Markov Models or deep neural networks, which utilize rudimentary string-matching techniques to classify input speech as either "correct" or "incorrect." These methods exhibit limited sensitivity to tonal and phonemic nuances. This limitation is especially pronounced in the context of the Chinese language, where the four tonal variations not only alter lexical meanings but also frequently lead to misunderstandings during oral communication. To address these deficiencies, the present study employs a speech database curated specifically for words with similar pronunciations and leverages Google Teachable Machine as the framework for developing a deep learning classification model. The trained model is capable of computing the percentage similarity distribution between a learner's spoken input and multiple candidate words. In contrast to conventional binary scoring approaches, this methodology substantially enhances recognition accuracy and offers Chinese language learners real-time, nuanced pronunciation feedback, thereby mitigating the inadequacies of existing speech recognition systems in delivering precise vocabulary-level evaluations.

T250164

Determination of Animal-based and Plant-based Meat Products with Electronic Nose Using Fuzzy Logic Algorithm

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Keywords: electronic nose, fuzzy logic, MQ gas sensors, volatile organic compounds (VOCs), plant-based meat

Abstract:
The increasing global demand for plant-based meat alternatives, driven by concerns for environmental sustainability, animal welfare, and health, has led to a growing need for reliable food authentication methods. Animal-based and plant-based meat products are often visually similar, which poses a challenge for consumers to distinguish them. This paper proposes a solution by developing an electronic nose (e-nose) system with an array of MQ gas sensors (MQ-2, MQ-3, MQ-7, MQ-135, MQ-136, MQ-138), an Arduino MEGA microcontroller, and an LCD for displaying results. A fuzzy logic algorithm was implemented to process sensor data and enable decision-making through membership functions and IF-THEN rule evaluation to classify meat products as either "Animal Meat" or "Plant-based Meat". The system performance was validated with 20 independent test samples. Determination accuracy for both categories, as well as the overall accuracy, was assessed using a confusion matrix. The findings demonstrate that the e-nose system can reliably distinguish between animal-based and plant-based meat products.

T250165

Laying Hens Behavior Recognition using Computer Vision and Deep Learning

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Keywords: laying hen, hen behavior, computer vision, deep learning, YOLOv11

Abstract:

Native chicken production in the Philippines is growing, as it accounts for almost half of the total population of raised chickens. Health-conscious consumers prefer native chicken because it has less fat. To increase native chicken production, the government established a breeding facility. The new breeding facility features 10 pens, each containing 2 to 6 laying hens and a rooster, which they began using in November 2023. In the past months, the staff observed a decrease in laying performance of some pens. Chicken behavior is one of the key indicators in understanding the growth and production performance. The objective of this study is to implement a real-time laying hen activity recognition system using YOLOv11 (You Only Look Once version 11) to classify laying hen behaviors into multiple activity categories such as active behaviors (walking, eating, drinking, pecking, dust bathing and preening), inactive behaviors (inactive or resting states), and environmental objects (chicken feeder and water can). The data set of 464 images of the laying hens was obtained in the breeding facility in Zamboanga City, Philippines. To capture the laying hen behavior, a TP-Link Tapo C510W outdoor WiFi camera was mounted on the ceiling 80 cm above the ground. The model has excellent performance on detecting static objects (i.e., feeders and water cans). It identifies pecking and walking as the most common behaviors, and drinking and dust bathing as rare behaviors. The YOLOv11-based chicken activity recognition system successfully demonstrates real-time behavior classification with strong performance on most activity classes. The system achieves 95% mAP50 with excellent detection of static objects and distinctive behaviors, while providing a foundation for future enhancements in challenging behavior recognition.

T250166

Defect Identification of Trinitario Cacao Beans Using ResNet-50 for Quality Control

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Keywords: ResNet-50, Deep Learning, Cacao Bean Quality Control, Trinitario Cacao, Defect Identification

Abstract:
The quality of cacao beans is pivotal to consistent chocolate production, yet defective beans can cause up to 20–40% yield loss, significantly lowering both economic value and final product quality. Manual inspection remains labor-intensive, variable, and unable to keep pace with rising demand, motivating the need for automation. This study presents a deep learning approach for automated defect identification in Trinitario cacao beans using a ResNet-50 image classifier. A dataset of 500 single-bean crops extracted from annotated images was prepared across five classes—moldy, slaty, germinated, dried-fermented, and over-fermented. Pre-processing consisted of resizing to 224×224, ImageNet normalization, and standard ImageNet pre-processing with light augmentations for robustness.
The model was initialized with ImageNet weights and fine-tuned using class-balanced sampling, label smoothing, AdamW with cosine learning-rate scheduling, and validation-based checkpointing. Data were split stratified 80/10/10 into train/validation/test. Performance was evaluated using mean Average Precision (mAP) in a one-vs-rest framework, with results of macro mAP = [0.9630], micro mAP = [0.9422], and weighted mAP = [0.9624]. The strongest class was germinated beans (AP = 1.000), while the weakest was over-fermented (AP = 0.9052). Confusion matrix analysis showed residual errors concentrated between fermented categories, likely due to overlapping visual cues and subtle texture similarities. This is the first study to demonstrate that a ResNet-50 can reliably discriminate between multiple defect categories in Trinitario cacao beans, enabling potential deployment in inline quality control. The approach offers a scalable alternative to manual inspection, reducing labor demands, improving throughput, and ensuring greater consistency in cacao quality assessment.

T250168

A Data-Driven LSTM Framework for Servo System Modeling and Optimization

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Keywords: Data-driven modeling, Servo system, LSTM network, Tracking error, Parameter optimization

Abstract:
This paper proposes a data-driven modeling approach for servo systems using Long Short-Term Memory (LSTM) networks. Key data including velocity, acceleration, jerk, and tracking error are collected to build a neural network model capable of predicting tracking error directly from interpolation commands. Compared to traditional servo system modeling which requires system identification, controller design, and friction modeling, the proposed method eliminates these complex steps and substantially reduces modeling time. Experimental results demonstrate that the LSTM-based model accurately predicts servo tracking performance and provides a fast evaluation tool for interpolation parameter optimization. This approach avoids the need for executing time-consuming test trajectories and improves parameter tuning efficiency. The proposed method offers a practical and efficient alternative to traditional physical modeling and optimization in smart manufacturing applications.

T250169

Enhancing Textual Description and Image Expression through Scenario Storytelling with Generative AI Support

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Keywords: Generative AI, Scenario Storytelling Method, Textual Description Ability, Image Generation, Design Education

Abstract:

Generative AI (GenAI) has become an essential tool for supporting design thinking and visual expression. Designers must possess strong communication and descriptive writing skills to collaborate effectively with GenAI. However, interior design students often lack complete and precise textual descriptions, resulting in fragmented design explanations that fail to fully convey spatial details and user scenarios, thereby affecting design outcomes. This study explores the application of the scenario storytelling method in spatial design and employs GenAI as an auxiliary design tool to analyze its impact on learners' textual descriptions and image outputs. Using a pre- and post-comparison approach, the research collected and analyzed students' textual and visual works before and after applying the scenario storytelling method. The textual inputs covered users, behaviors and habits, time, spatial contexts, and furniture or equipment. Evaluation indicators were divided into two main dimensions: text and images. For text, the focus was on richness and diversity, originality and uniqueness, and refinement of details; for images, the assessment emphasized problem solving, functional requirements, and spatial atmosphere. The results indicate that the scenario storytelling method effectively enhances the depth and diversity of learners' textual descriptions and further improves the quality of AI-generated images. The method not only strengthens problem solving and functional performance but also enriches the creation of spatial ambiance with a higher level of design quality. In conclusion, integrating GenAI with the scenario storytelling method can broaden and deepen designers' thinking, enhance their verbal expression and image generation capabilities, and provide practical insights for cultivating expressive and design competence in design education.

T250170

Prime Number Generator based on Chaotic System and FPGA Implementation

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Keywords: Chaotic System, RSA, FPGA, Encryption

Abstract:

With the growing importance of personal information security, numerous methods have been proposed for data encryption. To ensure system safety, it is critical to maintain ciphers that are both unpredictable and robust. In modern RSA encryption systems, two prime numbers are required for key generation, and their randomness and unpredictability are essential for security. In this study, we propose a secure system for generating the prime numbers used in RSA encryption. The inherent properties of chaotic systems are employed as a Pseudo Random Number Generator (PRNG), while a Ring Oscillator is utilized as a True Random Number Generator (TRNG). The Miller–Rabin algorithm is further applied to verify the primality of numbers produced by the PRNG. The entire design is implemented on a Field Programmable Gate Array (FPGA) to achieve a fully hardware system.

T250171

Hardware-in-the-Loop Simulation of a CAN-Based Battery Management System for Electric-Powered Emergency Response Boats

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Keywords: Battery Management System (BMS), Controller Area Network (CAN), Electric-Powered Emergency Boats, Hardware-in-the-Loop (HIL), Flood Rescue Operations

Abstract:
This paper presents a hardware-in-the-loop simulation of a battery management system (BMS) in which controller area network (CAN) is applied as the central communication backbone for electric-powered emergency response boats used in flood rescue operations. Communication reliability is as critical as battery safety, wherein signals must remain accurate and immune to interference to protect both equipment and crew. A lithium iron phosphate (LiFePO4) battery pack and discharge motor/charger subsystem were modeled in MATLAB Simulink and Simscape, while the BMS monitored operating values: voltage, current, temperature, and state of charge (SoC). Additionally, an STM32 Nucleo F446RE microcontroller was co-run with the virtual model in a hardware-in-the-loop setup, handling CAN messaging in real time. Results show that CAN performs particularly well for rescue scenarios. Arbitration ensured that life-critical warnings such as over-temperature and over-current events overrode routine data, allowing protective actions without delay. Error detection and retransmission preserved data integrity even under injected disturbances, reflecting the noisy and unpredictable environments of flood operations. Moreover, bus utilization analysis confirmed that urgent signals maintained low latency without disrupting continuous SoC tracking, enabling both safety and endurance management during extended missions. By guaranteeing that alarms are never lost and that monitoring remains uninterrupted, CAN reduced operator error risk and improved situational awareness under high-pressure conditions.

T250172

Campus-Scale Real-Time Waste Classification on Raspberry Pi 5 Using YOLOv8

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Keywords: YOLOv8, Deep Learning, Object Classification, Raspberry Pi 5, Waste Segregation

Abstract:
A deep learning–based waste detection system was developed for campus-scale use at Mapúa University to address improper waste disposal. The system runs YOLOv8 on a Raspberry Pi 5 with a Raspberry Pi Camera v3 to detect five classes: paper, plastic, metal, food waste, and e-waste. The dataset, with an 80/10/10 split, was expanded to 3,718 images at 640×640 through standard geometric and photometric augmentations using Roboflow. After evaluating multiple YOLOv8 variants (n/s/m/l), YOLOv8n was chosen for its highest results across evaluation metrics, demonstrating the best balance between accuracy and efficiency. Trained and evaluated under this setup, the model achieved an mAP50 of 0.990, an mAP50–95 of 0.974, and precision and recall of 0.980 on the held-out validation set. Per-class mAP50 scores were 0.995 for plastic, food waste, and metal, 0.987 for e-waste, and 0.973 for paper, with the best operating point reaching an F1 score of 0.980 at a confidence level of 0.827. These results indicate that the system is suitable for campus-scale deployment, helping reduce contamination at the source and enabling earlier intervention in waste sorting.

T250174

Thread Counter using AlexNet for Philippine Indigenous Textiles

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Keywords: Automated thread counting, fabrics, CNN, Philippine indigenous fabrics,, Kalinga, Piña, Raspberry Pi 4, Arducam, AlexNet,, Portable, textile, analysis, Image-based evaluation, cultural preservation, quality assessment

Abstract:

We have been using Thread counting to assess the quality and density of woven materials. This task has technical and cultural significance for Philippine indigenous textiles like Kalinga and Piña. However, counting threads by hand remains a time-consuming and error-prone operation that requires specialist equipment that many weavers lack. This paper provides an alternative: a portable system that automates thread counting using a Raspberry Pi 4, an ArduCam 64MP autofocus camera, and AlexNet, a convolutional neural network.

The study collected 600 textile photos, evenly split between Kalinga and Piña samples, under various situations to ensure adequate training and testing. Then, the images are processed to see thread structures, and the AlexNet counts warp and weft threads. The results are displayed on a screen, allowing users to assess fabric in real-time.

Initial tests indicate that the system can match or surpass manual counting with an accuracy rate above ninety percent, while completing analysis within just a few seconds per sample. The device supports quality control in the textile industry and is a tool for archiving indigenous fabrics in a digital form. The approach can be extended to other textile types with refinements and expanded to detect weaving defects or other materials. By merging AI and portability, this study provides both a technical solution and a contribution to sustaining cultural heritage.

T250175

Residential Smart Energy Meter with Load Forecasting using LSTM and Overload Protection

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Keywords: Smart Energy Meter, Internet of Things(IoT), Load Forecasting, Long Short-Term Memory (LSTM), Overload protection

Abstract:

The rapid increase in residential electricity consumption in the Philippines has underscored the need for accurate metering, predictive forecasting, and improved protection against electrical hazards. This paper presents the design and implementation of a Residential Smart Energy Meter with Load Forecasting using Long Short-Term Memory (LSTM) and integrated overload protection. The proposed system employs non-invasive SCT013 current sensors and a ZMPT101B voltage sensor interfaced with a Raspberry Pi to measure consumption across four residential branch circuits. Data is transmitted to a cloud-based dashboard for real-time monitoring, while a relay module automatically disconnects loads under overload conditions following IEC inverse-time trip characteristics. To validate accuracy, the prototype was deployed for one billing cycle and recorded 789.318 kWh compared to 746 kWh from the utility meter, resulting in a 5.80% error. The LSTM model, trained on hourly consumption data with calendar features, achieved strong predictive performance across circuits, with RMSE values ranging from 0.0102 to 0.0393, MAE values between 0.0062 and 0.0278, and R^2 values above 0.98. Overload protection tests demonstrated reliable tripping behavior within 6–23 seconds depending on current thresholds. Results confirm that the system provides accurate energy monitoring, reliable overload protection, and robust short-term load forecasting. The prototype demonstrates a cost-effective and scalable approach for enhancing residential energy management, safety, and forecasting in Philippine households.

T250180

Research on the dual application of Low-E glass and helium in buildings to isolate heat sources and improve the environment.

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Keywords: Low-E glass, Helium, Environment

Abstract:
This study conducts an in-depth discussion on the topic, which is a professional and in-depth research topic involving the comprehensive application of building energy-saving materials and technologies, the content combines theoretical foundations, technical mechanisms, experimental data, application challenges and future directions, this study will analyze the following core mechanisms, regarding low-emissivity Low-E insulating glass, technical details are provided, and the differences between Low-E glass and clear glass in terms of indoor comfort and air-conditioning power consumption are analyzed, the results show that the use of Low-E glass can reduce the amount of solar heat entering the room and reduce air-conditioning power consumption by approximately 16%, it also provides a comprehensive introduction to architectural glass insulation methods, including Low-E coating, multi-layer glass, and thermal insulation film, it also provides how to distinguish between true and false Low-E glass and why true Low-E with good insulation must be multi-layer glass, it also discusses the analysis and application of inert gas in insulating glass and details the working principle, types, and advantages of Low-E glass.

T250181

Class Identification Tasks Based on Large Language Models: A Choice Between Classification and Generation

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Keywords: Large Pre-trained Language Models, Entity Class Classifier, Sentence-level Classi-fication

Abstract:
Large-scale pre-trained language models have been widely applied to Knowledge Graph Question Answering (KGQA). Prior research shows that combining suitable models with carefully designed input–output structures can significantly improve Text-to-SPARQL generation, achieving F1 scores above 90%. However, error analyses reveal persistent issues, including entity translation, entity position, and RDF triple number errors, with the latter accounting for 24% of all errors. Nearly 90% of these number errors occur when triples involve class entities. To address this, we explore the use of prompts in large language models to reduce generation errors by providing accurate information such as instructions, examples, or knowledge.

We focus on automatically enriching prompts with class-entity-related information and propose two classification tasks: (1) determining whether a question contains a class entity, and (2) predicting the required number of RDF triples. In the LC-QuAD dataset, class entities occur only in single triples; thus, the first task identifies their presence, while the second mitigates quantity prediction errors.

We evaluate encoder-based and generative strategies. For encoder-based models, we adopt BERT and RoBERTa, as well as Sentence-BERT with mean pooling for richer sentence embeddings and fine-tuned variants for comparison. For generative models, we use Flan-T5, framing classification as constrained label generation, and also extract its encoder for fair comparison. By aligning encoder-only and encoder–decoder models under a unified pooling framework, we conduct a systematic evaluation.

The results show that generative models slightly outperform encoder-based models, indicating that applying generative approaches to classification tasks yields higher prediction accuracy and more reliable information, thereby improving the quality of Text-to-SPARQL generation.

T250182

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Keywords: NLP, LLM, in-context learning, fine-tuning, KGQA, Text-to-SPARQL , RDF triples.

Abstract:
Large Language Models (LLMs) demonstrate strong multi-task abilities through In-Context Learning (ICL) which enables few-shot learning without extensive fine-tuning. In Knowledge Graph Question Answering (KGQA), where natural language queries must be translated into structured queries such as SPARQL, ICI has been applied but often relies solely on semantic similarity for example selection, overlooking structural properties that may affect performance.

We hypothesize that incorporating structural features can enhance ICL effectiveness. To test this, we simplify SPARQL queries into RDF triple sequences and classify training data by structural type. We then compare four strategies: (1) fully random, (2) semantic similarity only, (3) same-type random, and (4) same-type semantic similarity.

Experiments on LC-QuAD 1.0 using Flan-T5 under zero-, one-, and few-shot settings show that, without fine-tuning, same-type semantic similarity achieves the best few-shot performance, underscoring the importance of structural consistency. After fine-tuning, performance improves as the number of examples increases, but strategy differences narrow: fully random is best at 1-shot, while semantic similarity only is best at 3-shot. This indicates that, once fine-tuned, models benefit more from diversity or semantic relevance than structural constraints.

In conclusion, structural and semantic integration is crucial for non-fine-tuned models, while diversity and semantic similarity dominate after fine-tuning, offering practical insights for ICL-based KGQA.

T250183

Divergent Strategies in the EV Battery Supply Chain: A Comparative Textual Analysis of Japanese and Chinese Automakers

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Keywords: ESG, Electric Vehicle (EV), Text Mining

Abstract:

As the automotive industry pivots to electrification, the battery supply chain has emerged as a central battleground for competitive advantage and geopolitical influence. However, how key national players strategically position themselves within this arena remains poorly quantified. This study addresses this gap by quantitatively comparing the discursive strategies of leading Japanese and Chinese automakers. We will employ text mining and content analysis on their corporate ESG and sustainability reports to measure the emphasis placed on critical themes, including resource security, supplier engagement, circular economy models, and next-generation technologies like solid-state batteries. This study hypothesizes a stark divergence in these strategies: we expect that Chinese firms' narratives will be dominated by themes of vertical integration and industrial sovereignty, closely aligning with state policy, while Japanese firms will construct a narrative centered on risk mitigation through global partnerships, responsible sourcing, and technological leadership. By providing an empirical, data-driven map of these competing strategies, this research aims to offer crucial insights for stakeholders navigating the complex geopolitics of the energy transition.

T250185

Threshold Analytics and Computational Approaches to Smart Carbon Pricing

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Keywords: Carbon pricing, carbon taxation, emissions trading scheme (ETS), threshold regression

Abstract:

While carbon pricing—particularly carbon taxation and emissions trading schemes (ETS)—is widely regarded as a cost-effective instrument for mitigating greenhouse gas (GHG) emissions, its effectiveness is not uniform. Empirical evidence shows that carbon taxation may only achieve significant emission reductions once regulatory and economic thresholds are met. This paper develops a threshold regression and computational framework to identify these critical turning points.

Drawing on panel data for EU member states, we apply Hansen's threshold regression model to examine the nonlinear dynamics between carbon taxation, ETS compliance, and CO_2 emissions. Our results reveal a critical ETS threshold ($\gamma = -0.6301$), beyond which carbon taxation exerts strong mitigation effects, while below the threshold its impact remains statistically insignificant. Additional our findings suggest that pollution taxes and energy consumption policies reinforce emission reductions in the post-threshold regime. By integrating computational analytics with IoT-enabled carbon monitoring systems, the study proposes a pathway to design adaptive, data-driven carbon pricing mechanisms capable of aligning environmental objectives with industrial competitiveness.

The contribution of this research lies in bridging economic policy instruments, and computational science. It demonstrates how threshold-based carbon pricing models, supported by real-time digital monitoring, can enhance the precision and effectiveness of low-carbon transitions.

T250188

FACTORS AFFECTING THE QUALITY OF ONLINE TEACHING AND LEARNING IN HIGHER EDUCATION: A CASE STUDY IN VIETNAM

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Keywords: online teaching and learning, higher education, quality, influencing factors, Vietnam

Abstract:

In the context of Vietnamese higher education being significantly influenced by globalization and the Fourth Industrial Revolution, online teaching and learning have become an inevitable trend, especially since the COVID-19 pandemic. This study aims to identify the factors affecting the quality of online teaching and learning in Vietnamese universities. A mixed-methods approach was employed, combining a large-scale survey of 573 lecturers and students across several universities with 12 in-depth interviews with educational management experts. Quantitative data were analyzed using Cronbach's Alpha, exploratory factor analysis (EFA), and multiple regression, while qualitative data were thematically analyzed to triangulate and enrich the findings. The results revealed five major groups of factors influencing the effectiveness of online education: (1) technological infrastructure and internet connectivity; (2) digital competence and readiness of lecturers; (3) active engagement of students; (4) institutional policies and managerial support; and (5) design of content and online teaching methods. These findings not only provide an empirical basis for understanding the practical implementation of online learning in Vietnam but also offer valuable insights for policymakers and higher education institutions to improve quality, enhance effectiveness, and ensure the long-term sustainability of digital education.

T250189

Solving the k-Hitting Set Problem with Dicke State Quantum Search

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Keywords: Dicke state, Hitting Set Problem, NP-Completeness, Qiskit, Quantum Algorithms

Abstract:

This paper proposes an algorithm, called DSQS-HSP, to generate quantum circuits using Dicke State Quantum Search (DSQS) to solve the k-Hitting Set Problem (k-HSP). The k-HSP is a well-known NP Complete problem, formally defined as follows: given a universe U, a family of subsets $s_1, s_2, ..., s_m$ of U, and an integer k, the task is to determine whether there exists a subset $H \subseteq U$ of size at most k such that $H \cap s_i \neq \varnothing$ for every $i=1,...,m$. The problem has wide-ranging applications, including biomarker selection in bioinformatics, intrusion detection in network security, facility location and resource allocation, feature selection in machine learning, and test case minimization in software engineering.

The proposed DSQS-HSP algorithm leverages the Dicke state $\ket{D_k^n}$ to generate all candidate subsets of U with size k, where the Dicke state $\ket{D_k^n}$ is the equal superposition of n-qubit states with exactly k 1's and the number D of all equal superposition states is $\binom{n}{k}=O(n^k)$, which is polynomial for min(k, n-k) << n/2. An oracle is designed to verify whether a candidate subset forms a valid hitting set. Specifically, for each subset s_i, the oracle checks whether at least one element in the candidate subset belongs to s_i. If so, the candidate subset is called a hitting set and the decision qubit y is set to 1, and the DSQS mirror-readout mechanism reflects the solution to the output register. This approach eliminates the need to traverse the entire solution space as in normal quantum search and enables efficient exploration within the Dicke-state subspace.

We further present a complexity analysis, showing that the required number of qubits and quantum gates grows polynomially with n and m, with improved resource efficiency when min(k, n-k) << n/2. Moreover, we conduct implementation and simulation experiments using the IBM Qiskit packages. The results demonstrate that the quantum circuit generated by the DSQS-HSP algorithm successfully identifies all valid hitting sets, with empirical outcomes consistent with theoretical derivations.

T250190

Application of Constraint Programming with Satisfiability in Nurse Scheduling

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Keywords: OR-Tools, Constraint Programming, Nurse Scheduling, Healthcare Staff Management, Combinatorial Optimization Problem

Abstract:

This paper investigates the application of Google OR-Tools in solving complex staff scheduling problems, with a particular focus on the nurse rostering or scheduling case at a hospital. Nurse scheduling is critical in healthcare staff management and is a well-known combinatorial optimization problem that requires balancing multiple constraints, including labor law regulations, hospital policies, workforce demand, staff preferences, and fairness. By leveraging the OR-Tools Constraint Programming with Satisfiability (CP-SAT) solver, this study develops a scheduling system capable of modeling diverse hard and soft constraints. The proposed system significantly reduces manual scheduling efforts, ensures compliance with labor standards, and improves fairness and staff satisfaction. Comparative analysis with alternative optimization approaches, such as genetic algorithms and simulated annealing, highlights the superior constraint-handling capability and efficiency of OR-Tools. Experimental results confirm that the system achieves high-quality schedules within reasonable computational time, providing practical value for healthcare institutions and potential applications in other industries.

T250191

Automatic Packet Reporting System (APRS) Payload Design for the Development of Backup Communication System and Disaster Risk Reduction Management

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Keywords: APRS, Digipeating (DP), AX.25 Protocol, APRS Packets, APRS Payload

Abstract:

This study presents the development of two distinct APRS payload designs aimed at establishing a more reliable backup communication system to support disaster risk reduction and management efforts in the Philippines. The payloads are designed to perform a significant key operation, primarily APRS Digipeating (DP), enabling continuous communication access even in areas where conventional ground-based infrastructure has been severely damaged by natural disasters through relay of APRS packets to extend communication coverage. A detailed framework outlining the communication system setup using the standard amateur packet radio (AX.25 protocol). It specifies the structure of APRS data frames and packets, which are used to transmit alerts, emergency status updates, and text messages (SMS). This structure ensures that important information is transmitted reliably and effectively during an emergency. The presented designs for both the APRS payloads share a common overall operation system architecture but differ in their VHF transceiver modules used for the amateur radio (BiM1H and DRA818V). The research analyzes the modules' performance, with a focus on their ability to transmit and receive emergency data. The inclusion of the DRA818V module is notably assessed for its advancements over the BiM1H, highlighting improved communication reliability and system robustness. Overall, this research illustrates APRS's promise as a robust communication method during disasters. By comparing the two payload designs, it provides vital insights on optimizing amateur radio gear for emergency communication, resulting in more effective disaster response and management in susceptible areas.

T250192

Dicke State-Initialized Grover's Algorithm for Solving the Hitting Set Problem

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Keywords: Dicke state, Grover's algorithm, Hitting set problem, NP completeness, Quantum search

Abstract:

The k-Hitting Set Problem (k-HSP), or simply the Hitting Set Problem (HSP), is a NP-Complete (NPC problem with broad applications in optimization, computational biology, and network design. The k-HSP is formally defined as follows: given a universe U, a family of subsets $s_1, s_2, ..., s_m$ of U, and an integer k, the problem is to determine whether there exists a k-hitting set, a subset $H \subseteq U$ of size at most k such that $H \cap s_i \neq \varnothing$ for every $i=1,...,m$. In this paper, we propose a quantum algorithm that integrates Dicke state initialization with Grover's algorithm, a well-known quantum search algorithm, to efficiently solve the HSP by finding all hitting set of size k. By preparing the initial superposition as the Dicke state $\ket{D^n_k}$, our method restricts the search space to subsets of fixed size k, thereby reducing the number of candidate states from 2^n to $\binom{n}{k}$. This significantly decreases the computational overhead and removes the need for explicit size-checking mechanisms, such as quantum counters. We further introduce a quantum flag mechanism to simplify oracle construction, along with a redesigned diffuser adapted to the Dicke state basis, which ensures effective amplitude amplification of valid hitting sets. The resulting algorithm achieves a oracle-call complexity of O$(\sqrt{\binom{n}{k}})$, which is of polynomial O(n^k) when $k \ll n/2$. To validate the feasibility of our algorithm, we conduct proof-of-concept experiments using IBM Qiskit packages. The experimental results confirm that the algorithm can identify valid hitting sets with high probability.

T250193

Decomposition of Large-Scale QUBO Problems for Quantum Annealers and Quantum-Inspired Annealers

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Keywords: One-Way-One-Hot Constraint, Problem Decomposition, Quantum Annealer, Quantum-Inspired Annealer, Quadratic Unconstrained Binary Optimization (QUBO)

Abstract:

Quadratic Unconstrained Binary Optimization (QUBO) has become a central formulation model for a wide range of combinatorial optimization problems (COPs), including the maximum cut, 0/1 knapsack, graph coloring and traveling salesperson problems. With QUBO formulation, COPs can be solved by quantum annealers, such as D-Wave Advantage, and quantum-inspired annealers, such as Fujitsu Digital Annealer and Compal GPU-based Quantix. However, the growth in problem size and the presence of complex constraints lead to extremely large QUBO matrixes, posing major challenges for direct solving COPs with annealers. In this paper, we propose a problem decomposition framework that transforms large and constrained QUBO formulations into smaller, manageable (or executable) subproblems. These subproblems are solved independently by quantum annealers or quantum-inspired annealers, and subsequently integrated to reconstruct final solutions. The framework focuses on one-way-one-hot constraints, which are decomposed into parallelizable and manageable subproblems to make large-scale QUBO problems solvable by annealers and be solved with significantly reduced variable counts and annealing time. We perform experiments on Compal Quantix with benchmark datasets of the 0/1 knapsack problem. Experimental results shows that the proposed decomposition framework enables Quantix to recover optimal or near-optimal solutions for problem instances that are otherwise intractable. This study highlights the effectiveness of combining decomposition strategies with annealers as a scalable approach for solving large-scale QUBO problems.

T250194

A study of the influencing elements of city street environments to alleviate mental stress

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Keywords: City street environment, City sustainability, stress relief, psychological experience, aesthetics

Abstract:

The concept of sustainable cities encompasses not only environmental concerns but also extends to the physical and mental well-being of residents. Urban design, particularly the structuring of street environments, plays a crucial role in alleviating stress and promoting public health when it emulates the qualities of natural settings. The present study adopts a multifaceted methodology, incorporating semi-structured interviews, semantic differential analysis and a seven-point imagery scale, to explore the influence of street life on emotional states. The case study focuses on Zhongshan Road in Chiayi City. Furthermore, field perceptual experiments, environmental feature extraction, and video recording were conducted to analyse correlations between specific street characteristics and psychological well-being. The findings identify several key environmental factors that significantly affect mental health: green space ratio, vehicle presence, walkability, environmental complexity, building enclosure, facility distribution, sky visibility, facade transparency, proportion of slow events, and color richness. The present study found vehicle presence and excessive environmental complexity to be positively correlated with feelings of boredom, while facade transparency was found to be positively correlated with engagement. Moreover, a higher ratio of green space and building enclosure has been demonstrated to be associated with heightened interest. The results of this study demonstrate that street environments exert a measurable psychological impact on well-being, either fostering or diminishing it, depending on their configuration. Beyond the empirical insights yielded by the study, its findings are closely aligned with the broader objectives of sustainable urban development. The expansion of green spaces and the prioritisation of pedestrian-friendly street design have been identified as key strategies for reducing carbon emissions and enhancing sustainability.

T250195

Artificial Intelligence Mathematical Foundations and Models: Cross-domain Applications in UAVs and Autonomous Vehicles

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Keywords: Artificial Intelligence, Deep Learning, Autonomous Vehicle, Mathematical Foundations

Abstract:

Artificial Intelligence (AI) and Machine Learning (ML) have advanced rapidly, yet their theoretical underpinnings remain incomplete. This paper proposes an integrated framework combining mathematical theory, uncertainty quantification, and dynamic validation across autonomous platforms such as UAVs and self-driving cars. We address key challenges in generalization bounds, safety-guaranteed control, and multimodal sensor fusion, while also exploring the role of Large Language Models (LLMs) in experiment design and teaching material generation. Preliminary simulation and system-level results demonstrate the feasibility of bridging theoretical AI models with real-world engineering systems. The proposed framework aims to provide a reproducible research and teaching platform that fosters interpretable, robust, and certifiable AI applications.

T250196

City-civil society dynamics in the development of city green infrastructure in Baoshan Township, Hsinchu County: Gov-ernance features and their impacts

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Keywords: Urban greening, environmental governance, city-civil society collaboration, sustainable cities, urban development

Abstract:

The challenges of biodiversity loss and environmental injustice are being exacerbated by global climate change and urbanisation. City green infrastructure(CGI) has been demonstrated to provide a multifarious set of benefits, including ecological, social and economic advantages. These advantages have been shown to foster urban resilience and sustainable development. Nevertheless, inadequate collaboration between gov-ernment and non-governmental entities significantly hinders the development of CGI. Integrated urban governance models encompass the participation of the market, the state, the third sector, and civil society, ranging from hierarchical to non-hierarchical structures. The present study employs an environmental governance framework to analyse urban governance interventions in Baoshan Township, Hsinchu County, thereby representing a range of governance models. The objective is to explore the fac-tors influencing the interaction between cities and civil society during urban govern-ance development. Through the implementation of action research, four common fac-tors were identified: limited information distribution during the idea development process, which acts as both a barrier and a facilitator; knowledge ownership; limited incentives for collaboration during implementation; and unclear responsibilities dur-ing the implementation and management phases. In order to enhance the interaction between urban areas and civil society, it is recommended that a systems thinking ap-proach be adopted. This approach should prioritise common factors, and move beyond the isolation of barriers to a systemic understanding of governance interactions. This approach is designed to assist scholars and practitioners in identifying pathways to enhance interaction between cities and civil society, with a view to fostering more adaptive and inclusive UGI governance, irrespective of the governance model employed.

T250197

From eye-tracking to stress relief: exploring low-tech solutions for sustainable cultural landscape management

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Keywords: Cultural Landscape, Eye-Tracking, Game, Insight, Landmark

Abstract:

Urban development is increasingly reliant on new technologies to address social, cultural and environmental challenges. Eye tracking (ET) is one such method employed to assess how urban development affects people's perception of architectural and cultural heritage, and to determine which cultural landscapes people find most stress-relieving. However, ET is not without its limitations, including the high cost and the difficulty of its administration to certain populations. The present paper puts for-ward the notion of utilising games, which have been meticulously evaluated with a select group of 15 office workers experiencing elevated levels of stress, for the purpose of fostering enhanced community participation in the realm of urban planning. Despite the prevailing perspective that games are not considered to be serious research tools, the present study demonstrates that they are capable of producing results that are compa-rable to those obtained through ET. A comparative analysis was conducted, which re-vealed a significant correlation between the manner in which participants arranged architectural puzzles and their spatial perception of cultural landscapes. The findings of this study indicate that games have the potential to offer a sustainable and cost-effective method for evaluating the impact of urban development on heritage sites. It is recom-mended that future research explore the broader applicability of puzzles and other game types in the context of urban management and heritage conservation.

T250198

A Service Design Approach to Developing a Mobile Application for the Mazu Pilgrimage

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Keywords: Mazu Pilgrimage, Service Design, Mobile Application, Customer Journey Map

Abstract:

This study applies a service design approach to the development of a mobile application specifically intended for participants of the annual Mazu Pilgrimage. The research commenced with semi-structured interviews to elicit expert insights, supplemented by observational methods used to construct Customer Journey Maps of the pilgrimage. These maps incorporated service touchpoints, user behaviors, needs, emotions, and cognitive responses, thereby identifying critical factors influencing the experience of pilgrimage . Analysis of the initial journey data summarized five primary design focuses, namely navigation support, willpower reinforcement, charity practice, entertainment interaction, and connection of faith. Building on these findings, participatory workshops were organized to collaboratively generate and validate design concepts. The outcome was the development of a mobile application that not only enhances the overall pilgrimage experience but also establishes five core design principles, ensuring accessibility of the user interface, fostering connected communities experiences through information objects, providing personalized tools tailored to individual characteristics, designing intuitive and guiding interfaces, and integrating physical infrastructure as service platforms and experiential nodes. Ultimately, this research demonstrates how a service design–driven mobile application can both enrich the digital experience of pilgrimage participants and effectively integrate traditional culture with modern technology.

T250199

Monitoring Circadian Disruption via Wearable Sensors: Physiological Evidence of Social Jetlag

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Keywords: social jetlag, wearable biosensor, heart rate

Abstract:

Social jetlag—the mismatch between a person's circadian rhythms and socially required schedules such as commuting or shift work—has become an important issue in occupational health. One common cause is the tendency for people to stay up late before weekends and then sleep in the next morning, which shifts their sleep schedule away from weekday patterns. Many workers therefore go to bed and wake up at different times on weekdays compared with weekends, disrupting circadian alignment. This disruption has been linked to increased fatigue, lower well-being, and negative health outcomes. In the workplace, these effects are especially concerning because they can reduce alertness, particularly at the start of the week, and contribute to the so-called "Monday morning blues." Research has even shown that workplace injuries occur more often on Mondays than on other weekdays, underscoring the real-world safety risks of circadian disruption among workers. To explore this issue, the present study used wearable sensors that continuously monitor heart rate to see whether regular fluctuations could be detected in workers' physiological activity. This method was also evaluated for its potential use in workplace health management, providing a practical way to track and reduce the risks linked to social jetlag and circadian misalignment in everyday work settings.

T250202

Tagalog Lip-Reading System Using a 3D Convolutional Neural Network with Bi-LSTM

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Keywords: Tagalog Lip-Reading, 3D Convolutional Neural Network, Bidirectional Long Short-Term Memory, 3D CNN, Bi-LSTM

Abstract:

We present a Tagalog lip-reading system designed to enhance communication accessibility for individuals with hearing impairments. Unlike existing lip-reading models, which primarily focus on English and other major languages, no prior system has been developed to recognize Tagalog visual speech patterns which is the primary dialect in the Philippines. To address this gap, we implemented a 3D Convolutional Neural Network (CNN) combined with a Bidirectional Long Short-Term Memory (Bi-LSTM) network, supported by a custom Tagalog dataset of common words. This architecture achieved an average Character Error Rate (CER) of 10.09% and Word Error Rate (WER) of 24.08% on the testing set, demonstrating promising recognition accuracy for Tagalog lip movements. By introducing one of the first Tagalog-specific lip-reading framework, this work highlights the potential of deep learning-based visual speech recognition to support inclusive technologies, with applications in daily communication, education, and assistive tools for the Filipino deaf community.

T250203

Hybrid DEMATEL-DANP-VIKOR Model for AI-Generated Image Quality Evaluation and Platform Optimization

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Keywords: AIGC, Image Quality Evaluation, Hybrid MCDM, DANP, VIKOR

Abstract:
The rapid emergence of AI-Generated Content (AIGC) in design necessitates robust quality evaluation frameworks. This study presents a multi-dimensional system, grounded in the CIPP model, evaluating AIGC image quality across four dimensions: Artistic Integration, Visual Expression, Spiritual Connotation, and Market Adaptability. To systematically assess complex interdependencies and performance, a hybrid Multi-Criteria Decision-Making (MCDM) model is employed. The methodology integrates DEMATEL to map causal influence relationships via expert pairwise comparisons, DANP to derive influence weights considering these interdependencies, and VIKOR to evaluate the performance gaps and rank mainstream AI art generators. Results highlight a 'Value-Feedback Regulation' pattern among dimensions and identify critical criteria like Emotional Resonance (highest influence weight) and Style Consistency. Analysis reveals paradoxes in AIGC generation (e.g., innovation- consistency). VIKOR outcomes show performance disparities across platforms (Midjourney, Dreamina, Kling, Stable Diffusion), detailing their strengths and weaknesses. Based on the MCDM results, the study proposes tailored optimization strategies for platforms and outlines a three-tier human-AI collaboration model for effective quality management. This research contributes a practical decision-making tool and empirical insights for evaluating and optimizing AIGC image quality, demonstrating a novel application of MCDM in AI-driven creative fields.

T250209

An AI-Powered Real-Time Image Recognition System with a Laser-Based Deterrent for Primate Pest Control in Orchards

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Keywords: AI Recognition, YOLOv5, Laser Calibration, Human-Machine Interface

Abstract:
This study proposes an automated system to address orchard crop damage caused by Formosan macaques, a problem where traditional deterrent methods have proven ineffective. The system integrates an IP camera with a YOLOv5 object detection model, which was trained on an augmented 6,000-image dataset featuring a simulated monkey puppet in an indoor setting to validate its real-time identification capability through simulation. Upon target detection, a high-power laser, controlled via the MQTT protocol, is actuated to perform dynamic and non-invasive repelling. A web-based Human-Machine Interface (HMI) is provided, allowing users for remote monitoring and strategy adjustment. This system offers a low-cost, highly efficient, and scalable solution for smart agriculture, with potential for expansion to other scenarios requiring a high degree of security and defense, such as warehouses and construction sites.

T250210

Hylocerus Undatus Fruit Maturity Classification Using YOLOv7

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Keywords: Dragon Fruit, Hylocerus Undatus, YOLOv7, Resnet

Abstract:

Dragon fruit (Hylocereus Undatus) is a high-value crop in the Philippines that has gained commercial importance due to its nutritional benefits and profitability. However, determining the optimal maturity stage remains challenging for farmers relying on manual classification. This study proposes developing an automated system that integrates YOLOv7 for Dragonfruit detection. A dataset of dragon fruit images across three maturity levels, unripe, ripe, and over-ripe, was collected and used to train the model. The system classifies maturity stages based on external features such as color and shape, and its performance will be evaluated using a confusion matrix. By providing an accurate classification, the proposed system aims to assist farmers in harvesting dragon fruits at their optimal stage, improving yield quality and market competitiveness while reducing human error.

T250211

Integrating AIoT in the Development of Sustainable Concrete: Recycling Oyster Shell and PET Bottle Waste for Enhanced Efficiency and Environmental Impact

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Keywords: AIoT, oyster shell, cement, concrete, construction material, sustainability, fiber reinforced concrete, waste management

Abstract:

The construction industry is a major contributor to global carbon emissions, with concrete production depleting natural resources and releasing substantial amounts of carbon dioxide. The unsustainable extraction of raw materials for cement and aggregate production disrupts ecosystems, underscoring the urgent need for eco-friendly alternatives. Globally, over 3.9 million tons of oyster shell waste and more than 55 million tons of polyethylene terephthalate (PET) waste are generated annually. Mismanaged oyster shells accumulate on seashores, while PET incineration exacerbates air pollution and acid rain. These waste materials, however, present promising opportunities for sustainable concrete production by offering multiple benefits: reducing environmental contamination, utilizing calcium-rich oyster shells, minimizing PET waste, lowering construction costs, and addressing waste disposal challenges. This paper investigates the integration of Artificial Intelligence of Things (AIoT) into the recycling of oyster shell and PET waste for the development of sustainable concrete. AIoT technologies are leveraged to optimize waste collection, processing, and concrete manufacturing, ensuring efficiency, precision, and scalability. The study explores the material properties of oyster shells and PET, current waste management practices in Asia, and their applications across industries. It also reviews research findings on using oyster shells as substitutes for cement, sand, and coarse aggregate, and PET bottles as replacements for sand and coarse aggregate in concrete. By combining AIoT with innovative recycling techniques, this research highlights how advanced technologies can enhance sustainability, improve waste management, and reduce the environmental impact of concrete production.

T250212

Design and Implementation of Facial Recognition Smart Glasses For Visually Challenged Person

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Keywords: Assistive technology, smart glasses, facial recognition, visually impaired, Raspberry Pi, edge computing, object detection, YOLOv5, Pi Camera, ultrasonic sensor, wearable AI, real-time processing.

Abstract:

This study presents the design and implementation of facial recognition smart glasses to aid visually impaired individuals in recognizing people and navigating their environment more safely and independently. The prototype utilizes a Raspberry Pi 4 as the processing unit, integrating a Pi Camera for facial recognition and a USB camera for object detection. The system employs the face_recognition library to extract 128-dimensional facial embeddings using a convolutional neural network (CNN), enabling real-time face identification at close range (5–10 cm) under proper lighting conditions. Object detection is handled via a YOLOv5-based model, while ultrasonic sensors provide proximity alerts through audio feedback. Real-time processing is performed locally to minimize latency and protect user privacy. The prototype was tested on participants with varying levels of visual impairment—low vision, legal blindness, and total blindness—demonstrating an overall facial recognition accuracy of 88.89% and object detection accuracy of 61.11%. Results confirm the viability of edge-AI wearables in assistive technology, with user feedback highlighting strengths in audio feedback and recognition accuracy, alongside areas for improvement such as device comfort and low-light performance.

T250213

TCFD Disclosure, ESG Indicators, and Geopolitical Risk: Effects on Financial Performance in Taiwan's Semiconductor Industry

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Keywords: TCFD, ESG, Geopolitical Risks, Corporate Image, Mediating Variable

Abstract:

Climate change and geopolitical risks have intensified uncertainties of demand, procurement, and sustainability, particularly in Taiwan's semiconductor industry. This study examines the impact of TCFD, ESG, and Geopolitical Risks on financial performance while incorporating Corporate Image as a mediating variable. Questionnaire data were analyzed using the PROCESS model to evaluate mediation effects for ensuring methodological rigor. Results reveal that all three factors have a significant positive influence on financial performance, with corporate image exerting a partial mediating role. This research provides managerial insights into TCFD, ESG, and Geopolitical Risks–financial performance linkages for firms developing sustainability operations and risk management.

T250214

Design of a Lightweight Video-Based Ear Biometric System on Raspberry Pi 5 using YOLOv12 and EfficientNet-4

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Keywords: Ear Biometrics, Ear Biometric System, Raspberry Pi 5, YOLOv12, EfficientNet-4

Abstract:
The existing literature on Ear Biometrics has advanced significantly in recent years, with more accurate ear detection and recognition methods emerging—driven by the ear's uniqueness and permanence as a non-invasive biometric. However, limitations remain, including computationally intensive models, inconsistent evaluation metrics, and portable systems constrained by manual capture and limited datasets. Therefore, this study proposes a lightweight, video-based Ear Biometric System on the Raspberry Pi 5, integrating YOLOv12 for detection, EfficientNet-4 for feature extraction, and k-Nearest Neighbors for recognition. The study aims to develop a robust hardware platform integrating the Raspberry Pi 5 with the Raspberry Pi AI Camera and AI HAT+; to train, fine-tune, and optimize YOLOv12 and EfficientNet-4 using the VGGFace-Ear dataset for training and UERC 2019 for validation, with k-NN for classification; and to comprehensively evaluate its classification and system-level performance. System-level testing involved 13 participants, comprising 10 enrolled and three unenrolled subjects. The enrolled participants were registered in the system and expected to be identified, while the unenrolled participants were excluded and expected to be rejected. The system achieved 92.31% accuracy, 95.45% precision, 96.97% recall, and a 0.95 F1-score, confirming the viability of deploying advanced ear biometric methods on embedded, resource-constrained devices.

T250215

Development of a Transactional Filipino Sign Language Recognition System using MediaPipe and Gated Recurrent Units

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Keywords: Filipino Sign Language Recognition (FSLR), Gated Recurrent Units (GRU), MediaPipe, Computer Vision, Machine Learning

Abstract:
Filipino Sign Language (FSL) is the official language used by the deaf community in the Philippines. Although the Filipino Sign Language Act has been enacted, communication barriers persist due to a shortage of interpreters and limited public awareness. Sign Language Recognition (SLR) systems have emerged as a technological response to these challenges, but most current models are restricted to basic signs and gestures. Current SLR systems fail to cover signs that are helpful in transactional settings, such as in markets, malls, and other areas of commerce. To address this gap, the study introduces a Filipino Sign Language Recognition System that translates transactional signs captured in a short video clip into text. The system adopts a vision-based approach using a Raspberry Pi 5 equipped with a web camera. MediaPipe detects hand and pose landmarks, while Gated Recurrent Units (GRU) analyze the progression of the sign and translates it into text. To support model training, the researchers meticulously collected and developed a custom dataset of 1,065 video samples reflecting the unique signing patterns and sequence of the 26 transactional signs. Each sign ranges from 38 to 44 recorded videos, with data augmentation processes implemented to increase the dataset exponentially. The system's performance was evaluated using a multi-class confusion matrix and its calculated accuracy against unseen data. The model was effective in recognizing the included transactional FSL signs, as it achieved an accuracy of 87%, closely matching the training data accuracy of 90.7%. The system can be used in commercial areas, shops, stalls, and grocery stores to assist the deaf and hard-of-hearing community in interactions that involve buying or availing products and services.

T250219

Vehicle Classification Using Instance Segmentation via SOLOv2

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Keywords: Vehicle Classification, Instance Segmentation, SOLOv2, Raspberry Pi 5, Computer Vision

Abstract:

Vehicle classification is essential for traffic monitoring and intelligent transportation, yet most systems rely on detection methods with limited precision. This study aims to develop a vehicle classification system using instance segmentation via SOLOv2, optimized for lightweight deployment on a Raspberry Pi 5 prototype. A dataset of 2,100 images across seven vehicle classes—Sedan, SUV, Pick-up Truck, Van, Bus, Traditional Jeepney, and Modern Jeepney—was collected and annotated. The system achieved a mean Average Precision (mAP) of 54.7%, with strong performance for Bus (91.05% AP) and Modern Jeepney (75.03% AP), demonstrating both technical feasibility and real-world applicability.

T250220

A Comparative Evaluation of CNN Models for Leaf-Based Endangered Tree Classification

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Keywords: Convolutional Neural Networks, NASNetMobile, EfficientNetB0, MobileNetV2, Biodiversity monitoring

Abstract:

The conservation of endemic tree species in the Philippines, particularly within the Bohol Biodiversity Complex, requires localized and lightweight technological solutions. This study benchmarks three Convolutional Neural Network (CNN) architectures, namely MobileNetV2, EfficientNetB0, and NASNetMobile, using an organized dataset of 1,800 leaf images from five endangered Dipterocarpaceae species and an "unknown" class. Models were trained via transfer learning and evaluated through validation accuracy, confusion matrices, and field deployment on a Raspberry Pi prototype. Validation accuracies exceeded 97.00%, with NASNetMobile reaching 99.44%. Field testing produced lower results: 85.00% for NASNetMobile, 77.78% for MobileNetV2, and 66.11% for EfficientNetB0. One-way ANOVA with Tukey's HSD revealed no statistically significant differences at the 0.05 significance level, partly due to sample size limitations. These findings underscore the importance of field validation and statistical testing in CNN benchmarking, thereby supporting the viability of multiple lightweight architectures for embedded biodiversity monitoring in tropical ecosystems.

T250222

E-Nose Based Classification of Honey Brands using Extreme Gradient-Boosted Decision Tree

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Keywords: Electronic-nose, Honey Brand Classification, MQ gas sensors, XGBoost (Extreme Gradient Boosting), Volatile Organic Compounds (VOCs)

Abstract:

Honey is one of the most valued natural food products, yet it remains highly vulnerable to fraud through mislabeling and adulteration, practices that mislead consumers and compromise food safety. This study presents the development of a low-cost and portable electronic nose (e-nose) system for classifying locally available honey brands in the Philippines. The system integrates an array of eight MQ gas sensors to detect volatile organic compounds (VOCs), with an Arduino Mega 2560 handling data acquisition and a Raspberry Pi 5 executing data processing and classification. An Extreme Gradient Boosted Decision Tree (XGBoost) algorithm was applied to analyze the VOC profiles of three honey brands, each with 25 sample readings, resulting in a total dataset of 75 readings. The dataset was divided into training, testing, and validation sets to assess the system's classifying and predictive performance, with accuracy evaluated using a 3 × 3 confusion matrix. Results showed that the system effectively distinguished between honey brands, achieving a validation accuracy of 83.33%, with 20 out of 24 validation trials correctly identified. The findings highlight, for the first time in a Philippine context, the potential of combining low-cost e-nose technology with advanced machine learning to achieve honey brand classification and authentication. This approach offers a reliable, efficient, and portable method that supports food quality assurance and reduces the risk of fraudulent brand labeling in the local market.

T250223

SCALEeat: Vision-Guided Food Scale for Automated Macronutrient Estimation

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Keywords: Food Recognition, MobileNetV3-Large, Calories, Macronutrients, Embedded AI

Abstract:

Manual dietary logging is often tedious and error-prone. Research shows that food logging apps significantly underestimate energy intake due to food omissions, difficulties in matching food items, and challenges in portion size estimation, with users citing time consumption and poor long-term motivation as significant barriers. This study presents an integrated smart food scale that automates calories and macronutrient estimation to address these limitations. The self-contained device integrates a Raspberry Pi 5, camera, and load cell to eliminate the need for manual nutrition monitoring using a separate weighing device and nutritional database. Using transfer learning, we adapted a MobileNetV3-Large model to classify 25 common food items sourced from national nutrition surveys and the Philippine Food Composition Tables (PhilFCT). The model achieved 97.33% Top-1 accuracy on the test set, demonstrating robust performance. Operating entirely offline, the system provides real-time food identification and accurate calculation of calories, carbohydrates, protein, and fat based on measured weight. This work validates the feasibility of using embedded AI for accurate, automated dietary assessment, eliminating the need for manual food logging.

T250228

The Impact of Environmental Education on the Willingness to Consume Recycled Green Building Materials from Construction Waste

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Keywords: environmental education, recycled green building materials, purchase intention

Abstract:

In recent years, economic growth and improvements in the standard of living have led to a significant increase in construction activities, including extensive building projects, dem-olition of old structures, renovations, and expansions. These activities, along with the indoor design industry, generate substantial amounts of construction waste that pose se-vere threats to the environment. This has resulted in serious issues such as environmen-tal pollution and ecological degradation. The reduction and reuse of construction waste have consistently been hot topics within this discourse. This study aims to explore the impact of environmental education on consumers' willingness to adopt recycled green building materials derived from construction waste.

T250229

Exploration of the Effectiveness of Daily Waste Classification and Recycling Implementation in Sustainable Thinking

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Keywords: Sustainable Thinking, Waste Classification and Recycling Plan

Abstract:

In the case of the office building, which houses over 50 tenants, a comprehensive waste recycling plan has been established alongside designated areas for waste classification disposal. More importantly, educational training on waste sorting is implemented for all tenants. The key factor in successful waste classification lies primarily in "how to dis-pose of waste correctly." This task is a top priority for the property management team of the building. After formulating an effective waste recycling plan, it is essential to intro-duce this plan and its associated classification procedures to all tenants. The property management team not only arranges training sessions for each tenant's designated con-tact person but also conducts periodic audits of the entire building's waste management practices. The primary purpose of these audits is twofold: first, to gain insights into the actual state of waste sorting on each floor; second, to obtain an overview of overall build-ing-wide waste conditions. Through this approach, it becomes possible to identify floors that exhibit poor sorting performance and require additional educational interventions. This continuous process plays a crucial role in enhancing the overall recycling rate and reducing total waste volume within the case study building's efforts toward effective waste classification

T250232

A Comparative Study of Deep Learning and Rigid Body Registration Methods for Dynamic Thermal Imaging of Human Forearm

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Keywords: image registration, thermal imaging, convolutional neural network

Abstract:

Thermal imaging holds potential in medical diagnostics, but long-duration experiments, such as brachial artery occlusion, suffer from patient motion that complicates reliable temperature oscillation analysis. This work investigates the suitability of Deep Learning (DL) models for low-contrast, feature-sparse Thermal–Thermal registration. We examined a Global–Local model trained under intensity-driven unsupervised learning and a label-driven weakly supervised variant. Both models were evaluated against an boundary-based rigid registration baseline (Gauss–Newton optimization with SSD similarity and B-spline interpolation). A comparative study was conducted to analyze the performance differences. In this specific scenario, the traditional boundary-based method achieved more reliable alignment than the DL-based approaches.

T250233

A Comparative Analysis of Sustainable Development Strategies in Taiwanese Airlines

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Keywords: Sustainable Development, Net Zero Emissions

Abstract:

This study focuses on the aviation industry, which not only connects nations but also sig-nificantly contributes to environmental pollution. The changes that the aviation sector must confront extend beyond merely maximizing the use of Sustainable Aviation Fuel (SAF). It is equally crucial to adhere to the standards established by the International Civil Aviation Organization (ICAO) under its Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), aiming for net-zero carbon emissions. The research se-lects Airlines A and B as case studies to explore relevant strategies for sustainable devel-opment within the aviation sector. Utilizing a questionnaire survey method, this study aims to assess consumer support and satisfaction regarding airlines' implementation of sustainability strategies. The findings indicate that while there is general satisfaction among consumers concerning airlines' management of resource waste, there is less ac-ceptance when it comes to reflecting costs associated with achieving carbon reduction or carbon neutrality in ticket prices. This suggests that airlines still have room for im-provement in balancing carbon reduction efforts with cost considerations. It is hoped that this research will provide insights into public perceptions and encourage airlines to incorporate consumer feedback into their future improvements.

T250234

Carbon Inventory Service Plan for Interior Design Company

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Keywords: Carbon Inventory Service Plan

Abstract:
In recent years, issues related to greenhouse gases have garnered significant attention from governments and enterprises worldwide. Company A was established in 2005 and plans to set up a corporate sustainability team in accordance with the United Nations' 17 Sustainable Development Goals (SDGs). This initiative aims to ensure that the company aligns its sustainable development policies with economic, social, and environmental sustainability through balanced development strategies, thereby enhancing its competitiveness in sustainability on an international scale. The purpose of this study is to assist small and medium-sized enterprises (SMEs), service industries, and design sectors in promoting carbon reduction management and sustainable development. It encourages businesses to leverage smart technologies to improve operational efficiency, facilitate early decision-making processes, innovate business models, and ultimately support both gov-ernment initiatives and corporate goals for carbon reduction. The project aims to create low-carbon operations and business models while accelerating the green transformation of industries. This plan has successfully assisted the company in drafting a carbon emission report with notable achievements. We anticipate that the company will con-tinue its commitment to sustainable development by diligently executing carbon reduc-tion practices moving forward.

T250235

IoT-Controlled Hydroponics Tower Mini Greenhouse for Urban Gardening

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Keywords: IoT, Hydroponics, Urban Greenhouse, Smart Agriculture, Automation

Abstract:

This study presents the development of an IoT-Controlled Hydroponics Tower Mini Greenhouse designed for urban gardening applications. The system integrates IoT sensors, a microcontroller, and automation mechanisms to regulate key environmental factors, including temperature, humidity, nutrient delivery, and lighting. By leveraging real-time data collection and automated adjustments, the setup aims to improve plant growth, resource efficiency, and sustainability. The system's performance will be evaluated against traditional hydroponic methods and existing automated setups, such as iPONICS, focusing on growth rate, water consumption, and energy efficiency. Initial targets include achieving a 15% increase in plant growth, reducing water use by 20%, and enhancing energy efficiency by 10%. The research addresses gaps in the integration of IoT and hydroponic technologies by combining automation, vertical farming design, and real-time monitoring within a compact urban greenhouse. Findings are expected to demonstrate the potential of IoT-enabled hydroponic systems as scalable and sustainable solutions for urban agriculture, contributing to improved food security, resource management, and environmental resilience in space-constrained environments.

T250236

Portable Image Classification System for Identifying Banana Leaf Diseases and its Severity

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Keywords: Banana, Disease, MobileNetV2, Image Classification, Disease Detection

Abstract:

Banana production is one of the most important agricultural sectors in the Philippines, but it faces major threats from different banana diseases such as the four major diseases which are the Bacterial Wilt, Banana Bunchy Top Disease, Sigatoka, and Panama. This study developed a portable and non-destructive detection system that uses image processing and deep learning to classify these diseases from banana leaves. A portable camera device was used to capture images, which were processed and analyzed using the MobileNetV2 architecture. In addition to classification, the system provided a severity score categorized as low, moderate, or high through OpenCV image segmentation. Results showed high accuracy, precision, recall, and F1 score on some diseases such as the Bacterial Wilt and Sigatoka but the performance was lower on the side of Banana Bunchy Top Disease. Although some hardware limitations were noted, such as power and overheating issues, the system proved effective as a field ready diagnostic tool.

T250240

Artificial Intelligence and Emerging Technologies for Energy Efficiency in Sustainable Buildings: A State of the Art with Focus on the Colombian Context

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Keywords: Artificial Intelligence, Smart control systems, Building energy management system

Abstract:

The energy transition and sustainable development demand technological solutions that optimize energy consumption, integrate renewable energy sources, and automate energy management (EM) in both residential and business settings. This article presents a review of the state of the art regarding the application of artificial intelligence (AI), data analytics, and IoT in the development of smart platforms for energy efficiency. It highlights interna-tional approaches, relevant cases in Latin America, and research gaps within the Colom-bian context. The article also emphasizes the technological maturity potential of platforms in the sector and sets out recommendations for their implementation and scaling in the country.

T250247

Inventory decisions of dominant retailers under a single-stage credit sales strategy, incorporating carbon capture technology investment and cash discounts

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Keywords: carbon capture technology, inventory, cash discounts, single-stage credit transaction, carbon-reduction

Abstract:

This study examines investment in carbon capture technology within a single-stage credit sales model, defining roles as suppliers and retailers. Some supply chains have a dominant member; for instance, Toyota's system shows retailer dominance, with suppliers and dealers following Toyota's directives. We focus on scenarios where a dominant retailer leads a single-stage credit transaction. These retailers use credit sales to encourage suppliers to invest in energy-saving and carbon-reduction technologies. However, this can increase the supplier's risk of bad debts from delayed payments. To mitigate this, suppliers often offer early payment discounts. If the retailer pays early, they receive a discount; otherwise, full payment is due within an extended period. This research investigates the inventory decisions of a dominant retailer under such credit sales with cash discounts, aimed at incentivizing suppliers to adopt carbon capture technology. In this arrangement, suppliers are encouraged to implement carbon capture technology; if they do, the retailer might pay immediately as an incentive. If not, delayed payment terms apply. The supplier's early payment discount strategy encourages early payment, reducing bad debt risk. Therefore, we explore dominant retailer inventory decisions under credit sales and early payment cash discounts to promote carbon capture investment. Additionally, this study provides a simple decision-making procedure for optimal inventory decisions for the dominant retailer, making the findings practical.

T250256

Repair of Cracked Composites and Investigation of Their Performances under Impact Load

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Keywords: composite repair, composite patch, low velocity impact, adhesive, cracked plate

Abstract:

In this study, composite plates with circular holes cracked on both edges were repaired using a composite patch. Epoxy adhesive was used to bond the patch to the plate. Low-velocity impact tests were applied to repaired specimens with varying crack lengths. Compared to specimens without holes, the maximum reaction force of repaired specimens without cracks increased by up to 50%. When the crack length reached its maximum, the maximum impact force of repaired specimens increased by 36% compared to the specimens without holes.

T250257

Improvement of an automated process for folding soft plastic bag

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Keywords: Industrial automation, Mechanical design, Automated folding

Abstract:

Soft plastic packaging bags are widely used in industries such as food, agriculture, and textiles. Their flexibility and low cost make them indispensable packaging materials, such as feed bags and general packaging bags. However, due to the soft and flexible characteristics of these materials, additional considerations are required during the folding process. Wrinkles formed during folding can lead to a loss of accuracy, which is why the folding of soft plastic bags has long relied on manual labor. This reliance results in low production efficiency and unstable quality control. In the past, when downstream manufacturers had lower requirements for quantity and quality, manual folding could still meet production demands. However, with rising labor costs and increasing quality requirements, manual folding has become an inefficient processing method. As a result, the demand for automated folding systems in industrial automation has been increasing. Most existing machines on the market focus on plastic bag forming processes, while automated folding mechanisms are relatively rare. This study focuses on the mechanical design and development of an automated folding device for plastic packaging bags to improve production efficiency, ensure folding accuracy, and reduce labor dependence.

T250258

Faster R-CNN–Based Solder Joint Inspection for ICs in Electric Vehicle Charger Production Lines

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Keywords: Faster R-CNN, YOLO, electric vehicle charger

Abstract:

In electric vehicle (EV) charger production lines, the quality inspection of integrated circuit (IC) solder joints plays a crucial role in ensuring the reliability of automotive electronic systems. This study proposes an automated inspection method based on Faster R-CNN for detecting and classifying solder joint defects on ICs, aiming to enhance accuracy and stability compared with YOLO-based approaches. The image dataset was collected from an actual surface-mount technology (SMT) production line, where solder joints were labeled into five categories: Good Solder, Low Solder, and Defective Solder. To improve model generalization and robustness to viewing angle variations, the dataset was augmented by rotating images at multiple orientations. Experimental results demonstrate that the Faster R-CNN–based method effectively detects and recognizes various solder joint defects, showing strong potential for automating IC quality inspection in electric vehicle charger manufacturing environments.

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