ECICE

2024 IEEE 6th Eurasia Conference on IoT, Communication and Engineering

15 - 17 November, 2024

National Formosa University, Yunlin, Taiwan

2024 IEEE 6th Eurasia Conference on IoT, Communication and Engineering

(IEEE ECICE 2024)

Yunlin, Taiwan
November 15–17, 2024

Organized by:

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

College of Engineering, National Formosa University, Yunlin, Taiwan

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

Welcome

Welcome to the 2024 IEEE 6th Eurasia Conference on IoT, Communication and Engineering (IEEE ECICE 2024). This conference is the collaboration among 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. IEEE ECICE 2024 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.

IEEE ECICE 2024 received a total of 229 submissions, with 162 papers finally selected and registered for this conference. 17 countries and regions of participation include Cambodia, China, Croatia, Ecuador, Germany, Indonesia, Japan, Macau, Malaysia, Taiwan, The Philippines, The USA, Turkey, UK and Vietnam. These papers on various topics are divided into 17 Regular Sessions and 1 Invited Session. 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 IEEE ECICE 2024 and National Formosa University!

Prof. Chi-Ting Ho, Ph. D.
Dean, College of Engineering,
National Formosa University, Yunlin, Taiwan
Program Chairman of IEEE ECICE 2024
November 15th, 2024

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

Invited

IV1. Intelligent System Design and Control of Advanced Mechatronic Systems

Content

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

College of Engineering, National Formosa University, Yunlin, Taiwan

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

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
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

Invited

IV1. Intelligent System Design and Control of Advanced Mechatronic Systems

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Keynote Speaker

Ai-Chun Pang, Ph. D.

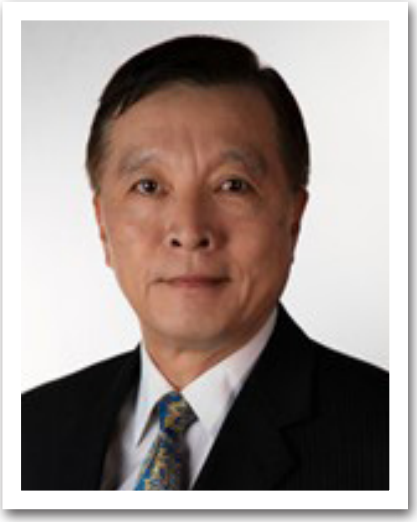
Distinguished Professor,
National Taiwan University

The director and the Distinguished Research Fellow of Research Center for Information Technology Innovation (CITI)

Toward 6G-Enabled Mobile Edge Intelligence

With the explosive development of AI, edge intelligence has been considered a must in developing future 6G mobile communications systems to provide timely responses to emerging applications on mobile devices. In 6G, the computation-intensive AI tasks will be distributed at the network edge, and the communications paradigm will shift from conventional symbol transmission to semantic information delivery. This lecture will overview key features of 6G mobile networks and elaborate on distributed AI learning driven by edge intelligence. We will present the effects of limited labeled and non-IID data in the edge-intelligence environment. We will also discuss the vulnerability of the edge-intelligence framework and defense methods against privacy leakage and security threats. Finally, we will introduce the GenAI-based semantic encoder to prioritize task-oriented communication, with the concept of understanding before transmitting and delivering the intended meaning of messages, to achieve the goal of pervasive computing for connected intelligence.

Keynote Speaker



F. Frank Chen, Ph. D.

Luther Brown Distinguished Chair Professor
in Advanced Manufacturing Center for
Advanced Manufacturing & Lean Systems
The University of Texas at San Antonio, USA

Realizing Smart Manufacturing through the Lean AI Paradigm: an AI-Enabled Lean Manufacturing Practice with Versatile Convolutional Neural Network

Integrating Lean Manufacturing tools with artificial intelligence (AI) is emerging as a revolutionary approach to realize smart manufacturing by optimizing production processes, reducing waste, and enhancing overall efficiency. Traditional Lean practices focus on waste reduction and process improvement, primarily relying on human expertise for problem identification and resolution. AI algorithms, on the other hand, excel in pattern recognition, data analysis, and decision-making. Lean tools and AI can offer more precise, data-driven solutions for common manufacturing challenges when integrated. AI algorithms can automate and refine Lean techniques like value stream mapping, Kanban, and 5S by providing real-time, actionable insights drawn from big data. This fusion of Lean and AI aids in predictive maintenance, quality control, and optimization, enhancing the efficiency and responsiveness of the manufacturing process. Moreover, AI's capability for machine learning allows the system to adapt and improve autonomously over time, further aligning with Lean's continuous improvement ethos. Several case studies were conducted to show how this alignment might aid Lean Manufacturing. However, successful implementation necessitates overcoming data quality and algorithmic bias challenges. Despite these hurdles, integrating Lean tools and AI can redefine best practices in manufacturing, setting new standards for operational excellence.

Guidelines

1. Official Languages

The official language of IEEE ECICE 2024 is English. All presentations including Q&A should be delivered in English.

2. Guideline for Participants

2.1. Conference Venue

National Formosa University, Yunlin, Taiwan

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

2.2. Registration

Time of Registration:

09:00~ 13:00, November 15, 2024 (UTC/GMT +8 hours)

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 15 minutes. The session chairs will allow the presenter 12 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 IEEE ECICE 2024 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 Taiwan Local Standard Time (GMT+8:00)

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

Main Conference		
Friday, 15 November 2024		
08:50	09:20	Welcoming Reception & Registration
09:20	09:40	Opening Ceremony
09:40	10:40	Keynote Speech – Speaker: Prof. F. Frank Chen (Virtual)
10:40	11:00	Coffee Break
11:00	12:00	Keynote Speech – Speaker: Prof. Ai-Chun Pang
12:00 - 13:00 Lunch Break		
13:00	17:00	Oral Paper Sessions & Poster Paper Sessions (Onsite)
14:30	16:00	Coffee Break
13:00	17:00	Oral Paper Sessions & Poster Paper Sessions (Remote)
18:00	20:00	Conference Banquet

Main Conference		
Saturday, 16 November 2024		
08:30	17:30	Technical Visit & Communication

Main Conference		
Sunday, 17 November 2024		
08:30	17:30	Sponsor Showcase & 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, 15 November 2024

Onsite Oral Paper Sessions
(Third campus, National Formosa University)
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	A4
T240211-B	T240037-C	T240109-C	T240186-C
T240017-C	T240038-C	T240131-C	T240199-C
T240022-C	T240074-C	T240150-C	T240208-C
T240026-C	T240100-C	T240158-C	T240222-C
Session B			
B1	B2	B3	B4
T240020-E	T240093-E	T240028-IV1	T240106-D
T240078-E	T240125-E	T240048-IV1	T240137-D
T240081-E	T240151-E	T240182-A	
T240092-E	T240010-F	T240207-A	
Session C			
C1	C2	C3	C4
T240091-O	T240184-O	T240112-P	T240061-L
T240118-O	T240062-P	T240136-P	T240102-L
T240166-O	T240063-P	T240025-Q	T240122-L
T240179-O	T240086-P	T240057-Q	
Session D			
D1	D2	D3	
T240014-M	T240143-M	T240079-K	T240225-K
T240015-M	T240178-M	T240080-K	T240219-IV1
T240097-M	T240181-M	T240095-K	
T240115-M	T240221-M	T240121-K	

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

13:00—14:00	14:00—15:00	15:00—16:00
Session E		
E1	E2	E3
T240058-A	T240195-A	T240023-D
T240129-A	T240214-A	T240032-D
T240160-A	T240065-B	T240172-D
T240175-A	T240176-B	T240202-D
Session F		
F1	F2	F3
T240033-C	T240152-C	T240206-C
T240049-C	T240161-C	T240217-C
T240055-C	T240164-C	T240135-G
T240071-C	T240185-C	
Session G		
G1	G2	G3
T240177-N	T240003-M	T240046-P
T240004-O	T240067-M	T240170-P
T240077-O	T240099-M	T240224-P
T240072-Q	T240120-M	
Session H		
H1	H2	
T240128-IV1	T240200-E	
T240029-E	T240210-E	
T240167-E	T240213-E	
T240171-E	T240216-E	

Poster Paper Schedule

Friday, 15 November 2024

Onsite Poster Paper Sessions
(Third campus, National Formosa University)
UTC/GMT +8 hours

Time / Number	13:00—14:00	14:00—15:00	15:00—16:00
1	T240113-A	T240035-IV1	T240215-K
2	T240193-B	T240036-IV1	T240039-M
3	T240016-C	T240040-IV1	T240108-M
4	T240018-C	T240042-IV1	T240123-M
5	T240101-C	T240060-IV1	T240138-O
6	T240141-C	T240064-IV1	T240144-O
7	T240192-C	T240139-D	T240226-O
8	T240021-E	T240183-D	T240068-P
9	T240084-E	T240228-D	T240075-P
10	T240096-E	T240230-D	T240076-P
11	T240201-E	T240011-F	T240082-P
12	T240190-G	T240034-F	T240083-P
13	T240231-G	T240127-F	T240085-P
14	T240088-L	T240209-F	T240191-P
15	T240142-L	T240218-F	T240229-D

Online (Remote) Poster Paper Sessions
UTC/GMT +8 hours

Time / Number	13:00—14:00	14:00—15:00	15:00—16:00
1	T240005-A	T240059-C	T240194-D
2	T240006-A	T240069-C	T240047-E
3	T240027-A	T240159-C	T240094-E
4	T240043-A	T240189-C	T240126-E
5	T240145-A	T240196-C	T240066-P
6	T240087-B	T240197-C	

Paper Abstracts

https://www.ecice.asia/Abstract

Contact Us

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T240003

Automated Solar Greenhouse Plant Monitoring and Control System via ESP32 and Blynk Application

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Keywords: Greenhouse Automation, Optimization, Blynk app, Solar Power, Light intensity

Abstract:
The concept of greenhouse farming has brought revolution in the agricultural field by making the climate favorable to grow crops in a place where it can be grown all year round. Besides securing the production of foods of higher quality, it also prolongs the growing seasons and protects crops from pests and weather. This can now be centrally controlled by the user due to the concurrent technological advancements of devices such as cell phones and a control system, like temperature, which is a factor in the raising process of the plant. In order to realize remote real-time monitoring with automated modifications according to the requirements of the greenhouse based on the user settings, an Android user platform app was developed by the researchers.

T240004

Classification of Non-Frozen and Frozen-Thawed Pork Meat with Adaptive Support Vector Machine and Electronic Nose

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Corresponding author: Dionis A. Padilla, dapadilla@mapua.edu.ph

Keywords: Electronic nose (e-nose), Frozen-thawed meat discrimination, Pork quality assessment, Machine learning for food safety, Gas sensor array

Abstract:
The quality of raw meat, particularly its freshness, is a critical factor in preventing foodborne illnesses, which pose a significant public health risk. This study aimed to develop a novel approach for differentiating frozen-thawed pork meat from non-frozen samples using an Electronic Nose (E-nose) system combined with an Adaptive Support Vector Machine (ASVM) classification model. The E-nose device was designed with MQ series gas sensors, temperature, and humidity sensors integrated with an Arduino Uno microcontroller. Sensor calibration was implemented for accurate data collection, and the ASVM model was employed for data classification. The ASVM model demonstrated promising results, achieving an overall accuracy of 88%, with high precision, recall, and F1-scores. Future research will focus on refining the model's performance by incorporating a wider array of gas sensors, increasing sample size, applying advanced data preprocessing techniques, and exploring alternative machine learning algorithms or ensemble methods. This study contributes to the development of innovative tools for enhancing food safety and quality control in the meat industry.

T240005

Assessing AI-Driven Large Language Models for Web Service Discovery and Composition

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Keywords: LLM, web services, IOT

Abstract:

The emergence of large language models (LLMs) has resulted in a notable shift in the development and generation of code, prompting an increasing focus on assessing their effectiveness, particularly in the contexts of web service discovery and service composition. The present research introduces a comprehensive framework for assessing the code generation capabilities of LLMs, following established platforms like LeetCode. Our framework comprises three primary stages: preparation of the coding problem, execution of the LLM, and analysis of the generated code. We conducted an empirical analysis on various LLMs, including GPT-3.5 and GPT-4, which demonstrates the effectiveness of the framework in evaluating LLMs across different prompt details, publication years of coding problems, and difficulty levels. In addition, we will examine the limitations and possible approaches to enhancing the evaluation framework, with the aim of improving its appropriateness and accuracy in different LLM architectures.

T240006

Optimizing Resource Allocation: A TOPSIS-Based Evaluation of Time and Energy Efficiency

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Keywords: iot, scheduling, resource allocation, data center

Abstract:

The growing number of Internet of Things (IoT) devices has resulted in greater demand for distributed computing paradigms, such as edge and fog computing, in order to overcome the constraints associated with cloud computing. Efficient resource scheduling for fog and edge resources depends heavily on the optimization of resource utilization and allocation. Conventional fog-based scheduling algorithms tend to focus merely on performance metrics, neglecting the significance of energy efficiency. In view of the aforementioned, we introduce a novel algorithm designed for IoT environments, with the objective of enhancing efficiency in terms of time and energy consumption, optimizing performance, and reducing costs related to data center processing tasks. The algorithm employs the TOPSIS method, a multi-criteria decision analysis (MCDA), to determine the optimum utilization of fog-based resources. This is achieved by taking into consideration computational parameters such as MIPS and TDP while utilizing all the virtual machines (VMs) that are currently available. Experimental results demonstrate the efficacy of our algorithm in dynamic multi-objective optimization for IoT task scheduling. Our results indicate a 25% improvement in makespan optimization and a 27% decrease in energy consumption in comparison to alternative algorithms.

T240010

Application of Convolutional Neural Network on a Terrain-based Tire Pressure Management System

John Paul Cruz[1,a], Carl Luis Ledesma[2,b], Emmanuel Salcedo[2,c], Charlothe John Tablizo[2,d], Emmy Grace Requillo[2,e] and Marites Tabanao[2,f]

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Keywords: central tire inflation system, tire pressure management system, terrain recognition, convolutional neural network, automation

Abstract:

Improper car tire pressure affects dynamics, fuel economy, and driver safety. Current central tire inflation systems (CTIS) can mitigate these effects by regulating tire pressure to its reference inflation pressure. However, current CTIS is limited to automatics concerning loading conditions and manual input of terrain conditions; thus, the system lacks intelligent components to increase efficiency. Adding a terrain recognition feature to the current CTIS technology, also referred to as tire pressure management systems (TPMS), will enhance the capability to adjust to the ideal tire pressure according to the terrain condition in real-time. This study aims to integrate the terrain recognition component using a ResNet-18 model into the TPMS to classify and detect terrains and apply the correct tire pressure level. The study developed a one-tire terrain-based TPMS model for system integration, tested under flat, uneven, and soft terrain conditions. The model demonstrated 95% accuracy in classifying the chosen terrains with adaptability to nighttime environments. Inflation and deflation tests conducted at varying speeds and terrains showed longer inflation times at higher pressure ranges, while deflation times remained consistent regardless of pressure range. Inflation and deflation tests conducted at varying speeds and terrains remained consistent regardless of the pressure range. The study also demonstrated a negligible impact of tire speed below 15 kph on inflation and deflation rates. System integration test results also showed instantaneous response time between the microcontrollers, which increases efficiency in the overall CTIS process.

T240011

Systematic Review on the Automation of Central Tire Inflation System based on Terrain Conditions

John Paul Cruz[1,a], Carl Luis Ledesma[2,b], Emmanuel Salcedo[2,c], Charlothe John Tablizo[2,d], Emmy Grace Requillo[2,e] and Marites Tabanao[2,f]

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Keywords: central tire inflation system, tire pressure management system, convolutional neural network, terrain recognition, systematic literature review

Abstract:

Incorrect tire pressure affects vehicle dynamics, fuel efficiency, and driver safety, especially on varying terrains. Current central tire inflation systems (CTIS) help alleviate these issues by adjusting tire pressure to a predetermined reference level. However, the existing CTIS is limited to adjustments based on load conditions and requires manual input for terrain type. Therefore, it lacks the advanced intelligence needed for optimal automation. Integrating a terrain recognition feature into CTIS would allow real-time adjustments of tire pressure to match terrain conditions, potentially enhancing system performance and efficiency. This study aims to integrate the terrain recognition component using a Convolutional Network (CNN) by reviewing relevant terrain-detection models. The goal is to enhance CTIS to classify and detect terrains and apply the correct tire pressure level. The researchers employed a systematic literature review to assess and validate the developmental procedures for integrating the intelligent component with the basic CTIS. ResNet-18 was determined to be the most appropriate CNN model to classify the selected terrains on a gathered local dataset. Based on relevant studies, a single-wheel testbed comprising the enhanced CTIS's fundamental components is also appropriate for laboratory and system integration testing.

T240014

Real-time Super Resolution Utilizing Dilation and Depthwise Separable Convolution

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Keywords: Super Resolution, Dilation Convolution, Depthwise Separable Convolution

Abstract:
Many computer vision applications require high-quality reproductions of original images, typically demanding complex models with many trainable parameters and floating-point operations. Such increases computational load and restricts deployment on resource-constrained devices. It motivates us to design our Dilation Depthwise Super Resolution (DDSR) model, mainly composed of dilation convolution, depthwise separable convolution, and residual connection, to overcome the predicaments above. Compared with the well-known model, Fast Super-Resolution Convolutional Neural Network (FSRCNN), our DDSR possesse better performance in traditional evaluations and YOLO confidence scores. Most importantly, our architecture has only 55% trainable parameters and 19% FLOPs of one-channel FSRCNN, as well as 27% trainable parameters and 8% FLOPs of three-channel FSRCNN.

T240015

Assessing the Impact of Seasonal Lighting Variations on Drone Visual Positioning

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Keywords: Drone Positioning, Convolutional Neural Network (CNN), Lighting Variations

Abstract:
Positioning systems and algorithms are essential for drone applications. Nowadays, Global Positioning Systems (GPS) are the most common method for drone positioning, but GPS may not always be precise and available. In the literature, a visual-based positioning study uses a Convolutional Neural Network (CNN) to match geometric features for drone positioning. However, they do not consider the impact of seasonal lighting variations. Hence, by incorporating several critical components into a CNN, we design a new architecture to position the drone despite the seasonal lighting variations. According to the experimental results, our method can deal appropriately with the issue above and provide enough accuracy and stability for drone positioning.

T240016

Real-time Head-Orientation and Eye Tracking Algorithms Using Adaptive Feature Extraction and Refinement Mechanisms

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Keywords: eye tracking, real time algorithm, head orientation, interactive machine, infrared images

Abstract:
In this paper, we propose a fast eye-tracking method which takes the depth image and the gray-scale infrared (IR) image as input, and put them into a traditional-image-processing-algorithm-based system. Given an IR image which containing exactly one face and the corresponding depth image, the purposed method can locate the real-world coordinate which the camera is at origin with high speed (>90 frames per second) with acceptable error. Basically, this method takes advantage of the depth information to quickly locate face, which can shrink the range we detect the eyeballs and then decrease the error rate and accelerate the operation. After finding the face region, in need of high execution speed, we apply some less complicated computer vision algorithms, such as refinement mechanisms like morphology and extracting features like edge distribution, to locate the eyeball's position and finally transform the pixel coordinate on the image to the real-world coordinate though pinhole camera model.

T240017

Automatic Dancing Scoring Algorithm Using Alignment and Least Square Approximation with Fractional Powers of Joint Features

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Keywords: motion evaluation, dancing scoring, alignment, feature extraction, least mean square error approximate

Abstract:

Automatic motion evaluation is a critical topic in exercise training and entertainment. In this work, an advanced automatic dancing scoring algorithm is proposed. First, to avoid the misjudgment from misalignment, space alignment and time alignment are performed. Then, instead of using the whole video frames as the input, we apply the joint information, including the relative locations, the moving velocities, the orientations, and the areas between the joint lines as the input features. Moreover, to make the features even more flexible and magnify the detail difference, we take the fractional powers on some input features. The correlation coefficients are adopted for feature selection and a nonlinear way is applied to determine the angle difference. Furthermore, the least mean square error approximation is applied to determine the linear combination coefficients of features. It can minimize the difference of the ground truth and the regression line computed from the input features. Experiments show that, with the proposed algorithm, a very accurate dancing scoring result can be achieved.

T240018

An Improved Low Complexity Predictor for Block-based Lossless Image Compression

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Keywords: lossless image compression, adaptive predictor, block-based compression, median edge predictor, data compression

Abstract:

Lossless image compression has been studied for several decades and is widely applied, particularly in fields such as medicine, space exploration, aerial photography and satellite communication. In this paper, we proposed an improved low complexity predictor based on the LOCO-I predictor which was used in JPEG-LS. We first analyze the nature of LOCO-I predictor and then offer several possible solutions, with the best method outperforms LOCO-I by 2.26% reduction on entropy for full image size and 2.70%, 2.81% and 2.89% for 32x32, 16x16 and 8x8 block-based compression respectively. In addition, we suggested vertical/horizontal flip for block-based compression, which costs extra bits to record but brings decreases in entropy. Compared to other SOTA lossless image compression predictor, out proposed method has low computation complexity, as it is multiplication and division free and therefore, is relatively easier for hardware implementation. Furthermore, as the predictor exploits no inter-block relation, thus, if encoded by Fix-length Coding (FLC), parallel processing and random access can be realized.

T240020

Evaluation and Enhancement of Power System Resilience under Weather Events

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Keywords: extreme weather event, power system resilience, metrics, resilience curves

Abstract:

Extreme weather events can cause significant damage to power system equipment. Although these events are infrequent, their impact can be substantial, making power system resilience under weather-related conditions a critical topic for modern grids. This study reviews weather-related resilience metrics and appropriate methods for assessing power system resilience. These metrics are often derived from various resilience curves. Additionally, the study compiles insights from different countries on resilience evaluation and methods to improve power system resilience. Based on the findings, this paper summarizes potential metrics, evaluation methods, operational experiences, and strategies for enhancing power system resilience.

T240021

Simulation and Fault diagnosis using I-V Characteristic of PV systems—A Case Study

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Keywords: I-V characteristics, PV system, fault detection and diagnosis

Abstract:
The I-V characteristics of a PV system reflect its real state and can effectively reveal the system's performance, making them widely applicable in the field of fault detection and diagnosis for PV systems. This paper outlines the modeling methods for common faults using Matlab/Simulink software, including module degradation, open circuit, short circuit, shading, and hotspot faults. A detailed analysis is provided on how these faults impact the I-V characteristics. Furthermore, a real PV system is used as a case study for fault diagnosis. By fitting the measured I-V curves from the PV system and diagnosing possible faults and their severity based on the fitted model parameters, the approach proposed in this work provides a cost-free, simple, and effective detection method. This paper aims to provide a valuable practical example for researchers and engineers in the PV field, promoting the advancement of fault detection and diagnosis technologies in PV systems.

T240022

Enhancing Adaptive Wiener Filtering for Frequency-Varying Noise with CNN-Based Feature Extraction

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Keywords: noise estimation, sparse time-frequency domain, denoising, image reconstruction, noise distribution model

Abstract:

Denoising has long been a challenge in image processing, with noise appearing in various forms, such as Additive White Gaussian Noise (AWGN) and Poisson noise, and even varying across different frequencies. Our work aims to blindly denoise noisy images without prior knowledge of the noise distribution. First, we estimate the noise power in the frequency domain, which is then used to approximate the local signal-to-noise ratio (SNR) and guide an adaptive Wiener filter. The initial denoised result is obtained by assembling the locally filtered patches. However, since the Wiener filter is a low-pass filter, it may remove fine details along with the noise. To overcome this limitation, we propose a postprocessing approach that enhances the denoised image by interpolating between the denoised patches and the original noisy ones, and by applying masking in the frequency domain to avoid grid-like artifacts. Additionally, we introduce a CNN-based detail refinement technique in the spatial domain to recover latent textures lost during denoising. We provide detailed insights and experimental analysis on the effectiveness of the proposed masking and feature extraction methods.

T240023

Dog Activity Recognition Using Convolutional Neural Network

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Keywords: dog activity, image classification, CNN, InceptionV3, Raspberry Pi

Abstract:

This study explores the use of convolutional neural networks (CNNs) on a Raspberry Pi platform to classify common dog activities, such as sitting, standing, and lying down, which are crucial for monitoring the well-being of pets. Using the InceptionV3 model optimized on a dataset of Siberian Husky photos, an 88% accuracy rate is achieved on a test set of 50 samples. For building the model, TensorFlow Keras is used in the implementation, while the OpenCV library is used for system interaction with the Raspberry Pi and its Camera module. With an effective approach for the image classification of dog behaviors in various environmental circumstances, this research substantially contributes to the development of pet welfare monitoring systems and may improve the care given to beloved animal companions.

T240025

Numerical Simulation of Aerodynamics Effect by Surface Modification in S1210 and S1223 Airfoils Under Martian Conditions

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Keywords: Modified S1210 and S1223 Airfoil, Computational Fluid Dynamics, Aerodynamic Performance, Surface Modification of Airfoil

Abstract:

The performance analysis of airfoil in extraterrestrial atmosphere is very important to create design of future drones and aircrafts intended for working in Martian conditions, and to learn the best airfoil performance for Martian condition. In this study, we have performed numerical simulation of the aerodynamic behavior of modified S1210 and S1223 airfoil. The modifications made is in the form of geometric surface modification like dimples and protrusions to improve the aerodynamic characteristics. Analysis has been done on an airfoil of 1m chord length with modifications, which were implemented on the upper surface of a 2-dimensional airfoil model and placed at 70% of chord length. CFD was used to evaluate how well the S1223 and S1210 Airfoils performed in terms of aerodynamics. The Airfoils were put through tests at different AOA to figure out the lift and drag coefficients, the Cl/Cd ratio determined the increase in aerodynamic performance in various flight scenarios. Reynolds Number 20000-40000 was taken into consideration and the AOA is between -6 to 20 Degree for S1210 airfoil and -4 to 20 Degree for S1223 airfoil. The S1210 and S1223 Airfoils both show delayed stall traits. The modifications helped to increase the stall trait and improve the Cl/Cd performance specially the semicircular and V-shaped inward and outward bulge. In the initial experiment considering S1210 airfoil five different modification taken into consideration such as normal outward bulge, V-shaped Inward and outward bulge and Semicircular inward and outward bulge. As the normal outward bulge geometry didn't show much promising result as compared to the S1210 airfoil without modification, while experimenting modification in S1223 airfoil it was not taken into consideration and the modification applied was the other four which includes V-Shaped and Semicircular Modification. The overall CL/CD performance of S1210 airfoil at both 20,000 and 40,000 RE is much better for all the modified Airfoils in negative AOA (-6 – 0 Degree) and also from 0 – 12 Degree AOA. In conclusion, protrusion on the surface of the airfoil benefits the aerodynamic performance of the airfoil in Martian conditions.

T240026

Using Image Descriptions to Help the Blind Locate Restroom Facilities

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Keywords: ESP32-CAM, Blip model, AI, Text-to-Speech (TTS) technology

Abstract:

Since the blind cannot visually observe the world, they have encountered difficulty in accurately finding objects in their surroundings. Particularly in the restrooms where the space is extremely narrow but full of various facilities, it is easy for people who lose eyesight to get tripped and injured. To avoid injuries, blind people shall be able to precisely locate these facilities. Prompted by this proposition, we designed a head-mounted device using artificial intelligence techniques to send images captured with the ESP32-CAM to a computer. Then, the images were converted into a model-compatible format, followed by the use of the Blip model to generate detailed English sentences. Finally, these descriptions were played out loud through a speaker. By providing these spoken messages, our goal of assisting the blind in locating the objects in the restroom could be achieved.

T240027

Research on Creating a Safe Living Environment for the Elderly Using Smart Facilities

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Keywords: elders, safe living environment, smart facility, IoT

Abstract:

There are nearly 500,000 homes in Taiwan where elderly people over the age of 65 live alone, facing daily inconveniences and dangers. This research develops the "Elderly Smart Home Environment Safety Monitoring and Protection System". The system includes a control board, sensing elements, and controllable facilities. When the system detects hazards such as carbon monoxide or fire, it automatically activates alarms, ventilation fans, window openers, gas shut-off devices, sends Line notifications, and unlocks doors to allow rescue personnel to enter. To collect data on the daily activities of the elderly, the study installed smart monitoring alert control hosts and various sensors and control facilities. After evaluation, three different versions of the elderly smart home environment safety monitoring and protection equipment were proposed for reference and purchase. This study proposes the principles for introducing smart safety protection equipment into the living spaces of the elderly, including considerations of user health status, user-friendly design, communication facilities, house age, and wiring. The proposed protection system helps improve the home safety and monitoring protection capabilities of the elderly and is worthy of reference and promotion by the government and related industries.

T240028

Application Analysis of Intelligent Ventilation Systems: A Case Study on Air Quality Cycle Monitoring

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Keywords: smart fan, control panel, air quality

Abstract:
To enhance indoor air quality in both newly constructed and older residential buildings, it is essential to plan installation methods and designs in advance. This proactive approach addresses construction challenges and suboptimal performance resulting from inadequate designs, thereby preventing increased construction costs. Currently, most building projects use centrifugal fans that are activated at specific times by a time relay within the control panel to balance power consumption with user needs. However, building management committees often operate these fans for shorter periods or not at all to reduce electricity costs and noise, resulting in poor air quality and potential health risks for occupants. To address this issue, this paper proposes the use of smart fans integrated with air quality detectors in construction and renovation settings, comparing their performance to traditional fans. Experimental results indicate that in renovation environments, smart fans significantly improve air quality control compared to traditional fans, thereby optimizing the operation of ventilation equipment and enhancing indoor air quality.

T240029

Power Distribution System Reliability Assessment of the Freeport Area of Bataan (FAB)

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Keywords: reliability indices, reliability, reliability assessment software, distribution system, economic analysis

Abstract:

The distribution system's ability to provide continuous electricity is defined as reliability where its effectiveness is measured through the computation of reliability indices. This study conducted a reliability assessment and evaluation of the distribution system of the Freeport Area of Bataan (FAB). A Reliability Assessment Software was also developed which automated the computation of indices such as SAIFI, SAIDI, CAIFI, and CAIDI. Through the conduct of reliability assessment and evaluation, the low-performin sections of the distribution network of FAB was successfully identified. After the identification of the low-performing sections of the said distribution facility, line reconductoring and redundant feeder line projects were proposed to alleviate and reduce the occurrence of power interruptions. An economic analysis was also conducted which showed that line reconductoring from bare conductor to insulated cable is the most feasible option since it resulted to higher Benefit-Cost Ratio (BCR) and a positive Net Present Value (NPV) for all the cases tested.

T240032

Identifying Barong Tagalog Textile using Convolutional Neural Network and Support Vector Machine, Through Structural Pattern Segmentation

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Keywords: Support Vector Machine (SVM), Convolutional Neural Network (CNN), Machine Learning, Textile Classification, Structural Pattern

Abstract:

The Barong Tagalog is a formal attire traditionally worn by men during special occasions. Despite its cultural significance, distinguishing between the Cocoon, Jusi, and Piña-silk types of Barong Tagalog can be challenging due to their similar color characteristics. Although these textiles may share similar hues, their patterns and textures can differ significantly, leading to potential misidentification by individuals. This study proposes the application of machine learning techniques, specifically Convolutional Neural Networks(CNN) and Support Vector Machines (SVM), to identify structural patterns in textile classification. The system employs a Raspberry Pi 4 Model B as the microprocessor and a Raspberry Pi Camera V2 for image capture. A comprehensive testing phase was conducted, involving 30 sample images per classification and an additional 30 unknown samples, totaling 90 tests. The prototype successfully classified 64 out of 90 sample images, achieving an accuracy rate of 71.1%. The evaluation was based on a confusion matrix. These findings illustrate the potential of integrating CNN and SVM for textile industry analysis and demonstrate how image processing can assist in the accurate identification and classification of Barong Tagalog textiles.

T240033

Simulated Adversarial Attacks on Traffic Sign Recognition of Autonomous Vehicles

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Keywords: Autonomous vehicles, adversarial attacks, simulated attacks, traffic sign attacks, LED strobes

Abstract:
With the development and application of artificial intelligence technology, autonomous driving systems are gradually put on the road. However, people have higher and higher requirements for the safety and reliability of unmanned vehicles. The autonomous driving systems installed in today's unmanned vehicles still have room to be strengthened in responding to information security attacks. If they cannot resist potential attacks, traffic accidents will occur and the lives of passengers will be exposed to risks.
This paper aims to investigate the adversarial attacks on traffic sign recognition of autonomous vehicles. We used YOLO to build a machine learning model for traffic sign recognition and conducts various simulated attacks on traffic signs to see if the recognition results are influenced. The simulated attacks include the LED light strobes, different color-light coverage, Gaussian noise and the other attacks. Regarding LED strobes and color-light overlays, translucent images are used to overlay the original traffic sign images to simulate corresponding attack scenarios. The Gaussian noise attack uses python to add noise to the original image. From the experimental results, we found that different attack methods interfere with the original machine learning model to a certain extent, affecting the ability of self-driving vehicles to recognize traffic signs. This may cause the self-driving system to fail to detect the presence of traffic signs, or make wrong recognition results.

T240034

Influence of magnetic field on double-diffusive natural convection of hybrid nanofluid within a porous cavity with complex-wavy surfaces and a partially-heated wall

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Keywords: Magnetic field, Energy flux vectors, Mass flux vectors, Porous cavity, Double-diffusive natural convection

Abstract:

The article studies the influence of magnetic field on double-diffusive natural convection behavior of hybrid nanofluid within a porous cavity with complex-wavy surfaces and a partially-heated wall utilizing the energy flux vectors and mass flux vectors for visualizing purpose. Numerical studies are imposed for exploring the effects of Hartmann number (Ha), Rayleigh number (Ra), buoyancy ratio (N), Lewis number (Le), Porosity (ε), and Darcy number (Da) on the energy flux vectors (E), mass flux vectors (M), mean Sherwood number (Shm) and mean Nusselt number (Num) within the cavity. Results indicate that the mean Sherwood number and mean Nusselt number enhance with a raising Ra, an enlarging Da, a magnifying ε, an augmenting buoyancy ratio, and a reducing Ha. Results also indicate that the mean Sherwood number increases but the mean Nusselt number diminishes with a reducing Le.

T240035

The Relationship of Optimal Cutting Parameter and Surface Roughness in Dry Milling

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Keywords: Industrial Internet of Things, sound level meter, Taguchi method, automatic processing, surface roughness

Abstract:

The processing industry is gradually transforming from traditional to automatic intelligent processing in response to low volume and high variability mode changes for customized products. Processing quality, efficiency, and cost are significant considerations in the manufacturing process. This research applies the Industrial Internet of Things (IIoT) and noise technology to automated milling systems, shedding light on the relationship between noise, vibration, workpiece surface roughness, and cutting-tool wear in automatic processing. The study begins by utilizing the Taguchi method to identify the optimal cutting parameter values. An IIoT, accelerometer, and sound level meter are integrated into the automated cutting system to capture vibration and noise data during the cutting process. The workpiece surface roughness and end milling cutter wear in experimental processes are then measured. The data analysis uncovers a mutually causal relationship between noise, vibration, workpiece surface roughness, and cutting-tool wear, providing practical insights for optimizing tool change timing and reducing processing costs, thereby equipping the industry with valuable knowledge for future advancements.

T240036

LQR control implementation of a rotary inverted pendulum using Elvis iii Embedded platform

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Keywords: Rotary inverted pendulum, Lagrangian equation, Linear Quadratic Regulator, Embedded System

Abstract:

Modern education is increasingly characterized by diversity and the need for extensibility. Educational experimental platforms are rapidly evolving; however, many software and hardware integrations are controlled by major domestic manufacturers, which imposes limitations on the development of teaching materials. This paper proposes and investigates the implementation of a rotational inverted pendulum control system on the NI ELVIS III embedded system experimental platform. The mathematical model of the rotational inverted pendulum is obtained using the Lagrangian equations and then represented in matrix form. Following the linearization of the nonlinear state equations, the Linear Quadratic Regulator controller of the rotational inverted pendulum apparatus is designed and implemented on the NI ELVIS III embedded system by LabVIEW graphical programming software. Illustrations are generated to compare the continuous tracking performance of the LQR and PID controllers against set target values. The results are then analyzed to evaluate and contrast the effectiveness of both control strategies in tracking the target values. The findings of this study are intended to enhance the educational content related to the ELVIS III embedded system experimental platform.

T240037

Augmented Reality in T-shirt Retail: Understanding User Engagement and Purchase Intention through Instagram Filters

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Keywords: Augmented Reality (AR), Instagram Filters, Purchase Intention, Mobile Shopping

Abstract:
This study explored the impact of augmented reality (AR) features, particularly Instagram filters, on consumer behavior in the T-shirt retail industry, aiming to evaluate how AR technology influences purchase intentions. As mobile shopping grew rapidly, AR emerged as a promising tool, enhancing the shopping experience by merging the digital and physical worlds. With consumers increasingly using smartphones to browse and purchase fashion, AR offered clearer product visualization, addressing key challenges of online shopping. This study employed the TIME (Theory of Interactive Media Effects) model, examining variables such as Perceived Augmentation and Interactivity as affordances, with Hedonic, Utilitarian, and Vividness factors as mediating variables. Repeat Usage and Purchase Intention were considered the outcomes. Responses from 105 participants were analyzed using the partial least squares method. The research identified interactivity as a key driver of purchase intention and repeat usage on digital platforms. While vividness and hedonic factors contributed to the overall user experience, they did not significantly affect purchase decisions or repeat usage. Interactivity and utilitarian proved more effective in driving engagement and purchase intention. The study recommended that brands prioritize interactive AR experiences to increase customer satisfaction and trust.

T240038

Performance Comparison of AI Pose Detection Models: A Case Study of AlphaPose, Lightweight OpenPose, and MoveNet

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Keywords: Fall Detection, Image Recognition, Skeleton Pose Models, Real-Time Alerts, AI

Abstract:

In June 2023, Taiwan's Ministry of Health and Welfare identified accidents and injuries as the eighth leading cause of death, with falls being the second most common cause, following transportation accidents. Falls are significant across various age groups, especially among the elderly and children, and can lead to severe physical and psychological consequences. This study proposes a real-time fall detection system utilizing image recognition technology to overcome the limitations of wearable sensors, which can be inconvenient for elderly individuals and children. The research evaluates three skeleton pose detection models—AlphaPose, Lightweight OpenPose, and MoveNet—to determine the most effective for detecting falls and issuing timely alerts. The goals are to develop a system that detects falls instantly and notifies family members or medical personnel to provide immediate assistance, thus reducing potential harm. By comparing the performance of these models, the study aims to enhance the efficiency of fall detection and improve the overall safety and quality of life for vulnerable individuals.

T240039

Application of 3D vision and networking technology for measuring the positional accuracy of industrial robots

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Keywords: position accuracy, industrial robot, CCD, DOF

Abstract:

In this study, a position accuracy measurement system for the industrial robot based on the 3D vision and Networking technology has been proposed. The 3D vision system comprises a Charge Cupled Device (CCD) module, reference sphere module and signal processing module. The reference sphere module is used to be the sensing object. The CCD module is used to capture the displacement image of the reference sphere module. The signal processing module is used to receive the signals output from the CCD module, and is used with the self-developed programming interface to calculate the X, Y, Z, θx, θy (namely five-degree-of-freedom, 5-DOF) position accuracy of industrial robot.

Experimental results demonstrate that the related linear (X, Y, Z) and angular (θx, θy) accuracy of 3D vision system was about 3 μm and 0.15 degrees respectively. Moreover, a Networking architecture is used to connect the controller of the machine tool and the industrial robot for the same motion path planning, and the industrial robot can be calibrated by using the high precision machine tool with 3D vision-based position accuracy measurement system.

T240040

Development of micro wind turbines combined with nanoceramic organic hybrid resin

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Keywords: vertical-axis wind turbine, outer rotor generator design, nano ceramic organic hybrid resin, finite element analysis

Abstract:

This paper presents an improved design of a small vertical-axis wind turbine (VAWT) for urban community applications, focusing on the design of an outer rotor generator. Finite element analysis (FEA) software was utilized as the platform for design and performance analysis. Through geometric structural parameters, such as magnet width, shoe width, etc., as control factors, the goal is to achieve low cogging torque and high power. Next, the generator was manufactured and developed with nano-ceramic organic hybrid resin as a self-adhesive material, which was used to bond the stator to improve the power, efficiency and heat dissipation effect of the generator. Simulation results showed that the generator could produce an output power of 316 W with an efficiency of 81.2% and a cogging torque of 0.01 N.m at a rated speed of 400 rpm. The outer rotor generator was manufactured by nano-ceramic organic hybrid resin lamination and traditional welding. Test results show that at a rated speed of 400 rpm, the output power of the self-adhesive stator is 4% more than that of the welded stator, and the efficiency is increased by 5%. The heat dissipation test results show that the convergence temperature of the self-bonded stator is 59.5 °C at an output power of 400 W, which is approximately 8.1% lower than the 65.2 °C of the welding group.

T240042

TOPCon and PERC solar module testing and discussion

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Keywords: TOPCon, PERC, electroluminescence tests, power degradation

Abstract:

The TOPCon (Tunnel Oxide Passivated Contact) solar cell is a type of solar cell that utilizes an ultra-thin tunnel oxide layer as its passivation layer structure. The performance difference between TOPCon and Passivated Emitter and Rear Cells (PERC) solar cells is significant, primarily due to differences in their structure and operational characteristics. Compared to PERC, TOPCon involves additional processes such as boron diffusion, tunnel oxide deposition, polysilicon doping, and cleaning, while eliminating the need for laser grooving. Most PERC production lines can be converted to TOPCon production lines, thus reducing equipment investment costs, making it a promising candidate to replace PERC products in the future. This study focuses on two different manufacturing technologies for TOPCon and PERC solar modules available in the market, conducting Electroluminescence (EL) tests to analyze the phenomenon of power degradation in solar modules after exposure.

T240043

Monitoring Leg Muscle Strength Symmetry via Electromyography

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Keywords: EMG, heart rate, muscle symmetry

Abstract:

Muscles are a part of the human body, and many movements rely on the leg muscles for power or weight-bearing. However, leg muscle symmetry is often ignored. To address this matter, this study deploys electromyography (EMG) to monitor uneven or asymmetric muscle strength between the legs. The developed system consists of EMG for detecting subject leg muscles and an HW827 sensor for monitoring subject heart rate. We display experimental data on the Node-RED dashboard and store them in SQLite database. These experimental results show that two subjects reach moderate levels of exercise intensity, and their non-dominant leg EMG values are higher than those for the dominant leg.

T240046

Characterization of Six Common Household Pollutants in a Multilayered Indoor Air Quality System for Monitoring and Reducing Volatile Organic Compounds (VOC) and Particulate Matter (PM2.5)

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Keywords: air pollution, indoor air quality, VOC, PM2.5, air filtration

Abstract:

Air pollution, a significant health concern identified by the WHO, poses serious health risks and climate impacts. WHO data indicates that 99% of the global population breathes air with pollutant levels exceeding safe guidelines. Indoor Particulate Level (IPL) is approximately 20% higher in naturally ventilated buildings compared to mechanically ventilated ones. Volatile Organic Compounds (VOCs), found in products like pesticides and gasoline, and pollutants like PM2.5 and PM10, contribute to these health risks. This study aims to characterize six common household pollutants, focusing on their concentrations and potential health impacts indoor environments. By understanding these pollutants, the study seeks to improve indoor air quality and mitigate associated health risks. The results showed that for TVOC LPG has the highest level of concentration at only 23.8% filtered while for PM2.5 vape has the highest concentration at 83.3% filtered. No significant difference was observed among the TVOC values of candle, mosquito coil, and cigarette. However for PM2.5, frying and LPG has the same levels of concentration while the other groups are statistically similar.

T240047

Development of UHF Loop Antenna using Solar Panel Frame Attached to CubeSat

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Keywords: Antenna, CubeSat, Loop, UHF, Solar cell

Abstract:

For more than twenty years, CubeSats have been widely employed as a low-cost and effective access to space for flight technology demonstrations and scientific explorations. However, system design and integration are often compromised by extreme space environments, subsystem size constraints, and limited DC power resources. For instance, the long-range (hundreds of kilometers) radio-frequency (RF) telecommunication with ground stations, in theory, calls for bulky antennas of large aperture for realizing highly directional beams. The conventional electrically large antenna, say helix antenna as an example, appears to be a good candidate in that regard. Unfortunately, the size constraint renders the helix less favorable unless the deformation/reconfigurability of some sort has to be introduced for compactness. In [1], the stowed configuration was demonstrated but the challenging kinetics during the antenna deployment has to be carefully addressed for an effective design. Similarly, the solar-panel-integrated patch/slot antennas [2] were presented to reduce the space and weight for antenna accommodation, but the design is rendered very challenging owing to the panel's impact on antenna performance and fabrication difficulty.

With the size and weight constraints, we propose a UHF loop antenna design via exploiting the metallic panel frame that is originally employed as a structure to support and secure the photovoltaic cells. Technically, the loop operating frequency is simply determined with the perimeter of the frame, and the circular-polarized radiation can be synthesized with four loops anchored to the four sides of the CubeSat. Indeed, the proposed configuration is much easier for fabrication, and the panel can uplift the antenna directivity instead of deteriorating the antenna performance.

[1] M. Sureda et al., "Design and Testing of a Helix Antenna Deployment System for a 1U CubeSat," in IEEE Access, vol. 9, pp. 66103-66114, 2021.

[2] T. Yekan and R. Baktur, "Conformal Integrated Solar Panel Antennas: Two effective integration methods of antennas with solar cells," in IEEE Antennas and Propagation Magazine, vol. 59, no. 2, pp. 69-78, April 2017.

T240048

Tunnel Traffic Enforcement Using Visual Computing and FPGA-based Vehicle Detection and Tracking

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Keywords: KNN, Foreground Detection, FPGA, Traffic Enforcement, Smart Traffic Management.

Abstract:
In Taiwan, tunnels are commonly found in small, enclosed environments on highways, roads, or city streets. They are typically constructed to pass through mountains or beneath crowded urban areas. To prevent safety incidents in these confined environments, single-lane or multi-lane one-way roads within tunnels generally prohibit lane changes, slow driving, or speeding. This study employs a foreground detection algorithm based on KNN and Gaussian Mixture Models, collecting approximately 400 frames. The KNN method is used to gather the first 200 frames of image data, which are then processed to remove differences and estimate a high-quality background. Once the background is obtained, new images are subtracted from the background image to extract the vehicle foreground. The background image is processed using Canny edge detection and the Hough Transform to calculate road lines. At the same time, ORB (Oriented FAST and Rotated BRIEF algorithm is employed to track vehicles in the foreground image, determining their movement positions and identifying lane deviations. This method also allows for the calculation of traffic flow and abnormal movements. In practice, we accelerate image processing using xfOpenCV provided by the PYNQ platform on FPGA Xilinx Zynq, giving the entire system the following advantages. The system does not require pre-labeled training models and only needs to be installed during the daytime, automatically collecting the required footage. For real-time monitoring, the proposed method achieves a tenfold increase in computation speed compared to YOLOv4-tiny. Additionally, it uses less than 1% of YOLO's storage space. In terms of cost, the proposed system operates stably using the PYNQ platform with existing surveillance cameras, without the need for additional hardware setup. These advantages make the designed system more suitable for smart traffic management compared to other existing frameworks.

T240049

Abaca Blend Fabric Classification using Yolov8 Architecture

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Keywords: Blended Abaca Fabric, YOLOv8 Architecture, Raspberry Pi4, Camera Module v3, Fabric Classification

Abstract:

Developments in deep learning have assisted in various operations in different industries. In the textile industry, fabric classification is a process in which the professional must have a trained eye or experience handling the specific fabric. It poses a problem for fabrics like abaca, where the same base material is intertwined with a different material. The versatile nature of Abaca is used in various products like paper bills, ropes, handwoven handicrafts, and fabric. Abaca fabric is an unsought product of fabric due to its rough texture. Blended Abaca fabrics are traditionally mixed with cotton, silk, and polyester. However, due to the combination of the characteristics of the materials, the fabric classification is more likely to be prone to human error. This study aims to create a device capable of classifying blends of Abaca fabric using YOLOv8 Architecture. The study will use a Raspberry Pi 4B with Camera Module v3 to capture images for classification. The dataset curated consists of 4 blends, specifically, Abaca, Cotton Abaca, Polyester Abaca, and Silk Abaca. Five hundred (500) images were used to test the model's performance. The study achieved a performance accuracy of 94.6%.

T240055

Identification of Grass Weed Species using Yolov5 Algorithm

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Keywords: Grass Weed Identification, YOLOv5, Image Processing, Raspberry Pi, Confusion Matrix

Abstract:
Grass weeds are considered as one of the major pests that compete for nutrients, space, and water, which pose a challenge to agricultural activity. With advancements in technology, these pests can be identified and removed. This research focused on the application of computer vision techniques that can be used for grass weed management control by knowing the specific type of grass weed. Knowing the specific type of weed helped with the right selection of weed control measures, which can potentially lessen the use of harmful substances such as herbicides and weedicides in a field. The YOLOv5 algorithm was used to perform this study, and it was trained by using training images that the researcher personally captured. These images were then processed with data augmentation techniques. By successfully training the YOLOv5 algorithm with mainly four different grass weed types and using Raspberry Pi to create a portable prototype, the study achieved an overall accuracy rate of 95.31% when detecting and identifying the target object. This showed that this study was able to develop a system that can detect and identify the four main weed types of this research, which may contribute to the improvement of weed control management by using computer vision technology.

T240057

Simulation of Staged Combustion Functions in Double P-Type Radiant Tubes

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Keywords: Double P-type Radiant Tube, —Double P-type Radiant Tube, Numerical Simulation, CFD, Staged Combustion

Abstract:

Radiant tubes serve as critical heat source components in industrial furnaces, and they are widely utilized across various furnace types. To enhance the thermal efficiency of radiant tubes, the most common and direct approach is to extend the length of the tube. This prolongs the residence time of flue gases inside the tube, facilitating more thorough heat exchange. However, excessively long radiant tubes may introduce issues related to strength and rigidity, which can shorten the tube's service life. To address these concerns, combining radiant tubes with finned-tube heat exchangers can recover the thermal energy of high-temperature flue gases to preheat combustion air, achieving energy savings without the need to extend the tube length.

However, while preheating with high-temperature flue gases significantly boosts efficiency, it may also lead to an increase in nitrogen oxides (NOx) emissions, posing potential environmental concerns. To address this issue, this study proposes four different nozzle designs, combining staged combustion technology to reduce NOx formation. Initially, the methane-air mixture undergoes primary combustion in the combustion chamber, followed by secondary combustion through the nozzles. Simulation results indicate that lowering the flame temperature effectively suppresses NOx formation. As the nozzle orifice diameter in the staged combustion system decreases, the flame position gradually shifts toward the bottom of the radiant tube, causing changes in flame size and shape, which subsequently affect the temperature distribution along the tube walls.

Additionally, the study conducted numerical simulations on U-shaped radiant tubes without heat exchangers under the same conditions, comparing the results with radiant tubes equipped with staged combustion technology and heat exchangers. The findings show that U-shaped radiant tubes exhibit higher flame and average wall temperatures at the same flow rate, with significant temperature differences between the walls of both sides. Furthermore, NOx emissions from U-shaped radiant tubes were found to be 20 times higher than those from double P-type radiant tubes.

T240058

IoT for Enhancing Public Safety, Disaster Response, and Emergency Management

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Keywords: Process innovation, IoT, Disaster, Emergency management

Abstract:

The Internet of Things (IoT) offers transformative capabilities in enhancing public safety, disaster response, and emergency management by leveraging interconnected devices and real-time data. Through IoT, smart sensors and networks can be deployed across cities and environments to monitor critical parameters like air quality, structural integrity, and environmental changes. These systems provide early warnings for natural disasters such as earthquakes, floods, and wildfires, enabling authorities to respond proactively. In emergency management, IoT devices can help coordinate resources and improve situational awareness during crises. Real-time data from wearable devices, smart infrastructure, and communication systems allow responders to track people, manage evacuations, and deploy resources more effectively. For example, IoT-enabled drones and autonomous vehicles can be used to deliver supplies or assess damage in hazardous areas without risking human lives. IoT technologies improve post-disaster recovery by continuously monitoring areas for safety hazards and supporting infrastructure restoration. Smart traffic management systems can assist in controlling traffic flow for emergency vehicles, while IoT-based communication networks can ensure connectivity when traditional systems fail. IoT significantly enhances the speed, accuracy, and effectiveness of disaster response and public safety operations, leading to better protection of communities and faster recovery from emergencies.

T240059

Machine Learning in Evolving Art Styles: A Study of Algorithmic Creativity

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Keywords: Machine learning, Deep learning algorithm, Contemporary artworks, Process innovation

Abstract:

Machine learning (ML) has played an increasingly pivotal role in shaping and evolving artistic expression, leading to new forms of algorithmic creativity. This study explores how ML models, particularly deep learning algorithms like generative adversarial networks (GANs), have contributed to evolving art styles by learning from vast datasets of historical and contemporary artworks. These algorithms mimic artistic techniques, generate new styles, and even create novel art forms that blend or deviate from traditional artistic boundaries. The study also highlights the challenges of algorithmic creativity, such as concerns about authorship, originality, and the potential loss of human touch in art. The role of machine learning in art raises important philosophical and ethical questions about the nature of creativity and the evolving relationship between human artists and machines. Machine learning has become a powerful tool in expanding the possibilities of artistic expression. While AI-generated art challenges traditional notions of creativity, it also opens up new horizons for collaboration and innovation in the art world, potentially leading to entirely new art styles in the digital age.

T240060

Optimum Research on General Milling of Al-Ni Alloy by Taguchi Method

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Keywords: General milling, Al-Ni alloy, Taguchi test method, surface roughness, residual stress.

Abstract:

With the rapid development of the aerospace industry, the processing methods for some difficult-to-machine aerospace materials have gradually shifted from traditional cutting methods. This study aims to explore the parameters of general milling and identify the important process parameters, including spindle speed, feed rate, cutting depth, and tool diameter. The Taguchi Method is then used to obtain the optimal parameter combination and its contribution to surface roughness.

In the experiment, the spindle speed parameters were set at 2000rpm, 2500rpm, and 3000rpm; the feed speed parameters were set at 400mm/min, 500mm/min, and 600mm/min; and the milling depth parameters were set at 0.2mm, 0.4mm, and 0.6mm. Based on the experimental results, the following conclusions can be drawn: the optimization factors for surface roughness in general milling are spindle speed A2 (2500rpm), feed speed B2 (500 mm/min), cutting depth C2 (0.15 mm), and tool diameter D3 (4 mm). After conducting a single quality optimization analysis and verification experiment, the optimized surface roughness measurement data is Ra 0.23 um, which is an improvement of 56.52% compared to the average best value of Ra 0.36 um from 9 groups.

T240061

Digital Twins for Vibration and Thermal Error Compensation in 3-Axis Machine Tools

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Keywords: Finite Element Analysis, Static and Dynamic, Lattice optimization, Digital Twins, Thermal deformation

Abstract:

Improvement of the vibration reduction capabilities of machine tools is essential for achieving optimal performance of challenging-to-machine materials. This investigation provides a thorough examination of the temperature characteristics, deformation, vibration, and stiffness in 3 axis machine tool (LG1370), employing both analytical and experimental methodologies. A thermal field model is constructed to replicate the heat distribution inside machine tool structures, demonstrating notable localized temperature elevations in close proximity to heat sources and negligible increases in remote areas (< 0.5 °C). The analysis focused on thermal deformation in the machine tool and spindle. The highest value of Z-axis deformation in the column was found to be -43 μm, which had an impact on the accuracy of the machine. Furthermore, the work investigates the influence of vibration in ultra-precision machining, with a specific emphasis on surface quality and structural integrity. Principal Eigen frequencies and modal shapes were determined using Experimental Modal Analysis (EMA) and Finite Element Analysis (FEA), revealing a robust agreemen between simulations and experimental data. In addition, the static and dynamic stiffness are assessed. The static stiffness analyses showed spindle deformations of 126.3 micrometres and worktable deformations of 40 micrometres. This study confirms the efficacy of the suggested analytical models in forecasting thermal errors, structural vibration, and stiffness performance, so establishing a strong foundation for enhancing machining accuracy. The combined approach of additive manufacturing and topology optimization is applied for the construction of sophisticated lattice structures. Topology optimization is applied to generate three lightweight lattice designs optimized under prescribed compressive loading conditions. The resulting structures are manufactured by additive manufacturing, effectively demonstrating the feasibility and practicality of lattice structure selection via topology optimization for lightweight design applications.

T240062

ESG and Financial Performance in the Semiconductor Industry: Causal Analysis Using Machine Learning and fsQCA

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Keywords: Sustainability, Machine Learning, fsQCA, ROA, ROE

Abstract:

Global economic growth has significantly impacted the environment, with industrial development contributing to increased greenhouse gas emissions, thus accelerating climate change. This has prompted global concern regarding environmental sustainability. Policies have driven corporations to adopt sustainable practices. Specifically, the semiconductor industry, a high-tech sector that is both technology- and capital-intensive, has shifted its focus from solely manufacturing to encompassing environmental sustainability, social responsibility, and corporate governance (ESG) considerations. The implementation of ESG policies not only aligns with global sustainability efforts but also necessitates the acquisition of additional financial support.

To explore the impact of ESG implementation on operational performance, this study selected publicly available ESG data from Taiwan's publicly listed semiconductor companies. A purposive sampling method was used to select 30 semiconductor firms. Machine learning models were applied to identify significant features including two environmental variables, four social variables, and two governance variables. Subsequently, the fuzzy set qualitative comparative analysis (fsQCA) method was employed to examine the causal relationship between ESG policy implementation and operational performance. This study evaluates how ESG ratings influence return on assets (ROA) and return on equity (ROE) and assesses the changes ir operational performance before and after ESG implementation in the semiconductor sector.

The results of this study indicate that the implementation of ESG in Taiwan's semiconductor industry is positively correlated with ROA and ROE, with the most significant factor being the board meeting attendance rate, followed by the average employee welfare, greenhouse gas emissions, and total weight of waste management. However, a negative correlation was observed with the proportion of female managers in senior positions. Through the analysis of ESG implementation effects, this study offers strategic recommendations for the semiconductor industry to enhance its contribution to sustainability goals.

T240063

Exploring the Impact of Carbon Pricing on Inflation

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Keywords: Carbon Pricing, Inflation, Emissions Trading System, Carbon Taxes, New Keynesian Phillips Curve

Abstract:

This study explores the inflationary effects of carbon pricing mechanisms, focusing on Emissions Trading Systems (ETS) and carbon taxes, using a New Keynesian Phillips Curve (NKPC) framework. Analyzing panel data from 35 OECD countries spanning 2004 to 2022, the results indicate that both ETS prices and carbon taxes exert significant impacts on the Consumer Price Index (CPI). Specifically, a $10 per ton increase in ETS prices leads to a CPI increase ranging from 0.018 to 0.043, depending on the model specification. Conversely, carbon taxes, when tested for robustness, also show a significant inflationary effect with CPI increases between 0.051 and 0.068. Unemployment's impact on CPI varies between models, exhibiting both positive and negative effects, while real labor costs consistently contribute to upward inflationary pressure. Additionally, the real exchange rate demonstrates a generally negative relationship with CPI, suggesting that currency appreciation helps to reduce inflation. These findings underscore the complex and varied influences of carbon pricing on inflation, highlighting the necessity for policymakers to consider these dynamics when designing climate and economic policies.

T240064

Optimization Study of Conventional Grinding (CG) for Taguchi Method to SiC Ceramics

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Keywords: Taguchi Methods, SiC Ceramics, Conventional Grinding(CG), Surface roughness, Residual stress

Abstract:

This study employs the Taguchi method to optimize traditional grinding processes of SiC, and examines the influence of traditional grinding parameters on the surface roughness and residual stress of SiC materials.Utilizing the Taguchi-style robust design method L9(3 ^4)orthogonal table to formulate combinations of control factors, the chosen control factors are as follows: (A) spindle speed 、(B) feed speed、(C) single grinding cutting depth and (D) abrasive particle size. The levels for the control factor parameters range from 1 to 3：(A) spindle speed at 2000 rpm、3000 rpm、4000 rpm；(B) feed speed at 50 mm/min、200 mm/min、350 mm/min；(C) single grinding depth at 20 μm 、30 μm、40 μm；(D) abrasive grain sizes #40、#60、#100. The surface roughness and residual stress of SiC materials were measured, and the optimal parameter combination of traditional grinding was obtained through Taguchi analysis for verification experiments.

The results indicate that the optimal combination for the single quality characteristic of SiC surface roughness, utilizing the traditional grinding process, consists of a spindle speed of 4000 rpm, a feed speed of 50 mm/min, a grinding depth of 20 μm , and an abrasive particle size of #100. The most optimized Ra verification value is 0.055 μm , representing an improvement of 83.636% compared to the average value of 0.101 μm across the 9 experiments. The optimal combination for single quality characteristic of residual stress the optimal combination involves a spindle speed of 4000 rpm, a feed speed of 350 mm/min, a grinding depth of 30 μm , and an abrasive particle size of #40. The most optimized verification value is -21.5 MPa, representing an improvement of 6.977% compared to the average value of -23.0 MPa across 9 experiments. Therefore, the findings of this study can serve as a reference for related industries in their application of relevant processing techniques.

T240065

Cloud, Fog and Dew Computing for IoT Service

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Keywords: cloud, fog, dew computing,

Abstract:
The rapid development of IoT and hand-held mobile devices with high computational capabilities and Internet connectivity enabled certain parts of Clouds to be "lowered" into so called "thin clients". This led to development of the Fog-Computing Paradigm as well as development of the IoT and "Internet of Everything (IoE)" concepts. The most significant amount of information processing all around us is done on the lowest possible computing level, outright connected to the physical environment and mostly directly controlling our human immediate surroundings. These "embedded" information processing which are neither at the cloud/fog edge, nor even at the mobile edge, but rather at the physical edge of computing are the basis of the Dew Computing Paradigm. Primarily oriented towards the physical-edge, human environment control devices i.e. lighting, traffic control, heating, cooling, energy distribution etc., where human control of the environment must take precedence over possible higher-level requests, or at least be coordinated with them, without disturbing the immediate human environment. This is the reason why in Dew-Computing there are two basic notions, which do not exist in the rest of the hierarchy, in the Fog and in the Cloud: self-sufficiency and co-operation. The major challenge is enabling seamless integration of those devices with higher level equipment into the Fog and Cloud, which leads to novel prospects of development and new usage scenarios.
The basic Dew-Computing element is the Dew-droplet, which consists of a self-organising co-operational communication layer, an ontological "interpreter" and individual physical Dew-devices, which contain all necessary sensors, effectors and needed algorithms to be able to independently perform their job. In other words, individual physical microcontrollers may or may not produce information (i.e. ontologically context full messages), but minimally have to have the ability to receive "suggestions" and transmit data. Naturally, specific application solutions will have to be developed to physically and informationally connect Dew-devices and Dew-droplets in the Dew-Computing Ecosystem.

T240066

ESG-Driven Engineering in Smart Energy Networks

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Keywords: ESG, Manufacturing technology, Process innovation

Abstract:

The integration of Environmental, Social, and Governance (ESG) principles into smart energy networks is reshaping the energy sector, driving sustainability, operational efficiency, and corporate responsibility. This paper explores the role of ESG-driven engineering in the design, deployment, and management of smart energy networks, with a focus on minimizing environmental impact, promoting social equity, and ensuring governance transparency. By leveraging Internet of Things (IoT) devices, advanced communication technologies, and data analytics, smart energy networks can optimize resource distribution, reduce carbon footprints, and enhance energy efficiency. Environmental benefits include the integration of renewable energy sources, real-time monitoring of emissions, and predictive maintenance to reduce energy wastage. Socially, these networks provide equitable access to clean energy, improving energy reliability in underserved areas. From a governance perspective, ESG frameworks foster transparency in energy reporting, compliance with regulatory standards, and responsible data management. This paper presents case studies of successful ESG implementations in smart grids and examines the technical challenges and future opportunities for engineering innovations that align with ESG goals, emphasizing the importance of interdisciplinary collaboration and policy support in advancing sustainable energy solutions.

T240067

Soft Robotics: Engineering Flexible Automation for Complex Environments

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Keywords: Soft Robotic, Automation, Emerging material, Process innovation

Abstract:

Soft robotics represents a transformative approach to automation, focusing on the design and development of robots constructed from flexible, compliant materials that mimic biological systems. Unlike traditional rigid robots, soft robots are engineered to adapt and operate efficiently in complex, unstructured environments, making them highly suitable for applications that require delicate manipulation, safe human-robot interaction, and mobility in uncertain terrains. This paper explores the key principles, materials, and fabrication techniques behind soft robotics, highlighting their versatility in industries such as healthcare, agriculture, and search-and-rescue operations. The core of soft robotic systems lies in their ability to deform and respond to environmental stimuli, enabling new paradigms in automation for tasks that demand flexibility, such as handling fragile objects, navigating narrow spaces, or interacting with humans. Emerging materials, such as elastomers, hydrogels, and shape-memory alloys, are driving innovations in actuation and sensing mechanisms, expanding the capabilities of soft robots in real-world applications. The paper also examines the challenges associated with the control and energy efficiency of soft robots, as well as opportunities for integrating AI and advanced sensing to enhance autonomous decision-making. Through case studies and experimental data, this research outlines the potential of soft robotics to revolutionize sectors requiring adaptive automation, ultimately contributing to safer, more efficient, and sustainable technological advancements.

T240068

Analysis of the Compressed Air Energy Storage system and evaluation of financial feasibility-A case study

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Keywords: compressed air energy storage, efficiency, financial feasibility

Abstract:

This study focuses on analyzing the performance and financial feasibility of a compressed air energy storage (CAES) system in a potential region in the Miaoli County with the aquifer in the underground structure. There are three parts of the present study. The first part involves performance analysis of the system using the commercial software Flownex. Initially, a model for the Huntorf case in Germany was built and compared for validation. The calculation results showed a deviation of about 1% in terms of efficiency, confirming the analytical capabilities and model accuracy. After verifying the system performance analysis model, the scale of output power was adjusted to 2 MW as a test case for the initial development and subsequent planning. The second part involves an analysis of geological characteristics, using multiphysics coupling software COMSOL to establish a multiphase flow analysis model. This model evaluates the flow rate and pressure required for the operation of the CAES system. Lastly, a financial analysis was conducted based on the results of first and second parts, estimating the cost of system components and evaluating the levelized cost of the proposed CAES system. Finally, a comparison with other energy storage technologies was made to assess the financial feasibility of the analyzed CAES system.

T240069

vFerryman: An AI-Driven Personalized Companion Providing Calming Visuals and Social Interaction for Emotional Well-Being

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Keywords: AI Companion, Emotional Well-Being, Mental Health, CrewAI, LLMOps

Abstract:

With growing awareness of mental health issues, there is a rising demand for innovative tools that offer effective emotional support. This paper introduces vFerryman, an AI-driven personalized emotional companion system. The system employs advanced natural language processing and machine learning techniques, utilizing the CrewAI framework to seamlessly integrate multiple AI agents, each responsible for distinct AI applications. These agents work together to provide customized, interactive experiences tailored to users' emotional states and personal preferences. Furthermore, vFerryman integrates LLMOps methodologies to efficiently manage and optimize large language models, allowing the system to dynamically adjust to real-time emotional feedback. A key feature of the system is the calming aquarium module, designed to create a soothing visual environment that helps alleviate stress and anxiety. Additionally, the system's social interaction features promote emotional connections and facilitate experience sharing among users. This paper evaluates the potential of the vFerryman system to enhance emotional well-being and support positive social interactions, while also highlighting opportunities for further technological advancements and innovative applications in the field of emotional support systems.

T240071

Detection of AI-Generated Product Reviews on Amazon

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Keywords: AI content detection, NLP, TF-IDF, SVM, Machine learning

Abstract:

Amazon product reviews have been flooded with AI-generated texts that offer minimal value to potential buyers. These AI reviews merely echo the product titles and descriptions without providing any authentic insights on how buyers feel when using the products. This study aims to develop a method for identifying and filtering AI product reviews, thereby enhancing the quality of the review-reading experience. The researcher compiled a dataset of 6,217 Amazon reviews including 1,116 identified as AI-generated. They are classified as AI or human reviews with 99.25% F1 score accuracy on the test data using TF-IDF and SVM This research contributes to the detection of AI-generated content on the internet, fostering a more authentic and reliable platform.

T240072

A Study on the Development of an Educational System for Buddhism and Meditation Using Virtual Reality Technology

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Keywords: Metaverse technology, Meditation culture, Virtual reality

Abstract:

In Taiwan, the professional training for Buddhist meditation often demands significant time and space resources. These limitations in time and space also reduce the effectiveness of learners' practice. Therefore, metaverse technology will be utilized in this project to enable students to deeply engage with Buddhist and meditation cultures, offering them the opportunity to learn virtual reality technology and further guiding them in developing a virtual reality system for meditation practice. The aim of this study is to create a virtual space for Buddhist studies, providing practitioners with a more immersive environment for meditation. Moreover, through in-depth learning of Buddhist culture, students can develop creative meditation training models under the guidance of experienced practitioners. This system features three main characteristics: (1) creating a virtual space for Buddhist studies and meditation, (2) providing educational and training models for Buddhist practice, and (3) enabling meditation through virtual reality at any time and place. Finally, through the validation of this research methodology, the system has been proved to be applicable in current virtual reality environments for Buddhist cultural settings, further promoting cultural heritage through digital technology and fully developing metaverse technology.

T240074

Design of Handwritten OPA Circuit Recognition and Instructional Animation Generating System for Smartphones

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Keywords: Handwritten circuit, electronic components recognition, engineering education, deep learning, object detection

Abstract:

With the recent developments in neural network, many advances were achieved in understanding handwritten texts so far. There are many researches on handwritten circuit analysis, but few of them concerning on the operational amplifier (op-amp) circuits. When people encounter or draw an op-amp circuits and wish to identify the type and characteristics of the op-amp, they often go to use image search tools like Google Images. However, these tools usually yield irrelevant results. It is frustrated for those seeking to learn about op-amps. As digital tools become increasingly prevalent in education and engineering, there is a pressing need for an accurate method to handle handwritten op-amp circuit diagrams. This paper introduces a new system designed for smartphone to recognize op-amp circuits and generate real-time instructional animations of their circuit diagram and characteristics. The system uses a deep neural network based on YOLO (You Only Look Once) to identify electronic components. It determines the type of circuit by analyzing the identified components and their relative positions. Once the type of op-amp circuit is established, users can input specific electronic component parameters, and the system generates waveform animations of the circuit's input and output voltages using Manim. In order to evaluate the effectiveness of this system, we have created a dataset of various handwritten op-amp circuits. The proposed system aims to enhance the learning effect and engagement by providing immediate, accurate visual representations of op-amp circuit characteristics.

T240075

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

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Keywords: DSSCs, Copper Chlorophyllin Sodium, Carboxylic, TiO2, doctor blade method

Abstract:

In this study utilized titanium dioxide (TiO2) to fabricate photoanode films using the doctor blade method and prepared dyes by incorporating sodium copper chlorophyllin powder into different solutions. Acetic acid (Glacial Acetic Acid, HOAc) and citric acid (Citric Acid, CA), both containing carboxyl groups, were added to the dye to investigate the impact on the photoelectric conversion efficiency of dye-sensitized solar cells (DSSCs) compared to the original dye.

The results indicate that adding pH 4+0.1ml of acetic acid or citric acid to the sodium copper chlorophyllin dye and encapsulating it into DSSCs increased the photoelectric conversion efficiency by 10.5% and 14.0%, respectively, compared to the original dye. On the seventh day, J-V curve measurements showed that, compared to the first day, the short-circuit current of DSSCs with acetic acid and citric acid increased by 7.14% and 5.91%, respectively, while the fill factor decreased by 9.03% and 1.32%, respectively.

These results indicate that the addition of citric acid to the sodium copper chlorophyllin dye enhances the photoelectric conversion efficiency of DSSCs. Additionally, the J-V characteristics after seven days of encapsulation demonstrated higher stability and lower energy loss, as observed from the fill factor. This suggests that sodium copper chlorophyllin dye exhibits higher feasibility and stability for practical applications.

T240076

The Impact of Binary Solvent Systems Based on Methyl Acetate on the Crystalline Quality of Perovskite Films

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Keywords: Perovskite Solar Cells, MAPbI3, Methyl Acetate, Antisolvent

Abstract:

As perovskite solar cells have garnered widespread attention due to their high photovoltaic conversion efficiency and low manufacturing cost potential, the crystallinity of the film has become one of the critical factors affecting its performance. This study systematically investigated the crystallinity of perovskite layers by adjusting the mixed ratio of anti-solvents methyl acetate (MA) and chlorobenzene (CB), optimizing the preparation process of perovskite layers.

The study results showed that using methyl acetate as an anti-solvent, the average size of the perovskite crystallites was 182 nm, with the largest crystallites reaching 498 nm. However, there were many pores, which negatively impacted photovoltaic conversion efficiency. By adding different proportions of chlorobenzene, it was found that when 40 vol% chlorobenzene was mixed, the average size of perovskite crystallites increased to 348 nm, with the largest crystallites reaching 772 nm. Additionally, the number of pores significantly decreased, and surface roughness was reduced to 17.6 nm, resulting in a photovoltaic conversion efficiency of 1.54%. However, further increasing the proportion of chlorobenzene to 50 vol% led to stratification of the perovskite layer crystallites, causing a deterioration in grain size and surface roughness and a decrease in photovoltaic conversion efficiency.

In summary, this study successfully improved the crystallinity and surface smoothness of perovskite layers by adjusting the mixed ratio of anti-solvents, thereby enhancing photovoltaic conversion efficiency. Therefore, it can be concluded that mixing an appropriate amount of chlorobenzene in methyl acetate solvent can improve the crystallinity, absorption rate, and efficiency of perovskite thin films.

T240077

RPA Based Functional Test Automation of High-Speed ADC Customer Evaluation Boards

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Keywords: Robotic Process Automation (RPA), High-speed ADCs, Automated testing, Test efficiency, Testing accuracy

Abstract:

With increasing complexity and demand for electronic components, evaluation boards provide the customer a way to assess if that component is suitable for their use. However, these evaluation boards are normally tested manually, and manual testing methods experience considerable challenges in terms of time efficiency, human error, and scalability.

This study addresses these issues by formulating an automated testing system based on Robotic Process Automation (RPA). The system integrates RPA with existing testing hardware for high-speed Analog-to-Digital Converter (ADC) evaluation boards to simplify processes such as configuration, data logging, and analysis of key parameters such as Signal-to-Noise Ratio Full Scale (SNRFS) and Spurious-Free Dynamic Range (SFDR).

The study's objectives include modifying the current hardware setup for automation, developing an RPA-based software solution for efficient testing, and comparing its performance with traditional methods in terms of time and repeatability. Results show a marked improvement in test time efficiency, with reductions of up to 69.68% for inexperienced operators and 41.4% for experienced ones. Additionally, the RPA-based method demonstrated high accuracy (99.9603%) and repeatability, with minimal variance between test runs.

The implementation of this system results in a more efficient and cost-effective test process that minimizes human intervention. This reduces process complexity for evaluation board functional testing, providing an effective solution to meet the growing demands of electronic components.

T240078

Application of Image Analysis Technology in Detecting and Diagnosing Liver Tumors

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Keywords: Medical images, Segmentation, Detection, Liver Tumor, Image processing

Abstract:

In this article, the proposed was applied processing technology to detect and diagnose liver tumors in patients. Our method is applied to the TCIA image dataset, which contains images of patients diagnosed with liver tumors by medical experts. These images are analyzed to detect and segment liver tumors using advanced segmentation techniques. Following segmentation, the images are converted into binary images, facilitating the automatic detection of the liver's shape. The tumors within the liver are then localized and measured. By employing these image segmentation techniques, we can accurately determine the size of the tumors. The application of medical image processing techniques, as discussed in this article, significantly aids medical experts in identifying liver tumors more efficiently.

T240079

Using Sagittal Sections and Axial Section CT Images for The Detection of Fractures and Cervical Curvature Abnormalities

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Keywords: fracture, cervical spine, Image segmentation, Computed tomography, Image enhencement

Abstract:

The human cervical spine comprises seven vertebrae (C1 to C7). Cervical fractures can compress and damage the spinal cord and nerves, while abnormal cervical curvature may cause disc herniation, bone spurs, and ligament thickening, leading to limb numbness and sensory abnormalities. This study uses CT images of sagittal sections and axial sections, employing image enhancement and segmentation techniques to detect cervical fractures and curvature abnormalities. This study helps doctors assess patient risks and conditions more accurately, aiding in better clinical decisions and treatment plans. To ensure compliance with ethical and regulatory standards, the proposal has obtained certification from the Institutional Review Board (IRB) with the reference number 202401261B0.

T240080

Use CT Image to Detect Cervical Spine Diseases: OPLL, Bone Spurs, Cervical Spondylosis

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Keywords: OPLL, Spine Diseases, Biomedical imaging, Image enhancement, Computed tomography

Abstract:
An automatic method for identifying various cervical spine pathologies, including ossification of the posterior longitudinal ligament (OPLL), bone spurs, and cervical spondylosis, in CT images is proposed. The methodology involves image resizing, cropping, histogram equalization, Gaussian filtering, gamma correction, and segmentation using Otsu's method and morphological operations. Results show promising potential in reducing processing time compared to manual interpretation.To ensure compliance with ethical and regulatory standards, the proposal has obtained certification from the Institutional Review Board (IRB) with the reference number 202401261B0.

T240081

Voltage Regulation of Data Strobe Inputs in Mobile DRAM to Prevent Unintended Activations

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Keywords: receiver, differential pairs, mobile DRAM, voltage regulation

Abstract:

In mobile DRAM receivers, the data strobe complement (DQS_c) and data strobe true (DQS_t) signals mus be maintained at high and low voltage levels, respectively, in the write data strobe off (WDQS_OFF) mode. This study proposes a voltage regulation circuit to optimize the differential voltage signals of DQS_c and DQS_t, ensuring the output is a high voltage level above 0.9 V and a low voltage level below 0.3 V, respectively. Experimental results show that the circuit can stably maintain DQS_c above 0.9 V and DQS_t below 0.3 V before the write preamble time (tWPRE) and in WDQS_OFF mode. This configuratio effectively prevents unintended activation in the mobile DRAM DQS input receiver.

T240082

Preparation of tin dioxide via low-temperature solution method for application in electron transport layer in perovskite solar cells

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Keywords: perovskite solar cells, SnO2, electron transport layer

Abstract:

Perovskite solar cells are currently the most promising fabrication technology due to their low production costs and the ability to be processed at lower temperatures, garnering significant attention. However, high-efficiency perovskite solar cells often use titanium dioxide (TiO2) as the electron transport layer, which requires high-temperature annealing, limiting their application. Therefore, this study employed a low-temperature process to fabricate a compact layer of tin dioxide (SnO2), selecting synthesis temperatures of 100°C, 140°C, 180°C, and 220°C to determine the optimal conditions for low-temperature synthesis of SnO2 as an electron transport layer.

The study found that all four synthesis temperatures successfully produced SnO2, and the crystallinity of SnO2 improved as the synthesis temperature increased. Additionally, X-ray photoelectron spectroscopy (XPS) analysis revealed that at a synthesis temperature of 100°C, incomplete reactions resulted in the formation of tin monoxide (SnO) and the presence of residual chlorine. However, as the synthesis temperature increased, the chlorine content gradually decreased, and SnO no longer appeared. UV-Vis spectroscopy and field emission scanning electron microscopy (FE-SEM) images demonstrated that the crystallinity of the perovskite layer was not affected by the SnO2 compact layer. Finally, in terms of photovoltaic conversion efficiency, perovskite solar cells with a mesoporous layer demonstrated better efficiency compared to those without a mesoporous layer. Additionally, the performance of the perovskite solar cells was optimal when the tin dioxide (SnO2) was synthesized at 180°C.

T240083

Exploration dye-sensitized solar cells on the tri-layer titanium dioxide structure doping with different dilute nano silver

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Keywords: Dye-sensitized solar cells, surface Plasmon resonance, silver nanowires, titanium dioxide, screen printing

Abstract:

Modern energy demands emphasize environmental sustainability, leading to extensive research aimed at developing solar technologies to meet current energy needs. Among solar cell technologies, third-generation dye-sensitized solar cells (DSSCs) are favored for their low cost and large-scale manufacturability. As solar cell technology advances, DSSCs face challenges in improving efficiency and reducing costs. Researchers are exploring composite materials to lower costs and enhance DSSC performance.

This study utilized screen printing to fabricate dye-sensitized solar cells and incorporated silver nanoparticles and silver nanowires to investigate localized surface plasmon resonance (LSPR) effects. The optical properties of different concentrations of silver nanoparticles and nanowires were examined, and based on these results, eight different structures were developed to potentially improve the maximum photovoltaic conversion efficiency of DSSCs.

The results indicated that incorporating silver nanoparticles increased the short-circuit current density (Jsc) from 11.90 mA/cm² to 12.59 mA/cm² and the photovoltaic conversion efficiency from 5.35% to 5.64%, an overall efficiency increase of 5%. With silver nanowires, Jsc rose from 11.90 mA/cm² to 13.94 mA/cm², and the efficiency increased from 5.35% to 6.26%, an overall efficiency improvement of 14%. Both silver nanoparticles and nanowires enhance light absorption through LSPR, and different structures can broaden the absorption wavelength. It was found that layered structures effectively reduce light scattering of silver particles and wires, with titanium dioxide and metal reflecting and scattering light, providing more photon pathways within the cell, thus increasing the absorption spectrum. For silver nanoparticles, Jsc increased from 12.59 mA/cm² to 14.13 mA/cm², and the efficiency improved from 5.64% to 6.15%, an 8% increase. Silver nanowires provided an electronic transport pathway and, through layering, reduced the risk of photon scattering, with Jsc rising from 13.94 mA/cm² to 14.70 mA/cm², and the efficiency increasing from 6.26% to 6.43%, a 2% improvement.

T240084

Implementation of Physical Unclonable Function in FPGA for Enhancing Hardware Security

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Keywords: PUF, chip security, FPGA, hardware

Abstract:

In recent years, the IC industry has undergone rapid development, with chip hardware security assuming a critical role in IC design. The Physical Unclonable Function (PUF) exploits semiconductor process variation differences, enabling it to generate unique responses randomly. Due to its non-replicability, PUF has emerged as one of the most commonly employed methods in hardware security. This paper proposes a PUF implementation employing an automatic scan selector to toggle between 8 sets of multiplexers. With an 8-bit selector, 256 state inputs can be automatically generated, and the PUF architecture produces a 256-bit unique identification code for the chip. Finally, the generated identification code can be outputted either serially or in parallel and implemented on an FPGA platform.

T240085

Optimizing Wet Scrubber Efficiency with Airfoil-Shaped Louvered Vents: A CFD-Based Performance Analysis

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Keywords: Wet Scrubber, Air Pollution Control, Computational Fluid Dynamics (CFD), Vent Angle Optimization

Abstract:

Environmental challenges, particularly air pollution, continue to present serious risks to both human health and ecosystems. As a result, the need for effective pollutant control technologies is increasingly urgent, driving advancements in the development and optimization of air pollution mitigation systems. This study examines the optimization of wet scrubbers, a key air pollution control device that removes contaminants from exhaust gases through liquid scrubbing. Specifically, the research explores the airflow dynamics within a wet scrubber fitted with louvered vents set at four different angles, assessing the impact of each configuration on pollutant removal efficiency. The scrubber components were designed and modeled using Onshape, a computer-aided design (CAD) platform, with prototypes produced via 3D printing. Computational Fluid Dynamics (CFD) simulations, conducted using COMSOL Multiphysics 5.6, were employed to analyze the aerodynamic performance and optimize vent configurations. The findings provide valuable insights into the most effective vent angles for improving scrubber efficiency, offering potential enhancements for air pollution control technologies.

T240086

Optimizing Airport Runway Planning Using Ant Colony Algorithm: A Case Study at Taoyuan International Airport

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Keywords: Ant Colony Optimization (ACO), Runway Planning, Airport Efficiency, Airside Traffic Optimization

Abstract:
This study investigates the integration of the Ant Colony Optimization (ACO) algorithm with Python and AutoCAD for airport runway planning. Efficient runway management is critical for enhancing both operational efficiency and safety in modern airports. The ACO algorithm, recognized for its robust optimization capabilities, is applied to address the complexities of runway design and traffic flow. By simulating the movement of aircraft, the ACO model identifies optimal paths, minimizing taxi times, fuel and reducing the risk of congestion. The methodology is validated through a case study conducted at Taoyuan International Airport (TPE), providing insights into its practical application for large-scale airport operations. The results demonstrate the potential of ACO in improving runway utilization and ensuring safer, more efficient airside operations.

T240087

Application of Terminal Audio Mixing in Multi-bandwidth End-to-End Encrypted Voice Conference

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Keywords: End-to-end encryption, audio mixing, voice conference

Abstract:

In recent years, the increasing frequency of cybersecurity incidents has promoted concerns about communication security and personal privacy. In a zero-trust network environment, it is critically important to protect communication content, ensuring it cannot be intercepted, recorded, or stored without proper authorization. End-to-end encryption is a reliable solution for this purpose. The COVID-19 pandemic has accelerated the adoption of remote work and virtual meetings, making the security of voice conferences a critical issue. This paper aims to explore the application of end-to-end encryption technology in voice conferences. We have designed and implemented an end-to-end encrypted voice conferencing system based on terminal mixing, which ensures security while also being applicable in low-bandwidth network environments. Through experimental evaluation, our system effectively prevents man-in-the-middle attacks and data wiretaps, while maintaining high performance and low latency. It is also suitable for low-bandwidth scenarios such as satellite networks. The results demonstrate that end-to-end encryption technology, when combined with terminal voice mixing, can significantly enhance the security and usability of voice conferences, providing a new solution for secure communication in the future.

T240088

To Develop a digital imaging inspection system for case grinding quality control of enterprise SSDs

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Keywords: aluminum case grinding, machine vision, quality control

Abstract:

The enterprise or data center don't use the M2. SATA because the cooling problem. Therefor the Enterprise SSDs use the metal case like the traditional 2.5" or 3.5" hard disk. The metal case usually use aluminum and it must be grinded after metal plate forming process. In conventional, the quality control operator must to check the aluminum case grinded quality by their eyes. It is not an accurate test method, and the data is difficult to digitize. In order to improve the quality control speed and efficiency. This paper builds a digital imaging base inspection system for the aluminum case grinding quality control of enterprise SSDs. The inspection system consists of a digital industrial camera, a CCTV lens, a LED ring light source, a personal computer. If the loading and unloading time is ignored, the test time is less 5 secs for one case. When the tested case was upload on the inspection system tested area, the camera of inspection system capture one image to computer and the image was processed, recognized the quality and record the tested results. Then the tested case can be classified by robot or operator.

T240091

Development of Universal Thermal Error Models for Multiple Machining Scenarios Using the Transfer Learning-Time Series Model

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Keywords: Thermal Error, Transfer Learning, Multiple Machining Scenarios

Abstract:

In current research on thermal errors in machine tool spindles, most models are developed only for a single machining scenario, thereby limiting their applicability to other scenarios. When switching to different machining scenarios is required, recollecting data and updating models often becomes necessary. These methods face several challenges: firstly, models are typically established based on data from just one machining scenario, hence they cannot be broadly applicable across all scenarios; secondly, the extensive data collection required for retraining models is not only time-consuming but also fails to promptly adapt to previous scenarios. Through the application of time series methods and transfer learning techniques, models for multiple machining scenarios have been developed, proving to significantly enhance adaptability and predictive accuracy across various machining scenarios.

T240092

Design and Application of Double-Sided LCC Compensation Circuit for Contactless Power Transmission in Autonomous Guided Vehicles

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Keywords: Autonomous Guided Vehicles, wireless charging, LCC circuits

Abstract:

With the advancement of technology in recent years, automated factories and unmanned factories have become increasingly popular. Autonomous Guided Vehicles (AGVs) are widely used systems in modern factories, addressing the issue of automated logistics and reducing labor costs. AGVs are highly flexible in scheduling and efficient, making them common in factories. However, the charging problem of AGVs remains reliant on plug-in charging and battery replacement. Plug-in charging requires the vehicle to connect to a charging station or plug after reaching the charging point, which is very inconvenient. The battery replacement requires manual execution, which contradicts the AGV's advantage of reducing labor costs. Therefore, to improve work efficiency and fully achieve labor reduction, Wireless Power Transfer (WPT) has become the focus of this research. This project uses the TMS320F28335 microcontroller produced by Texas Instruments. Through timing control, pulse signals are sent and enhanced by the drive circuit, making them sufficient to drive the IGBT switches used in this project. In the design of the compensation circuit, both the transmitting coil (Tx) and the receiving coil (Rx) utilize LCC compensation circuits, specifically Double-Sided LCC compensation circuits. This topology has the characteristic of stable primary coil current and offers superior circuit protection compared to other topologies. This paper compares the efficiency fluctuations of the system under optimal load conditions at distances of 6 cm, 8 cm, and 10 cm. The research results demonstrate that the Double-Sided LCC resonant compensation circuit used can maintain stable efficiency fluctuations despite changes in the coupling coefficient. Furthermore, even in low coupling coefficient conditions (such as a distance of 10 cm), the system efficiency range can from 57% to 60%.

T240093

Remote Control and Design of S-S Resonance Compensation Topology Wireless Power Transform for Overhead Hoist Transfer

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Keywords: Overhead Hoist Transfer, Remote control, S-S Resonance compensation topology

Abstract:

With the advent of Industry 4.0, the application of automation and intelligent technologies in manufacturing is becoming increasingly widespread. Overhead Hoist Transfer (OHT) systems make full use of the space above equipment in factories, becoming an indispensable part of transportation tasks. However, since OHTs are mobile vehicles, traditional fixed-point charging methods severely impact their operational efficiency and limit their flexibility. Therefore, this article optimizes the wireless charging system for OHTs using an S-S Resonance compensation topology and integrates Wi-Fi modules to achieve real-time data monitoring, allowing OHTs to be monitored and controlled at any time. This paper successfully developed an inductive power supply system, which consists of three main subsystems: a power supply system, a digital signal control system, and a high-power non-contact mobile electromagnetic induction transmission system capable of providing 15 amperes of current. Using this system, the 39 F supercapacitor in the OHT can be charged to 100% within 90 seconds, achieving efficient cyclic transport equipment for intelligent semiconductor manufacturing.

T240094

Review of Microgrids to Enhance the Power System Resilience

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Keywords: extreme events, natural disasters, power system resilience, microgrids

Abstract:

With the increasing frequency of extreme events, large-scale power system interruption events are also on the rise. Compared with typical power outages or failures, natural disasters usually cause more extensive damage and the system requires a longer recovery time. Therefore, in addition to having strong robustness and reliability, it is also crucial and urgent for the power system to have resilience. For the power system resilience, time is a very important factor. Microgrids can be connected to the main grid or operate independently, which significantly improves the flexibility of the system and has great potential in enhancing the power system resilience. This article summarizes the important concepts of power system resilience and microgrids as well as the challenges they face. Moreover, this article further classifies the recent literature on the application of microgrids in improving power system resilience and discusses various solutions for resolving resilience issues. This article aims to provide useful references for power-related practitioners regarding efficient design schemes and to improve the application of microgrids in enhancing resilience.

T240095

Real-time heat-stress assessment using a wearable biosensor network in environments with no established safety standards

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Keywords: occupational health, wearables, heat stroke

Abstract:

Global warming continues to accelerate, and the daily global average temperature in 2024 recorded the highest since observations began. While people are exposed to heat like they have never experienced, the United Nations noted that 2.4 billion workers are working in excessive heat. Although such heat exposure increases the risk of heat-related illness, the current temperatures exceed the temperature range assumed by conventional safety standards, such as heat stress standard ISO 7243. Even if the occupational environments are dangerously hot and not supported by traditional safety standards, workers would have no choice but to continue working. To challenge such issues, we need to establish new efficient heat stress assessment methods and look after the safety of our workers. This study proposes a real-time heat-stress assessment approach using a wearable biosensor network of heart rate monitors. Although conventional standards propose a heart-rate-based heat strain evaluation method based on the relationship between core body temperature and heart rate, no approach has yet been established to adjust the heart-rate-based measure to account for individual workloads. Moreover, it is not feasible for many companies to equip all workers with heart rate monitors due to the cost. To address this, we introduce a method that quantifies heat stress in a given work environment by analyzing a subset of worker sample data. This approach adjusts the heart rate increase based on the estimated workloads using accelerometers, thereby accommodating the non-uniformity of work content in the workplace. We demonstrate the practicality and cost-effectiveness of our method using data collected from construction sites and factories in Japan.

T240096

A Design of Beam-forming Antenna with A Magnetron

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Keywords: Vane-type magnetron design, MHz resonant frequency, CST simulation (Eigenmode & PIC), Beam focusing and HPBW reduction

Abstract:

This article presents the design of a vane-type magnetron with a resonant frequency in the MHz range. The initial dimensions were determined based on magnetron empirical formulas, and CST Studio Suite was used to simulate a series of magnetron behaviors, including eigenmode analysis and Particle-in-Cell (PIC) simulations. It is well known that the relationship between volume and frequency results in a significantly large magnetron size for MHz frequencies. Considering manufacturing convenience and cost factors, the magnetron was simplified from its initial design, and a frequency comparison was made, revealing a difference of about 40 MHz. Ultimately, a simulated frequency of 193 MHz was achieved. Furthermore, the magnetron field patterns were also simulated using CST, and a horn antenna-like structure was employed to reduce the magnetron's half-power beamwidth (HPBW), narrowing it from 101.0 degrees to 50.0 degrees. This outcome is beneficial for beam focusing.

T240097

Neural Network Approach for Solving the Inverse Kinematics of a 4-DOF Robotic Manipulator

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Keywords: Neural Network, Inverse Kinematics, Robotic Manipulator

Abstract:

This paper addresses the inverse kinematics problem of a 4-axis robotic arm by proposing a solution method based on neural networks. It incorporates inverse kinematics techniques originally developed for 6-axis robotic arms, adapting the model architecture and parameters to suit the 4-axis system. The experimental results successfully demonstrate that the proposed method achieves high accuracy in solving the inverse kinematics of 4-axis robotic arms, particularly excelling in handling nonlinear motions and complex environments. The results of this study also provide a valuable reference for future research and applications in robotic arm kinematics.

T240099

Research on Dual Machine Visions with a Hybrid Neural Network Model for Robotic Arms

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Keywords: Deep Learning, Machine Vision, Inverse Kinematics, Robotic Arm Control

Abstract:

This study presents a method that integrates deep learning and machine vision technology for the precise positioning and control of multi-axis robotic arms. Traditional approaches to robotic arm operations often require complex inverse kinematics calculations, which are time-consuming and computationally intensive. To address this issue, our method uses deep learning hybrid neural networks to perform inverse kinematics posture calculations and convert dual machine vision coordinates into the operational parameters of each axis of the robotic arm, enabling accurate operation. This approach significantly reduces the time and computational complexity required by traditional methods while greatly improving operational efficiency and accuracy.

In this research, we combine the YOLOv4-tiny object recognition model with multivariate regression analysis, leveraging a dual-camera system to enhance positioning accuracy and system stability. Experimental results demonstrate that this system holds great potential in various industrial automation scenarios, effectively improving production efficiency and operational precision. Additionally, our approach highlights the value of machine vision and deep learning technology in smart manufacturing, reducing manual intervention and computational burdens while enhancing flexibility and stability in production.

T240100

Bird Deterrence Using Image Recognition Technology

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Keywords: Bird deterrence, Image recognition, Deep learning, Air nozzle, Sustainable solutions

Abstract:

Bird deterrence is a critical issue in various sectors, including agriculture, aviation, and energy production, where birds pose risks to crops, aircraft safety, and power infrastructure. Traditional bird control methods, such as sound cannons, nets, and chemical repellents, often lack precision and can harm the environment. The use of image recognition technology presents a promising solution by providing an intelligent, non-invasive, and automated approach to bird deterrence.

This paper explores how image recognition technology, combined with real-time monitoring systems, can accurately identify bird species and predict their behaviors. Advanced algorithms, such as deep learning and neural networks, enable the system to differentiate between harmful species and non-target animals, ensuring a targeted and efficient response. Once birds are detected, the system can automatically activate air nozzle mechanisms that emit harmless bursts of air to scare birds away without causing harm. This targeted deterrence method reduces the need for human intervention and minimizes the ecological footprint associated with traditional deterrence techniques.

By integrating image recognition technology into bird deterrence systems, precision is enhanced, and the environmental impact is mitigated. This technology also offers scalability, adaptability to various environments, and the potential for continuous learning and improvement. The paper concludes that image recognition represents a significant step forward in developing sustainable bird management solutions, contributing to safer, more productive industries and protecting ecosystems.

T240101

A Shoe Recommendation System Integrating Generative AI and Convolutional Neural Networks for Image Recognition

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Keywords: Convolutional Neural Networks (CNNs), Generative AI, Image Recognition, Recommendation System, Personalized Shopping

Abstract:
This paper introduces a pioneering Shoe Recommendation System that integrates Generative AI and Convolutional Neural Networks (CNNs) for enhanced image recognition and personalized shopping experiences. As e-commerce continues to advance, there is a growing demand for highly customized and interactive shopping solutions. Our system addresses this demand by combining cutting-edge technologies to refine shoe selection and customization.

The core contribution of our research lies in developing a system that utilizes CNNs for accurate image recognition, enabling precise identification and classification of various shoe types and styles from user-uploaded images. This capability forms the basis for delivering highly personalized recommendations. The recommendation engine employs collaborative filtering techniques, analyzing user behavior, ratings, and purchase history to provide contextually relevant suggestions.

In addition to personalized recommendations, our system incorporates Generative AI, specifically Generative Adversarial Networks (GANs), to generate custom shoe designs tailored to individual user preferences and current fashion trends. This feature allows users to visualize and explore unique footwear options, significantly enhancing user engagement and satisfaction.

The system's effectiveness is validated through rigorous testing, demonstrating notable improvements in recommendation accuracy, relevance, and user interaction. By integrating CNNs with Generative AI, this research represents a significant advancement in the realm of personalized online shopping, offering a seamless and creative experience that aligns with contemporary consumer expectations. The contributions of this research advance e-commerce technology by providing an innovative tool for elevating the online shopping journey.

T240102

Development of a thermal error measurement system for CNC multi-axis motion

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Keywords: Thermal Error, 5-axis Machine, Dynamic Trajectory Error, comprehensive accuracy

Abstract:

The sources of accuracy errors in five-axis machine tools primarily include static geometric errors and dynamic thermal errors, which account for approximately 70% of the total errors. Currently, various sources of errors are primarily addressed through different testing equipment, such as the IBS R-Test, ball bar, interferometer, and touch probe, along with the use of different ISO standards for measurement and error analysis. For example, ISO 10791-6 is used to evaluate the dynamic path errors of five-axis machine tools, while ISO 230-3 is used to assess thermal drift errors. However, a key issue with the above methods during the measurement process is that in most measurement paths, the machine tool's motion axes and spindle cannot operate simultaneously. As a result, it is not possible to measure or simulate the coexistence of geometric and thermal errors.

This study will develop a three-axis co-moving detection device and method, with the method's paths primarily based on the ISO-230-3 and ISO-10791-6 standards. The established 3-axis co-moving hybrid inspection path can measure 3-axis dynamic trajectory errors, 3- axis dynamic thermal errors, spindle thermal temperature rise errors, and can also measure the motion trajectory error of the 3-axis co-moving with the spindle during the machining process. The developed method for measuring dynamic trajectory errors will be closer to the errors caused by trajectory and thermal error in the actual machining process.

T240106

Optimizing Wet Fingerprint Denoising Net (WFDN) for Enhanced Biometric Security

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Keywords: Biometric systems, Fingerprint image enhancement, Wet fingerprint denoising

Abstract:

Biometric systems, particularly fingerprint recognition, face significant challenges under suboptimal conditions, such as wet or small fingerprints, which often introduce noise and hinder recognition accuracy. These conditions elevate False Acceptance Rates (FAR) and False Rejection Rates (FRR), as traditional denoising models optimized for larger fingerprints struggle with smaller, noise-afflicted samples commonly found in portable and embedded devices.

In this study, we collected approximately 70,000 pairs of wet and dry fingerprints using a capacitive sensor. To prepare the data, we preprocess fingerprint images of varying sizes (176x36, 88x88, 80x100 pixels) by padding and cropping them to a uniform size of 48x48 pixels. This preprocessing not only enables combining data from different domains but also facilitates effective data augmentation, enhancing the model's ability to handle diverse data types.

This paper introduces the Wet Fingerprint Denoising Network (WFDN), a multi-stage neural network designed to enhance the quality of wet fingerprints across both small and large samples. By integrating SIFT feature extraction, the WFDN restores critical fingerprint minutiae points, significantly improving feature preservation compared to existing models. The network also utilizes an automatic KNN classifier and cyclic multivariate functions to further reduce noise. Despite its compact architecture, the WFDN achieves superior performance and efficiency, yielding enhanced results in challenging fingerprint restoration tasks. Experimental results show that the WFDN reduces FRR from 13.6% to 5.8% for small fingerprints, while NFIQ2 and PSNR assessments for large fingerprints indicate substantial improvements in system reliability.

The proposed model not only addresses a critical gap in biometric processing but also sets the stage for more reliable security systems, particularly in environments where traditional methods struggle. The WFDN marks a significant advancement in practical fingerprint-based identification, delivering improved performance and robustness in demanding conditions.

T240108

Implementation of Autonomous Navigation for Solar Panel Cleaning Vehicle Based on YOLOv4-tiny

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Keywords: Raspberry Pi, PID controller, YOLO, Neural compute stick, gyroscope

Abstract:

This study developed an autonomous navigation system for a solar panel cleaning vehicle. The system integrates the YOLOv4-Tiny object detection model to identify white lines on solar panels, combined with a PID controller to enable autonomous navigation. The core platform runs on a Raspberry Pi, with hardware acceleration provided by the Intel Neural Compute Stick 2 (NCS2). This boosted the system's inference speed from 2 frames per second (FPS) to 8 FPS, significantly enhancing real-time performance.

To achieve optimal performance, the PID controller parameters were tuned to K_P=11, K_i=0.01, andK_d=30. With these settings, the system maintained an average error value of -0.0412 and a standard deviation of 0.1826, ensuring precise control. The vehicle can autonomously follow white lines on the solar panels and perform automatic turns at boundaries, thus allowing for fully autonomous cleaning.

The results show that this navigation system improves both the efficiency and ease of solar panel cleaning, offering a practical solution for maintaining solar energy installations.

T240109

The Effectiveness of applying active learning to flipped classroom in an ICT course

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Keywords: ICT course, blended learning, flipped classroom, game technology engineering, motivation

Abstract:

Abstract—This paper presents the experience of redesigning an ICT course with blended learning concept. This course aims to teach students an introduction to game technology. It covers three main topics: Introduction to Computer, Game software technology, Game art technology. Additionally, they need to cover basic computer science concepts such as binary numbers, algebra, vector, basic data structure, computer graphics and artificial intelligence. The flipped classroom puts lectures outside the classroom, this approach has the challenge of insufficient preparation of students before class and increased workload of students and teachers. The active learning is carried out in the classroom, it can enhance students' enrolling in the classroom. This study applied active learning in flipped classroom in this course and compared the learning effects of this approach with traditional method. The learning outcomes were significantly better. The pre- and post-test was used to investigate the effects of in-class and out-of-class activities in this method. In-class active learning had significant effects both quantitatively and qualitatively. The learning outcomes of out-of-class activities for which students were usually insufficient prepared can also be improved.

T240112

An Adaptive Smart System for Energy-Saving Campus

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Keywords: Achievement System, Gamification, Internet of Things, Expert System, Machine Learning

Abstract:

Due to the increasing severity of global warming and climate change issues, environmental problems caused by human activities are receiving more attention. Although energy saving and carbon reduction have become global consensus, the actual implementation of energy-saving mechanisms remains limited. To address this, an adaptive smart energy-saving campus system is developed in this paper to aime at improving students' electricity usage habits. The system utilizes Internet of Things (IoT) with control interfaces to enhance convenience. Through expert system rules, it regulates the operation of IoT to achieve efficient and energy-saving control during classroom activities. Additionally, by incorporating Random Forest Classifier, the system learns users' electricity usage habits to create a tailored energy-saving environment. It also introduces gamification to create a reward system that stimulates users' desire to achieve goals, thus promoting autonomous energy saving.

An experiment of user-friendly was conducted using a survey method of 62 students. We use a sample size of 59 out of a population of 62, and a sampling error of ±2.8% at a 95% confidence level. According to the survey results, the average SUS (System Usability Scale) score reached 84, surpassing the cross-industry average standard (68). It indicates that the system is user-friendly. The average self-efficacy score for energy saving reached 4.28 (σ=3), very closing to a perfect score of 5. It shows that the system has a significant positive impact on motivation to enhance energy-saving. The NPS (Net Promoter Score) achieved 29. It indicates that, although users are generally satisfied with the system, there is still room for improvement.

T240113

A Decentralized Framework for DDoS Attack Detection and Prevention Using Federated Learning and Blockchain Technology

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Keywords: Federated Learning, Blockchain, DDoS attack detection, IoT security, SDN

Abstract:

With the rapid development of the Internet of Things (IoT) and smart cities, the risk of network attacks, particularly Distributed Denial of Service (DDoS) attacks, has significantly increased. Traditional centralized security systems struggle to address large-scale attacks while simultaneously safeguarding privacy. This study proposes a decentralized security framework that integrates Federated Learning (FL) with blockchain technology for DDoS attack detection and prevention. Federated Learning enables devices to collaboratively learn without sharing raw data, ensuring data privacy, while blockchain provides immutable event logging and distributed monitoring, enhancing the overall security of the system. The proposed framework leverages multi-layer encryption and Hashgraph technology for event recording, ensuring data integrity and efficiency. Additionally, Software-Defined Networking (SDN) is employed for dynamic resource management and rapid response to attacks. Experimental results demonstrate that the system not only improves DDoS detection accuracy but also effectively reduces communication costs and resource consumption, showing significant potential for large-scale attack defense in IoT and smart city environments.

T240115

Performance Evaluation of Pool Ball Detection with Deep Learning Network

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Keywords: Pool robot system, Deep learning, U-Net, Mask R-CNN, Real-time detection

Abstract:

This paper presents a Pool Robot System (PRS) designed to assist in detecting and locating balls based on deep learning techniques. The system leverages U-Net and Mask R-CNN architectures to effectively extract ball features despite challenges such as glare, shadows, light reflections, and image noise. Feature annotation is performed on images collected from the pool table. A comparison between the U-Net and Mask R-CNN models revealed differences in validation indexes, with U-Net outperforming Mask R-CNN in both inference time and memory efficiency. To further achieve real-time detection for edge computing applications, Eff-UNet and Mask R-CNN with an EfficientNet backbone were employed to evaluate overall performance and memory usage. Experiments were carried out to verify effectiveness of the PRS on a quarter-size standard pool table. With the integration of deep learning segmentation, the PRS can complete a stroke within 15 seconds, averages 20 strokes per game, and has a potting rate exceeding 80%.

T240118

Development of a Production Traceability System for the Machine Tool Supply Chain

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Keywords: Production Traceability System, Machine Tool Supply Chain

Abstract:

Many machine tool suppliers still rely on traditional paper-based methods to record the control of raw materials and the production process. Suppliers need to keep detailed records of raw material procurement, product machining, pre-shipment inspections, and order progress management. However, using paper records makes it difficult to update and track order progress in real-time and such records are easily affected by external factors. Making data preservation more challenging. This research develops a production traceability system using HTML, CSS, JavaScript, PHP, and MySQL. By digitizing the process, the syster handles and analyzes data to optimize operational workflows. Digital visualization techniques are employed to record and store data for easy searching and retrieval. The system adopts a modular design to create forms based on different order requirements. Planning the management of order shipments and deliveries. It graphically presents the annual status of orders, product sales and material usage each year. Enabling better management of material usage, product sales, and inventory. The system also tracks the materials used and purchased for each order, improving production efficiency and raw material management.

T240120

Task-Based Motion Planning Optimization for Digital Twin-Enhanced Robotic Systems

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Keywords: motion planning, trajectory evaluation, task-based optimization, digital twin, robotic

Abstract:
Efficient motion planning is essential for the effective operation of digital twin systems, especially in complex and dynamic environments. By selecting the most suitable algorithm based on the specific task, the performance of robotic systems can be significantly enhanced. This paper introduces a motion planning optimization framework for digital twin systems, focusing on task-based algorithm selection to improve robotic performance across various environments. The proposed methodology evaluates multiple motion planning algorithms by generating and analyzing robotic paths based on key task-specific criteria, such as path length, smoothness, collision avoidance, energy efficiency, and execution time. These metrics is weighted according to the task's requirements, enabling the selection of the most suitable algorithm for optimizing the trajectory in manufacturing and other industrial applications. The framework enhances flexibility and efficiency, allowing robots to adapt to varying task demands and operational conditions effectively.

T240121

Menstruation-related physical condition management for women using an underwear-type wearable biosensor

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Keywords: IoT wearable sensor, femtech, menstruation management, heart rate variability, premenstrual syndrome

Abstract:

Many women experience physical problems caused by menstruation, such as menstrual cramps and premenstrual syndrome, which can disrupt their daily lives and work. Knowing when menstruation will begin is essential for managing a schedule with such physical conditions in mind. However, menstrual periods are not always perfectly cyclic, and can be extended by physical and mental stress. Currently used menstrual management applications rely on self-reported cycle length and basal body temperature (BBT), which are difficult to predict irregular periods. Advances in smart wearables have made continuous, non-invasive health monitoring more accessible, such as heart rate variability (HRV). HRV characteristics reflect autonomic nervous system activity and is used as physical and mental health status indices. This study aimed to explore the relationship between HRV indices and the menstrual cycle using smart wearables. Our study included 13 female participants aged 18 to 20 years (one excluded due to incomplete data) and measured using an underwear-type wearable device for about six months. The device can measure HRV and body acceleration continuously. Participants recorded their BBT every morning and answered questionnaires about their physical and mental status every morning and evening. They also reported the start and end dates of menstruation. Our analysis separated HRV data into sleep and wake phases using acceleration and calculated time- and frequency-domain HRV indices. Cross-correlation and regression analysis assessed the relation between the menstrual cycle and phases, such as follicular and luteal, and the HRV indices. Our results revealed a significant relationship between HRV indices and the menstrual cycle length, particularly in the difference between the follicular and luteal phases of HRV indices. This difference showed a relatively high association with the menstrual cycle length. Importantly, our regression analysis suggests that HRV indices can be used to predict the length of the menstrual cycle and potential physical and mental disorders. These findings could significantly improve menstrual health management and contribute to the Femtech industry.

T240122

Thermal Modal Analysis for Precision Thermal Compensation in Machine Tool Spindles

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Keywords: Thermal Modal Analysis, Finite Elements Analysis, Machine tool Spindle

Abstract:

This study presents a comprehensive thermal modal analysis (TMA) of a machine tool spindle subjected to a localized heat source, aimed at enhancing thermal compensation in precision engineering applications. A simplified spindle model is simulated under applied power on one end, with film convection on all other surfaces. Using finite element analysis (FEA), the first 11 thermal modes and corresponding time constants were computed, providing critical insight into the system's thermal behavior. The thermal eigenvectors obtained from the TMA are employed to develop a transfer function, which is implemented in MATLAB Simulink to predict the thermal response at the opposite end of the spindle. This approach balances computational efficiency with accuracy, highlighting the impact of modal truncation on response fidelity. The results are validated against a transient thermal response analysis, confirming that the TMA-based model offers a robust method for predicting temperature distribution in thermally sensitive components. The findings contribute to the development of more effective thermal management strategies for precision machinery

T240123

Design of an AGV Pallet Docking Navigation System Based on ROS2

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Keywords: AGV, ROS2, Pallet Docking, SLAM, Navigation System

Abstract:

Automated Guided Vehicles (AGVs) play an essential role in warehousing systems, but the mainstream guidance modes, including track-guided and trackless-guided methods, have various drawbacks. With the advent of the "Industry 4.0" era, AGV guidance in smart warehousing is transitioning from track-guided to trackless-guided systems. To bridge these two guidance modes and address their limitations, this study proposes an AGV pallet docking navigation system based on ROS2.0 using the MIAT methodology. This system integrates SLAM mapping and positioning, deep learning object recognition, and QR code positioning algorithms to obtain the precise location of pallets and navigate the AGV to the docking position. The system combines the advantages of both guidance modes to provide stable and efficient navigation. Experimental results demonstrate a 94% success rate in simple scenarios and an 84% success rate in complex scenarios, indicating that the system effectively completes the AGV pallet docking navigation task. This system is highly flexible and exhibits a superior success rate, making it a viable solution for pallet docking navigation in suitable working environments.

T240125

Design and Dynamic Response Optimization of Electromechanical Actuator Drive System

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Keywords: actuator, drive system, predictive control, BLDC

Abstract:

This paper aims to design a predictive control system to optimize the performance of electromechanical actuators. Since the dynamic response speed of the current loop is 10 to 20 times faster than that of the speed loop, predictive current can be used to determine the switching of the brushless DC motor (BLDC). This method generates precise voltage vectors and reduces the harmonic content of the stator current, making it an ideal motor drive system for electromechanical actuators. MATLAB's simulation tool, Simulink, is used to design, simulate, execute, and test various time-varying systems, allowing for the comparison of control system effectiveness with and without predictive controllers. The study results show that adopting a predictive control system can improve the performance and reliability of electromechanical actuators, especially in handling emergency release functionality. These improvements are mainly reflected in more precise control, lower energy consumption, and higher operational stability, ensuring reliable actuator operation in various complex environments.

T240126

Signal Enhancement and Interference Reduction in the Minimum Variance Distortionless Response (MVDR) Algorithm: A Study Using MATLAB and GNU Radio Simulations

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Keywords: smart antenna, beamforming, Minimum Variance Distortionless Response (MVDR), algorithm, Matlab

Abstract:

This paper provides a detailed analysis of the MVDR algorithm and its potential to improve signal reception by minimizing interference in dynamic communication environments. During the research, the conditions of the MVDR algorithm are simulated using MATLAB and GNU Radio in order to be fully able to establish its capabilities in noise and interference suppression. We use MATLAB simulations to illustrate the adaptive beamforming performance of MVDR and compare it against traditional beamforming techniques to present the advantages of proper beam steering towards desired signals. The comparative analysis has supported that MVDR is effective in interference reduction and improvement of signal clarity, thus assuring its superiority over the traditional approaches in scenarios with complex interference patterns. After MATLAB simulations, we expand our study in GNU Radios in a complete SDR environment that gives us real-world conditions to study MVDR. We can then approximate real-world applications by integrating with GNU Radio, which gives insight into the robustness and adaptability of the algorithm under question in live signal processing. The results from these two simulation platforms support the potential of MVDR for being a strong dynamic interference suppressor that enables superior signal reception which would create more possibilities for future in inplemeting this algorithm on practical communication system.

T240127

Design analysis of high-precision dual-axis roller cam turntable and study on intelligent diagnosis technology.

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Keywords: Roller cam dual rotary axis table, Finite element method, Modal percussion test, Topology optimization ·

Abstract:

Industries are increasingly adopting multi-axis machining and Industry 4.0, driving a growing demand for greater machining flexibility, speed, and precision in machine tools. Machine tools consist of components supplied by various manufacturers, and the alignment precision, structural integrity, rigidity, and dynamic performance of these components all influence the overall machining precision of multi-axis machine tools. Therefore, the structural design of each component plays a critical role.

In this study, a roller cam dual rotary axis table was selected for analysis using the finite element method, taking into account the machine's operational constraints. The analysis covers aspects such as mode shape, gravitational loading, external force, transient response, spectral analysis, and topology optimization. Through static analysis, the weak points in the machine's structure are identified. Modal analysis helps to pinpoint the natural frequencies that impact the machine's structure, allowing for the avoidance of resonant frequencies during machining, which improves overall machining precision.

A modal impact test was conducted using accelerometers and an impact hammer, with ME'scope curve fitting utilized to determine the mode shapes and natural frequencies. These results were compared with the analytical findings to verify the accuracy of the simulations. Additionally, topological optimization was applied to the machine components to reduce weight and improve natural frequencies, yielding an optimized design compared to the original design. For rotary tables, precision tests, such as repeatability and indexing accuracy, are critical. These tests provide insight into angular errors, ensuring that the rotary table operates with accuracy, reliability, and high quality throughout the machining process.

T240128

Research on High-Speed Recognition AI Chip Based on ARM+FPGA Platform

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Keywords: FPGA, Recognition, deep learning

Abstract:

This study presents a high-speed license plate recognition system based on an ARM+FPGA platform, designed to enhance both accuracy and speed in license plate recognition tasks. The system leverages the ARM processor for initial image processing, including extracting the license plate area, segmenting the numbers and characters, and applying filtering and grayscale processing to produce 28x28 grayscale images. These images are then transmitted to the FPGA for high-speed recognition. The FPGA's digital circuitry, implemented in Verilog, integrates a deep learning neural network with neuron layers configured as (20, 20, 30, 36), trained over 100 iterations. The neural network model is trained in a Python environment using an image dataset comprising 26 alphabet characters and 10 digits, augmented with techniques such as dilation, erosion, and rotation, achieving a recognition accuracy of 96.88%. This technology has been successfully implemented and deployed in a high-speed license plate recognition AI chip, demonstrating its potential for intelligent and high-speed recognition applications. The platform utilizes Xilinx Zynq 7000 devices, which combine multi-core ARM processors with FPGA to deliver high-performance license plate recognition in embedded systems, highlighting its broad potential in AI chip applications.

T240129

Developing Frugal Internet of Things from BPNN for Predicting Gemini AI Impact on Student Mindfulness Meditation and Relaxation

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Keywords: Gemini AI, TGAM, GSR

Abstract:

In recent years, with rapid development of generative artificial intelligence (AI) technologies, large language model models have been developing by leaps and bounds in the field of education. In this study, we employ the Google Gemini AI tool to annotate teacher's programming teaching materials. When student learns these annotated teaching materials, the ThinkGear ASIC Module (TGAM) and Galvanic Skin Response (GSR sensor were deployed for measuring student mindfulness meditation and relaxation levels and learning stress, respectively. Furthermore, we construct a Backpropagation Neural Network (BPNN) model with three hidden layers to predict student concentration and relaxation levels using GSR data and the time students spend answering questions. In the proposed system, we deployed a Node-Red dashboard to monitor all sensing data and prediction results for mindfulness meditation and relaxation levels. Additionally, they were stored in a SQLite database. According to the experimental results, the BPNN model effectively predicts students' mindfulness meditation and relaxation levels. For example, based on the multiple-choice question teaching materials, the BPNN model can obtain scores of 14.29 for mindfulness meditation and 10.54 for relaxation in terms of mean absolute error (MAE) indicator.

T240131

Development of a Real-Time Detection and Process Status Integration System for High-Pressure Gas Leakage Using Smoke Recognition and Big Data Analysis

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Keywords: Gas Leak Detection, Dark Channel Prior, Machine Learning

Abstract:
This study aims to develop a real-time gas leak detection system for application in gas cylinder filling machines. The goal is to promptly recover gas during leakage incidents, thereby enhancing the efficiency of the gas filling process and reducing resource wastage. The system utilizes a Raspberry Pi with a camera for image-based detection and employs the dark channel prior method to detect the presence of gas. The message queue system achieves real-time data transmission, including gas leak status, temperature, pressure, and flow data. The system sends data to a central server via MQTT, and Node-RED is used for data visualization and anomaly alerts. In terms of data analysis, machine learning methods such as Support Vector Machines (SVM) and decision trees are applied to analyze the correlation between gas leaks and other environmental parameters, allowing for the prediction of leak incidents. This system effectively realizes real-time gas leak detection, data transmission, and analysis, significantly improving the operational efficiency of the gas cylinder filling process.

T240135

Powder-Mixed Micro Electrical Discharge Machining assisted Surface modification of Ti–35Nb–7Zr–5Ta Alloy for Biomedical Applications

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Keywords: Biomedical Application, Powder-Mixed Micro Electrical Discharge Machining, Surface morphology, Ti–35Nb–7Zr–5Ta Alloy

Abstract:

One of the most popular alloys used for biomedical applications is TiAl6V4. Even though TiAl6V4 is widely used, it faces several challenges. Firstly, TiAl6V4 is prone to stress shielding caused by the difference in Young's moduli of this alloy (110 GPa) and human bones (20–30 GPa). Secondly, aluminum and vanadium are cytotoxic materials. Researchers focus on Ti-35Nb-7Zr-5Ta (TNZT) alloy to overcome these disadvantages, an excellent substitute for natural human bones. This alloy offers a lower elastic modulus (~81 GPa), much closer to human bones than TiAl6V4 alloy. Also, TNZT alloy contains no cytotoxic elements and has excellent biocompatibility and high corrosion resistance. Given the positive outcomes of previous literature on powder-mixed micro electrical discharge machining (PM-μ-EDM) of Ti alloy using hydroxyapatite (HA) powder, this paper focuses on studying the machinability of TNZT alloy using Hydroxyapatite powder mixed -μ-EDM. By changing the HA powder concentration (0 g/L, 5 g/L, and 10 g/L), gap voltage (90 V, 100 V, and 110 V), and capacitance (4 nF, 5 nF, and 6 nF) according to the Taguchi L9 design of experiment, machining performance metrics such as material removal rate (MRR), overcut, circularity and crater size were examined using tungsten carbide tool of 720 μm diameter. Preliminary results showed an overcut of 18.27 μm, circularity of 3.48 μm, and microhardness of 250.33 for the lowest energy setup. Therefore, using HA powder in PM-μ-EDM of TNZT alloy shows a promising machinability potential for biomedical implants.

T240136

Research on Integrating Sustainable Concepts into Leftover Blended Learning and Interactive Game System Design

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Keywords: Sustainable Concepts, Blended Learning, Mixed Reality, Game Design, Leftover bread

Abstract:
Food, as one of the essential pillars for sustaining human life, is undoubtedly cherished. However, while people love delicious food, they often neglect the care for it. Most people think of leftovers as the food left on the table. In fact, one of the most commonly wasted foods is bread, which can make a delightful breakfast. Most research focuses on leftovers in general, with less attention given to bread. Related studies have also found that the carbon emissions from bread are not less than those from meat products. Therefore, this research aims to integrate sustainable concepts with mixed learning approaches into the design of an MR (Mixed Reality) interactive system, focusing on bakeries in Macau. We will conduct field research and observations of leftover bread from eight local bakeries, categorizing and photographing them. The goal is to combine knowledge and teaching about carbon emissions with interactive games, allowing users to understand the relationship between bread and carbon emissions. Finally, after learning the relevant knowledge and content, users will experience the MR game to complete challenges. This study's interactive game design model will provide a reference for future related sustainability research.

T240137

Guarded Diagnosis: Preserving Privacy in Cervical Cancer Detection with CNNs on Pap Smear Images

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Keywords: Convolutional Neural Network (CNN), cervical cancer detection, Pap smear exam, X-rays, medical diagnostics

Abstract:
Advancements in image processing have transformed medical diagnostics, especially in image classification, impacting healthcare by offering faster and more accurate analyses of MRI and X-rays. Manual examination of these images is often slow, error-prone, and costly. This paper proposes a new method focusing on the Pap smear exam, crucial for early cervical cancer detection. Using a Convolutional Neural Network (CNN) and the SIPaKMeD dataset, our approach categorizes cervical cells into five types, distinguishing normal, precancerous, and benign cells after segmentation. The CNN's architecture is simple yet efficient, achieving an impressive 91.29% accuracy.

T240138

Interpolator Parameter Optimization Based on Reinforcement Learning for CNC Machine Tools

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Keywords: Reinforcement learning, Deep Q-learning, Interpolator, Parameter optimization

Abstract:

The paper presents an interpolator parameter optimization method based on reinforcement learning to enhance machining performance for CNC machine tools. Key interpolator parameters such as maximum acceleration before interpolation, arc allowable acceleration, corner speed deviation, acceleration/deceleration time before and after interpolation are regarded as experimental factors. A Back Propagation Neural Network (BPNN) is employed to assess the influence of feedrate and interpolation parameter combinations by analyzing tracking and contouring errors gathered from the KAKINO toolpath. A Deep Q-Network (DQN) reinforcement learning algorithm is applied to continuously adjust the interpolator parameters based on a reward mechanism, aiming to obtain the optimal parameter set and improve machining performance. Experimental results validate the proposed method effectively reduces cycle time while satisfying contour tolerance constraints.

T240139

Revolutionizing Prenatal Care:Harnessing Machine Learning for Gestational Diabetes Anticipation

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Keywords: Machine learning (ML), Logistic Regression (LR), Random Forest (RF), K-Nearest Neighbors (KNN), Decision Tree (DT)

Abstract:
Our primary objective is to implement a robust framework for diabetes prediction, leveraging a diverse array of machine learning algorithms. Through comprehensive analysis of diabetes-related characteristics, we aim to identify the most accurate classifier. We employ a diverse set of algorithms, including K-Nearest Neighbors (KNN), Random Forest (RF), Support Vector Machine (SVM), Logistic Regression (LR), Naïv Bayes (NB), and Decision Tree (DT), as we navigate the complexities of data science, recognizing the varying accuracy of our models. This study culminates in the presentation of a model capable of accurately predicting diabetes, with the Decision Tree emerging as a standout performer among its peers, demonstrating exceptional forecasting accuracy.

T240141

Focal Vision Transformer with Partial Feature Masking for Facial Expression Recognition

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Keywords: deep learning, facial expression recognition, vision transformer

Abstract:

With the rapid advancement of deep learning (DL) and computer vision (CV) technologies, researchers have made significant progress in facial expression identification, resulting in substantial improvements in facial expression recognition (FER) for real-world applications. However, FER still faces challenges such as occlusion and head pose variations, which make it difficult for FER models to maintain stability and accuracy in real-world environments. This study proposes a focal vision transformer (FViT) with partial facial feature masking (PFFM) for FER to address these issues. This approach efficiently simulates the challenges posed by occlusion and head pose variations by introducing PFFM-based data augmentation, where parts of the image are randomly masked while ensuring that key facial expression cues are preserved. The experimental results show that the proposed FViT achieves an accuracy of approximately 88.60% on the RAF-DB database, which includes scenarios with occlusion and head pose variations. Furthermore, according to the ablation study, PFFM enhances the model's performance. Therefore, this research demonstrates that the proposed method effectively addresses the challenges of occlusion and head pose variations in FER.

T240142

Lightweight Vision Transformer for Coffee Bean Quality Inspection

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Keywords: deep learning, coffee bean, vision transformer, lightweight

Abstract:

As global trade networks rapidly expand, coffee production and consumption have spread worldwide, profoundly influencing modern lifestyles. However, the coffee production process still demands substantial labor resources, especially in the selection and processing of coffee beans. The high implementation costs have impeded its widespread adoption. Therefore, this work proposes a lightweight vision transformer (ViT) based on deep learning (DL) method for extracting features from coffee bean images, enabling defect detection and roasting level recognition. This approach effectively reduces the overall cost of the coffee production process. According to experimental results, the proposed method achieves an accuracy of 98.49% on the defective coffee bean database and 99.68% on the roasted coffee bean database. Furthermore, the model parameters is only 0.13M, making it suited for deployment on low-cost embedded platforms of real-world environments.

T240143

Development of a Low-Power Real-Time Recognition Platform for Robotic Arms Using Edge Computing and TinyML Technology

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Keywords: Edge computing, Robotic arm controlling, AOI

Abstract:

This study focuses on integrating visual recognition technology and multi-object recognition into robotic arms to improve flexibility and automation in the production process. By applying TinyML (Tiny et al.) technology and machine vision algorithms, combined with edge computing devices to control the robotic arms, precise identification and operation of objects on the production line with ultra-low energy consumption are achieved.

This system uses the SparkFun Edge development board and Raspberry Pi Camera Module 3 as edge devices responsible for data processing, image recognition, and robotic arm control. By utilizing the Edge Impulse platform for data collection, model training, and optimization—specifically designed for edge devices—models suitable for resource-limited environments can be efficiently generated. Through Edge Impulse's automated toolchain, real-time image processing and object recognition are realized. The system achieved the expected results in both recognition accuracy and operational speed, demonstrating the potential of TinyML technology in enhancing the intelligence of robotic arms. Additionally, MariaDB was chosen for data storage. The system's operation process employs Grafana to design a user-friendly web interface for real-time data monitoring and visualization, facilitating immediate data analysis and system status monitoring. Experimental results show that the system achieved an impressive success rate of 99% in an actual operating environment, instilling confidence in its performance.

T240144

Development of an Automatic Inspection and Optimization Platform for CNC Machining Using AOI and AI Technologies

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Keywords: AOI, CNC, Smart Manufacturing

Abstract:

This study proposes a novel Automatic Optical Inspection (AOI) system for detecting defects in finished workpieces and generating recommendations for CNC machining conditions. The system addresses quality control issues in CNC machining through image processing, machine learning, and G-code analysis techniques. The main objectives are to improve the accuracy and efficiency of the CNC machining process by reducing manual inspection tasks, minimizing production downtime, and achieving higher precision in defect detection and correction.

Relevant experiments were conducted in a pre-planned CNC machining environment to validate the effectiveness of the proposed AOI system. The system was tested on various materials (including metals and composites) and CNC machines (lathes and milling machines). The results showed that the AOI system significantly improved defect detection accuracy, with an average detection rate exceeding 95% across different defect types. The proposed machining condition diagnosis technique reduced the recurrence rate of defects by approximately 80%, demonstrating the potential to enhance overall machining quality.

This research attempts to develop AOI recognition and optimize CNC machining quality control, presenting an automated and intelligent defect detection and correction solution. The experimental results indicate that the reliability and accuracy of CNC processes can be improved, and data-driven automated manufacturing and process optimization can be achieved to meet the goals of intelligent manufacturing and Industry 4.0.

T240145

Design and Implementation of Environmental Monitoring System by Using Micro-Framework Web Application

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Keywords: Flask, Bluetooth, IoT, microframework web application

Abstract:

This work proposes a low-cost, real-time environmental monitoring system. The system is built using a microframework web application with the Flask library in Python. Bluetooth is becoming popular wireless facility in Internet of Things (IoT) systems due to its longer transmission range and low power consumption. In this work, the star topology network of Bluetooth is used and consists of one master with many slave nodes. Arduino Uno microcontrollers serve as slave node and data are aggregated from multiple sensors and actuators locally. Raspberry Pi microcomputer is role for the master node. Between master and slave nodes, the data is communicated remotely by Bluetooth and that forms a wireless sensor network (WSN).

In this work , the cores libraries of microframework, Flask, Werkzeug and Jinja2 of Pallets project are used to develop both frontend and backend components of web application in python. The environmental monitoring data are stored in mater node, and the polty library are used for data analysis and visualization. The master node executes multiple tasks simultaneously, including data collection, signal processing, actuator control, fetching video-stream and web server, thus deploying a multithreading parallel scheme to ensure real-time web content delivery.

The experimental results show that the proposed system offers an effective approach for monitoring real-time environmental monitoring by deploying the microframework and ad hoc network. Furthermore, the components of system are off-the-shelf commodity that are readily available on the market, reducing the cost of system maintenance. In addition to the system is scalable expendably with number of sensors of slave nodes by the needs of the environmental monitoring.

T240150

Applying AI in Software Development Education

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Keywords: Artificial intelligence, Software engineering, Pegaogy, Curriculum development

Abstract:
Artificial intelligence (AI) is being applied at a pace that challenges the verification of its suitability to the domains of application. This situation may arise from the proliferation of AI development being conducted from a data science point of view rather than a software engineering approach. This observation leads to the question of whether software development course curricula are addressing the necessary educational needs for graduates to respond to the challenges of applying AI development in emerging domains. The challenge has two parts: the first is the use of AI in developing software systems, and the second is the development of AI systems. The work addressed in this paper looks at the first part of this challenge by proposing a pedagogy for introducing AI tool usage in software engineering education as a springboard for structuring a methodology for AI application development that incorporates established software engineering principles. This work is exploratory in nature and first reviews existing works in this area of interest, with the aim of identifying commonalities of approaches towards selecting a required set of topics, course outcomes, and structure for a curriculum on AI in software development.

T240151

The Impact of Preferential Flow in Ionic Rare Earth Macropores on Water and Salt Transport by sensors

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Keywords: rare earth ore, preferential flow, macropores, solute transport, leaching rate

Abstract:

Investigates the impact of preferential flow in ionic rare earth macropores on water and salt transport, dynamic leaching experiments were conducted on ionic rare earth ores using ammonium sulfate as the leaching agent. Indoor column leaching tests were employed to study the transport process of the leaching agent in the macropore and matrix zones of soil samples. By monitoring the distribution of water potential and solute concentration, the mechanisms and influencing factors of macropore preferential flow were analyzed. Additionally, the relationship between rare earth leaching efficiency and factors such as moisture content, temperature, and solution concentration (electrical conductivity) was examined. To gain a clearer and more intuitive understanding of the water and salt transport process, and to obtain richer data such as flow velocity distribution for a comprehensive evaluation of various factors affecting macropore preferential flow or solute transport, numerical simulation studies were conducted using COMSOL Multiphysics software based on the physical model from indoor experiments. The combined analysis of indoor experiments and numerical simulation results aims to provide technical reference for rare earth leaching in mining operations.

T240152

Classification of Ocimum Basilicum For Species Identification Using Convolutional Neural Network

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Keywords: CNN, Convolutional Neural Network, VGG16 Architecture, Basil, CLAHE

Abstract:
The classification of basil varieties using convolutional neural network (CNN) with VGG16 architecture is studied in this paper. A system that can identify and classify the variety of the input basil image was developed by the researchers. To determine which variety of basil each image belongs to, the system first applies the Contrast Limited Adaptive Histogram Equalization (CLAHE) algorithm to the basil image ir which the architecture VGG16 extracted features and classify the said basil images. When the system was tested for actual samples using a set of 30 images, a Confusion Matrix showed that it had an 76.67% accuracy rate. In regard to this, an inaccurate output, which might have been impacted by changes in positioning of the leaf or the size of the leaf. 23 of the 30 basil images have the correct outcomes. Two models were created for the study in which epochs equal to 8 and 10 are carried out. The model that was used in the study was chosen based on the highest accuracy as well as surveying the accuracy plots. The model that was chosen has an epoch of 10 with an accuracy of 97% in the training phase.

T240158

Technological management of distant water fisheries in enforcing transshipment and landing declarations using big data analysis

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Keywords: Early warning system, Transshipment, Landing, Distant water fisheries, Fishery management

Abstract:

Illegal, Unreported, and Unregulated (IUU) fishing can deplete fishery resources if unaddressed. The Food and Agriculture Organization of the United Nations (FAO) has taken this problem seriously by approving an International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU) to achieve sustainable fishery. The Taiwan Fisheries Agency has also taken measures by requiring all fishing vessels to provide prior transshipment and landing notices with estimated information on fish cargo amount. After the completion, an updated actual report must be submitted to verify. However, due to complex circumstances on the seas, fishermen sometimes forget to submit prior notices and violate the regulations. This research aims to develop an early warning system to detect possible transshipment or landing of a fishing vessel and notify the fishermen and authorities in advance.

Our algorithm captures the fishing behaviors of over 900 registered vessels by calculating the moving average and standard deviations of catch weight in the first step. Following, we test to find a suitable threshold for triggering the alarm to issue a notification to suggest a report submission. Finally, two indicators were used to evaluate the effectiveness of the system. The first indicator is the number of report records successfully warned by simulating our algorithm over historical data. The second is the ratio of average warning days to the average days of each fishing trip, defined as a start of fishing activity to a successful transshipment or landing. We aim to maximize the number of successful warnings and minimize the average warning days.

Preliminary developments in this research show that by simulating our algorithm with historical data, 77.5% of all true transshipment and landing events are alerted and early warned. The average early warning period is 46 days, whereas the average days of each fishing trip are 175 days. With more adjustments to this research, we can assist fisheries management by helping not only the authorities monitor the activities and fishing status of registered vessels but also fishermen to avoid violating regulations.

T240159

Attempt to Improve Fingers Movement Measure Using Music-Tapping Game and Generative AI

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Keywords: Fingers Movement Measure, Music-Tapping Game, Generative AI, Assistive Technology, Smart Healthcare

Abstract:

In an aging society, measuring finger movement is a crucial method for early detection of cognitive decline. However, traditional measurement methods are monotonous and can induce participant fatigue. This study proposes designing a novel system that combines a music-tapping game with generative AI for measuring finger movement functions in elderly individuals. We aim to utilize generative AI to create personalized background music (BGM) that reflects participants' musical preferences, engages their interests, and reduces fatigue during measurement. The proposed system comprises four main modules: the first is an AI-driven personalized BGM recommendation module; the second is a tapping game module with a simple interface; the third is a real-time music adjustment module powered by generative AI; and the fourth is a data analysis and visualization module. These modules will record data such as participants' reaction times and operational accuracy in real-time, allowing us to evaluate how personalized music contributes to reducing fatigue and enhancing motivation. We expect to create a more enjoyable and engaging measurement experience while facilitating the collection of rich data that will contribute to a detailed assessment of finger movement functions in older adults and the early detection of cognitive decline.

T240160

Classification of Salmon Freshness in Fish Markets in the Philippines using Convolutional Neural Network

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Keywords: Convolutional Neural Network, Image Processing, ResNet50, Fish Freshness, Salmon

Abstract:

Fish is an important resource in the Philippines, an economic contributor, and a staple food for Filipinos. However, for the safety and satisfaction of consumers, fish freshness is a crucial factor. Freshness can be traditionally determined through subjective sensory assessments or complex scientific methods. This study uses the Convolutional Neural Network algorithm to classify salmon fillet freshness. A total of 7000 images were used for training and 40 for testing. The deep learning technique, specifically ResNet50 architecture, is implemented with Raspberry Pi 4B and Raspberry Pi Camera V2. The study achieved a 92.5% accuracy rate. The study's success highlights how CNN-based methods can potentially improve the evaluation of seafood quality. Additional training data and exploring complementary techniques, such as integrating an electric nose for improved accuracy, can be added to further refine the study. A hybrid model can also be used to increase the study's accuracy. Also, an added cooling unit can be applied to the prototype to keep the freshness of the fish constant while testing.

T240161

Comparative Analysis of a Real-Time Visual Identification System and Traditional Methods of Observation for Assessing Maturity, Size, and Defects in Dragon Fruits

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Keywords: Dragon Fruit, YOLOV8, EfficientNet, Identification System

Abstract:
In the Philippines, dragon fruit has become an essential, high-value crop in the agricultural sector and is vital to the country's economy. However, due to inefficient manual inspection methods, farmers need help with quality control and market preparation. This study introduces an automated, real-time visual identification system for dragon fruits, addressing maturity, size, and defect detection. The system utilizes advanced deep learning models (EfficientNet and YOLOV8) trained on a diverse dataset of dragon fruit images from online sources and a local Philippine farm, captured using DSLR and smartphone cameras. Implemented on a Raspberry Pi 4B with an HQ camera and wide-angle lens, the solution is cost-effective and accessible for local farmers. The prototype achieved impressive accuracy rates: 93.33% for maturity and size classification, 96.67% for defect detection, and % overall accuracy of 83.33%. These results demonstrate equivalence of traditional methods regarding accuracy and reliability, representing a crucial technological advancement for Philippine agriculture and addressing the pressing need for objective innovation in fruit identification – mainly dragon fruits.

T240164

Road Wetness Estimation Using Deep Learning Models

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Keywords: Road Surface Condition, Road Wetness Estimation, SqueezeNet, ENet, Confusion Matrix

Abstract:
Accurately identifying road conditions, particularly wetness, is crucial for ensuring road safety and enhancing vehicle performance. This thesis presents a comprehensive study on road surface classification and road wetness estimation using state-of-the-art deep learning models. This study aims to implement the SqueezeNet model and ENet model in the
Raspberry Pi Model 4 that will classify road surface and estimate road wetness. The researchers employed SqueezeNet, a lightweight convolutional neural network, to classify road surfaces into wet and dry categories, achieving an impressive total accuracy of 90%. Additionally, the researchers utilized the ENet model, known for its efficiency in semantic segmentation tasks, to estimate the degree of road wetness, categorizing it into damp, wet, and very wet conditions. The ENet model also achieved a total accuracy of 90.48%. Our approach demonstrates the efficacy of deep learning models in road surface monitoring. The study used a confusion matrix to create the margin classifier for the algorithms results. Three hundred (300) training datasets samples were used per category achieving a total of one thousand two hundred (1200) training images. The study used twenty (20) testing samples for road surface classification and twenty-one (21) testing samples for road wetness estimation. The results highlight the robustness and applicability of SqueezeNet and ENet models in diverse environmental road conditions.

T240166

Laser Marking Detection for a Key Machining Automation System

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Keywords: Laser Marking, Key Machining, Smart Manufacturing

Abstract:

Under the advancement of modern smart manufacturing technologies, product quality and production efficiency have been significantly improved, with laser marking technology playing a key role in the key production process. To ensure the clarity and accuracy of laser markings (such as serial numbers and product codes) on each key, this study developed an automated font recognition system based on image processing techniques. The system first accurately extracts the font from the laser markings through HSV thresholding, binarization, morphological operations, and Gaussian blurring. Character segmentation is then performed using the vertical projection method, followed by font matching and recognition with the XOR operation. Ultimately, the system can automatically recognize the font content on each key and synchronize the results in real-time with the production line system, significantly enhancing the automation level and accuracy of font recognition. This system not only improves production efficiency but also ensures that the laser markings on each key meet high-quality standards, providing strong technical support for smart manufacturing in the key production line.

T240167

Enhancing Urban Energy Infrastructure: Optimizing Underground Transmission Line Routing in Phnom Penh

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Keywords: Route, Geographic Information System (GIS), Shortest Path Algorithm, Underground Utility Route, Automation

Abstract:
The swift urbanisation and technical progress in Cambodia, especially in Phnom Penh, have resulted in the emergence of underground transmission lines (UGTL) as a feasible substitute for conventional overhead transmission lines (OHTL). Nevertheless, the substantial expense of UGTL has impeded its extensive implementation. This study presents an automated approach to determine the most cost-effective and technically feasible routing option for underground transmission lines between substations. The researchers utilised Geographic Information System (GIS) data to create algorithms that identify the optimal route for UGTL installation, hence minimising material and labour expenses. The outcome is an automated instrument for route optimisation, which can enhance energy project planning and alleviate the financial strain of UGTL implementation. This technology has the potential to transform urban energy infrastructure planning by providing a data-driven, cost-effective, and environmentally sustainable approach to UGTL routing, hence enabling the development of more resilient and sustainable urban energy systems in comparable urban environments.

T240170

Insect detection of limited insects for efficient waste management using Teachable machine and Raspberry Pi 4

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Keywords: Insect detection, waste management, Raspberry Pi 4, Teachable Machine, trash bin capacity, public health, real-time monitoring

Abstract:

Effective solid waste management is increasingly challenging, particularly in urban environments where insect populations can proliferate, posing serious public health risks. This study presents an innovative and cost-effective system designed to detect common insects around waste sites and monitor trash bin capacity. Utilizing a Raspberry Pi 4 paired with models trained on Teachable Machine, the system targets specific insect species, including maggots, ants, flies, and fruit flies, enhancing real-time monitoring capabilities. Additionally, integrated sensors measure and report the capacity of trash bins, facilitating timely waste collection and preventing overflow, which further attracts pests. The methodology involved training image recognition models to accurately identify the selected insects and employing ultrasonic sensors for precise bin capacity detection. Results demonstrate that the system effectively identifies insects with a detection accuracy exceeding 90%, while regression analysis of bin capacity data indicates a strong correlation (R^2 = 0.98) between actual and detected capacities. This approach not only mitigates the health risks associated with insect-borne diseases but also contributes to more efficient waste management practices. The findings underscore the importance of integrating insect detection and waste capacity monitoring to promote cleaner, healthier urban environments.

T240171

Classification of Flavored Filipino Vinegar Varieties Using Electronic Nose

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Keywords: Food Industry, Electronic Nose, MQ Sensors, Linear Discriminant Analysis, Support Vector Machine

Abstract:

Innovations in the food industry have been vastly improving in today's time to the point where the work done is made easy and automated. Condiments such as Vinegar are made and fermented manually with the help of the human nose. This study aims to create an electronic nose for classifying pure Filipino vinegar varieties, allowing the automation of vinegar classification. MQ sensors will be used to determine the sensitivity of gas content among each vinegar flavor, namely, Sinamak, Pinakurat, and Iloko. The study will use Linear Discriminant Analysis dimensionality reduction to create a margin between the dataset's features and Support Vector Machine as the algorithm to utilize the data gathered and create a more accurate prediction. Three hundred sixty (360) sample training datasets were used to test the algorithm. The study used one hundred eight (108) testing datasets, equivalent to 30% of the training dataset. The researchers achieved a 78.7% accuracy. The study classified pure vinegar Filipino varieties. The study will use Linear Discriminant Analysis dimensionality reduction to create a margin between the features of the dataset, and Support Vector Machine as the algorithm to utilize the dataset gathered and create a more accurate prediction. Three hundred sixty (360) training datasets from the samples were used to test the algorithm. The study used one hundred eight (108) testing dataset which is equivalent to 30% of the training dataset. The researchers achieved a 78.7% accuracy. The study classified pure vinegar Filipino varieties.

T240172

Machine Learning Speech Delay Assistive Device for Speech-to-Text Transcription

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Keywords: Machine Learning, Assistive Technology, Speech-to-text

Abstract:
Despite advancements made by leading companies, current technologies often struggle to accurately interpret speech from individuals with speech delays. To address this issue, a portable Machine Learning (ML) speech-to-text assistive device was developed specifically for children with speech delays. The device utilizes a Raspberry Pi 4 and the Google Web Speech API, with a focus on accurately transcribing difficult speech sounds in children aged 6 to 14. The study's key contributions include noise reduction, digital transcription, and performance validation by Speech-Language Pathologists (SLPs). The device demonstrated 94% word accuracy and 92% sentence accuracy, with a Word Error Rate (WER) ranging from 0 to 14%. This ML-based device significantly improves existing speech therapy tools, providing a more accessible solution for children with speech delays.

T240175

Networked Symphony Orchestra as a Project that Applies Concepts From IoT Courses

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Keywords: Internet of Things, Networked Systems, Distributed Systems, wireless communication, RNDIs

Abstract:
Internet of Things (IoT) education is hindered by a deficiency of dynamic and interactive courses, in addition to a lack of components and difficulty in device configuration. These difficulties may diminish students' enthusiasm for IoT's initiatives and reduce their drive and involvement. This article proposes the design and construction of a networked symphony orchestra using the Lego Mindstorms EV3 package as a project belonging to the IoT subject. Lego Mindstorms EV3 has been selected due to its easy configuration. In this contribution, the knowledge obtained during the subject is utilized. It should be mentioned that, in IoT courses at the University of Guayaquil, there is strong encouragement to apply the studied material to new initiatives. This article presents the design, the assessment of multiple technologies, and the final implementation, proposing the inclusion of the described project as a way to motivate students in the practical application of concepts related to IoT.

T240176

Design and Development of 35 MHz – 4.4 GHz Inset-Fed 2x2 Phased Array Microstrip Patch Antenna for Intentional Electromagnetic Interference (IEMI) Testing

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Keywords: electromagnetic interference, patch antennas, polarization, destructive interference, radial field

Abstract:
Communication devices are frequency-operating electronics equipment that can utilize Analog Modulation, Frequency Modulation, Shortwave Frequency, and even higher frequencies in telecommunications. The study thoroughly discusses the effects and conditions of achieving electromagnetic interference and designing an antenna to transmit interfering frequencies for testing equipment and components. Ansys 2024 is used to design the 35 MHz to 4.4 GHz 2x2 patch antennas and simulate the response using a sample frequency of 35 MHz to determine the antenna's polarization. The polarization was circular in contrast to the results of the phases Phi and Theta observed in the radial field 3D polar plot which are completely out of phase and different in magnitude of 5.4 in Phi and 5402.01 in Theta. The measurements from Ansys were congruent to the 2D model dimensions in AutoCAD and were fabricated under a double-layered photosensitive FR-4 copper board. The testing was conducted in the electronics laboratory and the antenna connected to the signal generator ADF 4351, effectively interfered using a frequency near to the actual frequency the radio is tuned in to FM with a maximum distance of 7.5 meters around the room. The frequencies interfered were from 91.5 MHz to 102.7 MHz broadcasting stations. Concluding, that strong electromagnetic waves for interference could disrupt frequency operating devices due to high signal power achieving destructive interference.

T240177

Real-time detection and counting of melted spatter particles during deposition of biomedical grade Co-Cr-Mo-4Ti powder using Micro-Plasma Transferred Arc Additive Manufacturing Process

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Keywords: Spatter particles, Kalman Filter, Additive Manufacturing, Real-Time Monitoring

Abstract:

Spatters in the powder based additive manufacturing processes have a high influence on the deposition quality, part surface quality, and internal defects. Spatters typically consist of either melted or unmelted powder particles that do not integrate into the deposited layers. Unmelted spatter particles can sometimes be reused after proper characterization and sieving, but melted spatter particles are considered waste, leading to the loss of costly powder. Additionally, the fumes from evaporated spatter particles pose health hazards. Therefore, reducing the number of melted spatter is essential from economical and safety aspects. This paper aims to propose a video analysis approach to monitor and count the melted spatter particles of biomedical grade Co-Cr-Mo-4Ti powder particles used for depositing layers using Micro-Plasma Transferred Arc Additive Manufacturing (M-PTAAM) process. The objectives include capturing of the spatters using weld monitoring camera and building dataset of videos for different combinations of M-PTAAM process parameters, processing of the videos to capture the melted spatter particles and count the melted spatter particles in real-time using Kalman filter. From the captured videos, it was observed that the weld monitoring camera was able to capture the melted spatter particles, and the fumes generated by the evaporated spatter particles. The video processing algorithm developed in this study demonstrated the ability to accurately capture melted spatter particles. In images without fumes, nearly all melted spatter particles were successfully detected. Even in images with the presence of fumes, the algorithm maintained a detection accuracy of 90%. The real-time melted spatter count particle exhibits distinct trends the changing powder feed rate from 30 g/min to 35 g/min and then to 50 g/min. The melted spatter particle count is lowest with a powder feed rate of 30 g/min and increases with increasing powder feed rate.

T240178

The Development of PID Based Self-balancing Robot Using ESP32 for STEM Eduication

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Keywords: Self-balance Robot, ESP32, PID Control, Gyroscope Sensor, STEM Education

Abstract:

The STEM education usually provides young students a friendly and efficient environment for learning science, technology, engineering and math. According to the needs from STEM programs and activities, several robots like humanoid robots, biped robots and quadruped robots, have been developed and built. Those robots are serviced as a learning tool supporting students to explore the principle and theory of robotics and its related applications. In addition, those robots are open sources which usually provide people free instructions to build their own low cost robots. In order to enhance the effects, this project attempts to develop a low cost two-wheel robot. Unlike other robots, two-wheel robots depend on a gyroscope sensor and a motion controller to cooperate closely for keeping them to stay balanced. The developed robot can be seen as an integrated system which includes hardware and firmware. The hardware consists of a ESP32 micro-controller, a pair of DC motors, a gyroscope sensor MPU6050, and a driver for DC motors. As for the firmware, its main task is to handle the events of balancing robot such as receiving signals from gyroscope, controlling DC motors based on PID and etc. The concerned themes in this paper include design prototype of the robot, sensor calibration, and PID tuning.

T240179

RAG-Based Digital After-Sales Service Platform development

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Keywords: generative AI, Retrieval Augmented Generation, RAG Deployment, chatbots, LLM

Abstract:

The introduction of a digital production tracking system in the manufacturing industry facilitates the collection and recording of data. However, in the context of digitalization, various types of production-related data continue to accumulate. In these data, maintenance, and after-sales service records of machinery are only stored in databases without being fully utilized. Expanding the application of these digital maintenance and after-sales service records has become a challenge. Therefore, this research aims to develop a digital after-sales service platform based on an RAG system. By building a vector database using maintenance and service records collected from the digital production tracking system, we connect the vector database to a retrieval augmented generation (RAG) framework, providing Q&A services related to maintenance and after-sales within the digital production tracking platform. This allows the existing data to offer maintenance suggestions, enhancing the utilization of digital maintenance and service records. The system is web-based and includes an interface for managing the vector database. The vector database uses Chroma DB, while the front end is developed with Vue.js, and the back end connects to the Python-based RAG system to implement the intelligent Q&A system.

This research combines a vector data management system with retrieval augmented generation (RAG) technology to build a digital after-sales service platform. Users can leverage the maintenance and after-sales records stored in the digital production tracking system. The vector data management system manages and organizes maintenance and service records for various companies, ensuring that data is efficiently stored and accessed. At the same time, the connection between the maintenance records and the RAG system allows large language models to handle Natural Language Processing (NLP) tasks without hallucinations. This technical architecture is expected to ensure the effective utilization of after-sales service records for different companies, while also improving the speed of fault diagnosis and problem resolution, ultimately providing higher efficiency and competitiveness.

T240181

Development of an Improved Rapidly-Exploring Random Trees Algorithm for Path Planning of Autonomous UAVs

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Keywords: autonomous vehicle, obstacle avoidance, path planning, Rapidly-Exploring Random Trees

Abstract:

Path planning is essential to the operation of autonomous unmanned aerial vehicles (UAVs) to travel from the launch site to each point of interest within the surveillance/observation area. A safe path planning algorithm with obstacle avoidance in autonomous UAV is developed in this work. The algorithm that combines the Rapidly-Exploring Random Trees (RRT) by integrating path pruning, smoothing and optimization with geometric collision detection. RRT has been shown to be effective in searching for high-dimensional, non-convex areas by creating spatial filling trees at random. The path pruning, prerequisite to path smoothing, is to remove the redundant points generated by the random trees for a new path without colliding with the obstacles. The path smoothing is to modify the path so that it becomes continuous differentiable with curvature implementable by airborne UAV. The optimization is to select a "near" optimal path of shortest distance among the feasible paths for path efficiency. The path planning algorithm is embedded in an onboard 32-bit microcontroller based on the Arm Cortex®-M processor (STM32) for autonomous UAV path planning with high performance, real-time, digital signal processing, and low-power/-voltage operation. In experimental verification, an autonomous UAV is shown to track the planned path predicted by the algorithm.

T240182

IOT-Based Obstacle Avoidance and Navigation for UGV in Wooded Environment Using Adaptive Fuzzy Artificial Potential Field

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Keywords: Internet of Things, unmanned ground vehicle, fuzzy system, artificial potential field, light detection and ranging

Abstract:

With the increasing popularity of Internet of Things (IoT) applications, the data collection and navigation control of unmanned ground vehicles (UGV) in the environment has become a practical solution. In this study, we develop an obstacle avoidance and navigation framework based on IoT and Adaptive Fuzzy Artificial Potential Field (AFAPF) for application in wooded environments. UGV is deployed in wooded areas with dense obstacles, and light detection and ranging (LiDAR) is used to scan its surrounding environment. This framework utilizes the IoT integrated monitoring platform, NVIDIA® Jetson AGX Xavier™, global positioning system, LiDAR, AFAPF, battery, and UGV control system to ensure the stable movement of the UGV in unknown environments. The proposed AFAPF obstacle avoidance method uses the distance between the UGV and the obstacle and the point cloud density generated by LiDAR to obtain adaptive fuzzy decision-making to adjust the expansion radius of the obstacle to ensure that the UGV can immediately and effectively avoid obstacles. The experimental results in two unknown wooded environments show that our proposed AFAPF method reduces navigation time and driving distance by an average of 17.62% and 14.87%, respectively, compared with the traditional APF method.

T240183

Obstacle Avoidance and Navigation of Unmanned Ground Vehicles Using a Type-2 Fuzzy Neural Controller Based on Improved Mantis Search Algorithm

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Keywords: Unmanned ground vehicle, fuzzy neural controller, mantis search algorithm

Abstract:
In this study, we use the type-2 fuzzy neural controller (T2FNC) based on the improved mantis search algorithm (IMSA) for navigation and obstacle avoidance applications of unmanned ground vehicles (UGVs) with differential wheels in unknown environments. In unknown environments, lidar sensors are used to capture distance information between UGVs and the surrounding environment. The T2FNC has a five-layer architecture. The first to fifth layers are the input, fuzzified, rule, order reduction process, and output layers, respectively. In the T2FNC, we use the IMSA to adjust the parameters in the network. In addition, the simulated annealing reciprocal local search algorithm (SARLSA) is proposed to avoid the traditional MSA from falling into the local optimal solution. Experimental results indicate that the fitness value of the proposed IMSA based on SARLSA is 0.983452. Compared with other heuristic algorithms, the proposed method improves the fitness value range by approximately 0.0013 to 0.056. In addition, the experimental results show that the proposed method can have excellent obstacle avoidance and navigation capabilities in unknown environments.

T240184

Optimizing technology for the development of smart coolers based on decision-making objectives

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Keywords: Machine Tool, Energy Consumption, GAN, LLM

Abstract:
As the green energy issue is becoming a global focus, the machining industry is facing the need to reduce energy consumption while improving machining accuracy. The purpose of this study is to optimize the cooling machine parameters during tool machining, mainly considering three variables: temperature setting, fan speed and compressor speed. The optimal combination of cooling parameters for each spindle speed is found by setting different spindle speeds, and the lowest energy consumption and the best machining accuracy are used as the evaluation criteria. The Generative Adversarial Network (GAN) technique is introduced in this study to generate parameters at more speeds through data augmentation, which improves data diversity and model robustness, leading to better optimization results. The final result will provide an intelligent simulation system that allows users to input the relevant cooling parameters according to their customized spindle speeds to simulate and predict the corresponding energy consumption and accuracy records. It is hoped that the LLM will be used as an interface to integrate the above functions, so that users can quickly solve the problems in cooling parameter setting and system usage, and have more complete after-sales service functions.

T240185

Anomalous Weapon Detection For Armed Robbery Using Yolo V8

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Keywords: YOLO, Robbery, Detection

Abstract:

Improved surveillance systems that can provide early warnings and improve public safety are desperately needed in light of the rising number of armed robberies in private and public places, a constant problem. A YOLOv8-based system specifically intended for CCTV-based armed robbery detection is developed during this study to meet this demand. This study presents the development of a YOLOv8-based system for armed robbery detection through CCTV. The research focuses on identifying weapons such as handguns, assault weapons, Shotguns, and other anomalous weapons or objects in real-time, utilizing a custom-trained model. The system demonstrated a strong performance with an overall anomaly detection accuracy of 87.50%. This research also yielded a confidence level of 1.2 meters (58.79) when it comes to the given height and 2 meters (59.74) for the given distance when determining the optimal height and distance when it comes to the positioning of the CCTV camera. The low confidence level can be attributed to the mixture of images from a general database from the internet and self-captured images that resulted in the overfitting of the datasets. Although improvements can be made in increasing the confidence level and reducing false negatives, the results indicate the potential of YOLOv8 to enhance public safety by providing early warnings of armed robberies.

T240186

Development and Evaluation of a Learning Portfolio Query System Based on the $LangChain$ Framework

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Keywords: Large Language Models, LanChain, Education technology

Abstract:

With the increasing use of online education platforms, managing and analyzing the vast amounts of data, such as course information and student progress, presents significant challenges. Traditional methods often require considerable expertise and manual effort. This research leverages the large-scale language model framework LangChain to address this issue by enabling natural language queries on the OpenEdu platform's database. The system converts user queries into SQL using a large language model and translates the results back into natural language. Two query methods were designed: sequential query and agent-based query, resulting in four versions with different model and prompt combinations. The study evaluates the accuracy of these versions and performs an error analysis, identifying schema linking as the primary error source. Results show an execution accuracy of 85.7%, demonstrating the potential of large language models for efficient data querying on educational platforms.

T240189

Development of a Hand-Eye Coordination Analysis System using Mixed-Reality Technology

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Keywords: Hand-Eye Coordination, Mixed-Reality, Super-Elderly Society, Delay in Disability

Abstract:

As Taiwan is about to enter a super-elderly society (the elderly over 65 years old account for more than 20% of the total population), how to delay the disability and dementia of the elderly has become one of the most important issues in Taiwan society. Based on numerous related studies, increasing the use of toys and games for the elderly can help delay their disability. Our study used Mixed-Reality Technology (MR) to develop three 3D interactive games suitable for the elderly. These three games are designed for hand-eye coordination in the elderly, including digital cognition, object shape recognition, and color recognition ability. The reaction time will be recorded for analyzing the elderly's reaction ability when using these game systems. According to the questionnaire analysis of the elderly, more than 83% of the elderly are satisfied with the use of MR equipment. More than 87% of the elderly can accept the interactive mechanism of MR. And more than 80% of the elderly feel that using these three games can help improve their reaction ability.

T240190

Study on magnetic deburring method of the hypodermic needle for human bodies

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Keywords: Magnetic abrasive machining process, Deburring, hypodermic needle

Abstract:

In the manufacturing process of precision micro parts, burrs generated in cutting and grinding processes cause various problems. Shot blasting was used in the deburring technology of cutting and grinding burr in the manufacturing process of the hypodermic needle for the human body. However, a secondary burr facing the inside occurs in a chin part of the needle in blast processing. The existence of burrs on a hypodermic needle may cause several problems. This study proposes a new deburring method by the application of a vibration magnetic abrasive machining process. The experimental setup was made, and the deburring experiments were performed. As a result, the effectiveness of this magnetic deburring method was demonstrated. This paper reports the detailed results.

T240191

ESG Performance Analysis of Japanese EV Manufacturers: A Study Using Text Mining and Predictive Methods

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Keywords: ESG, Electric Vehicle (EV), Japanese Automotive Industry

Abstract:

The value of ESG (Environmental, Social, and Governance) is increasingly highlighted across different industries worldwide, consisting of the automobile market, where its relevance has come to be particularly pronounced. This research study evaluates the environmental campaigns of Japanese electric vehicle (EV) manufacturing business, mostly focusing on significant EV suppliers, from an ESG (Environmental, Social, and Governance) viewpoint. The evaluation concentrates on Toyota, Nissan, and Honda, a leading Japanese firm in EV manufacturing from an ESG perspective. By applying text mining techniques to sustainability and CSR reports from the past five years, we extract key environmental keywords and conduct topic modeling to identify major themes and trends in their environmental efforts. Furthermore, we analyze the correlation between the frequency of environmental keywords and CO2 emissions to assess the alignment between corporate communication and actual performance. Additionally, predictive analysis base

T240192

A Pansharpening Approach Using Generative Adversarial Network for Remote Sensing Images

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Keywords: generative adversarial network, pansharpening, remote sensing, super resolution

Abstract:

Pansharpening is a remote sensing image fusion technique that combines a high-resolution panchromatic (PAN) image with a low-resolution multispectral (MS) image to produce a high-resolution MS image. The primary challenge in pansharpening lies in preserving the spatial details of the PAN image while maintaining the spectral integrity of the MS image. To address this, this article presents a generative adversarial network (GAN) for pansharpening. The GAN discriminator ensures that the generated image's intensity matches the high-resolution PAN image while maintaining the spectral characteristics of the low-resolution MS image.

Super-resolution GANs (SRGANs) are employed to enhance the resolution of low-resolution images. In this article, ground truth images are generated using two approaches: 1) an Adobe Photoshop fusion algorithm that combines a low-resolution MS image with a high-resolution PAN image, and 2) a conventional pansharpening algorithm that fuses a low-resolution MS image with a high-resolution PAN image. These ground truth images are then used to train a GAN model to generate super-resolution images from low-resolution inputs.

The performance of the generated images is evaluated using the peak signal-to-noise ratio (PSNR). In the experiments, the original low-resolution MS satellite images and high-resolution PAN satellite images were divided into smaller patches, and validation was conducted using an 80/20 training and testing data ratio. The results illustrate that the super-resolution images generated by the SRGAN model achieved a PSNR of 31 dB. Experiments on Pleiades satellite images have illustrated that the proposed approach produces better visual results. These results demonstrate the approach's ability to reconstruct high-frequency information related to geometry, texture, and spectral content in the images.

T240193

A New μ-Law-Based Companding Scheme for PAPR Reduction in OFDM Systems

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Keywords: orthogonal frequency division multiplexing (OFDM), peak-to-average power ratio (PAPR), bit error rate (BER), dual μ-law (D-μ-law), complementary cumulative distribution function (CCDF)

Abstract:
Orthogonal frequency division multiplexing (OFDM) is the most prevalent and mature technology renowned for its robustness against multipath fading and high spectral efficiency. However, OFDM's inherent high peak-to-average power ratio (PAPR) is an inevitable issue in multi-carrier systems, leading to nonlinear distortion when the transmitted signal passes through the linear power amplifier (PA). To address the high PAPR problem, we adopt the advantages of two different μ-law companding rules according to component amplitude to propose an improved μ-law companding scheme. The proposed scheme sorts the transmitted signals according to amplitude and performs efficient pre-calculations to estimate the rough watershed for grouping, simultaneously determining the appropriate output power allocation threshold. Moreover, the two group signals are compressed using two μ-law companding rules with different characteristics through this threshold. We refer to this as the dual μ-law (D-μ-law) companding scheme. Simulation results show that, when the complementary cumulative distribution function (CCDF) is equal to 10^−4, the proposed D-μ-law companding scheme significantly reduces PAPR by approximately 3.5 dB (around 39%) compared to the original μ-law while maintaining a satisfactory bit error rate (BER) performance. The complexity of the D-μ-law scheme is only marginally higher than the original μ-law (around 0.18%). Moreover, compared with other companding schemes, the proposed scheme achieves a superior balance among PAPR, BER, and complexity.

T240194

Applying Parameterized Quantum Circuit to Anomaly Detection

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Keywords: parameterized quantum circuit, quantum computer, anomaly detection

Abstract:

Quantum computers operate on quantum bits (or qubits), utilizing physical phenomena such as quantum superposition and quantum entanglement to perform computations. Universal quantum computers, like IBM Q and Google Sycamore, employ quantum circuits composed of quantum gates to solve a wide range of problems. This paper applies a parameterized quantum circuit (PQC) to anomaly detection. A PQC is a quantum circuit with trainable parameters linked to quantum gates, which are iteratively optimized by classical optimizers to ensure that the circuit's output satisfies specific objectives. This is analogous to the way trainable parameters, such as weights, are adjusted in classical machine learning and neural network models. This paper first uses the amplitude embedding mechanism to embed classical data into quantum states of qubits. These states are then fed into a PQC which contains strongly entangled layers, and the circuit is trained to determine whether an anomaly exists. Since anomaly detection datasets are often imbalanced, resampling techniques, such as random oversampling, the synthetic minority oversampling technique (SMOTE), random downsampling, and T-Link downsampling, are applied to mitigate the imbalance issue. For comparison, the proposed PQC and various resampling techniques are applied to the public Musk dataset for anomaly detection. These combinations are also compared with the combination of the classical autoencoder and the classical isolation forest, in terms of the f1-score. By analyzing the comparison results, we identify the advantages and disadvantages of the PQC for future research.

T240195

A Deep Learning Approach to Cassava Disease Detection Using EfficientNetB0 and Image Augmentation

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Keywords: cassava, disease, disease detection, deep learning, EfficientNetB0

Abstract:
Cassava, a vital crop in the Philippines and other tropical regions, is highly susceptible to various diseases that can drastically reduce its yield. Traditional inspection methods for detecting these diseases are often manual, time-consuming, expensive, and prone to inaccuracies. While recent advances have improved detection, many approaches focus primarily on leaves and stems, overlooking tubers—one of the most critical parts of the plant. Since tubers are the harvested portion of the cassava and a direct source of food and income, early disease detection in this part is crucial for preventing severe yield losses. Furthermore, symptoms may often manifest in the tubers before becoming visible in other areas, making their monitoring essential for timely intervention. To address these challenges and improve accuracy, this study employs EfficientNetB0 along with data augmentation techniques to enhance disease detection across multiple parts of the cassava plant. Integrated into a Raspberry Pi 4B with a camera module, LCD screen, and enclosed in a 3D-printed casing for ease of use by farmers, the system achieves detection accuracies: 94% for leaves, 90% for stems, and 92% for tubers. Statistical analysis confirms the system's reliability, with p-values well below the 0.05 significance level. By reducing the need for expensive manual inspections, this device offers a robust solution for early disease detection, particularly in the tubers, helping to mitigate yield losses. Its proven accuracy and practical design support better disease management practices, improving crop health while enhancing food security and supporting the livelihoods of cassava farmers.

T240196

An explainable memorization scheme for noisy instances in downstream tasks

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Keywords: explainability, memorization, noisy instance

Abstract:

Deep learning models are often perceived as black boxes, making it challenging to analyze the causal relationships between inputs and outputs. For this reason, the explainability of model learning has garnered increasing attention in recent years. Some previous studies proposed influence functions, which evaluate how the weighting of data impacts the model by mathematical analysis, thereby explaining how it realizes the data. This inspires us to suggest that when data in downstream tasks is affected by varying levels of noise interference, it is practical to apply Taylor expansion in conjunction with the Hessian matrix to estimate perturbations that each data point causes in the model. Additionally, utilizing Integrated Gradients to compute the loss difference between the original data instances and a baseline instance which does not affect the model is powerful to yield a memorization matrix that allows researchers to observe the changes in model reasoning before and after noise interference, helping to analyze the causes of erroneous inference.

T240197

Data augmentation for robustness enhancement of CAML

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Keywords: data augmentation, in-context learning, CAML

Abstract:

In recent years, most large language models have in-context learning capabilities, demonstrating new concepts learning during inference without fine-tuning, as required by traditional models. As a previous study introduced the CAML(Context-Aware Meta-Learning) model, similar capabilities could also be extended to visual models. CAML utilizes a frozen pre-trained feature extractor, analogous to in-context learning to perform sequential modeling with a support set containing known labels and a query set with unknown labels. In this study, we build upon the CAML model to apply the mixup method for the query set augmentation to help latent features reasoning during meta-learning process. Experimental results show that in most cases of image classification across various datasets, our approach effectively enhances the robustness of the CAML model and improves its performance of in-context inference of augmented query data.

T240199

Harnessing CNN-ResNet for Discerning AI-Generated Synthetic Images

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Keywords: CNN-ResNet, Latent Diffusion Model (LDM), AI-generated images

Abstract:

With the rapid development of generative artificial intelligence technology, especially the widespread application of generative adversarial networks (GAN) and latent diffusion models (LDM), the simulation capabilities of artificial intelligence-generated images have been significantly enhanced. This phenomenon reflects the challenge of effectively distinguishing real images from processed AI-generated images. This research aims to enhance the recognition capabilities of artificial intelligence-generated images by applying deep learning technology. This study uses the CNN-ResNet model to identify subtle differences in image features, especially abnormal features generated by artificial intelligence, such as texture inconsistency, abnormal color distribution, and edge information defects. We selected the CIFAKE data set in the Kaggle platform for model evaluation. A ten-fold cross-validation method was used to ensure the stability and generalization ability of the data set on different models. The research results show that compared with traditional classification methods, the CNN-ResNet model performs excellently in terms of accuracy and generalization, especially in its ability to handle complex image features. This achievement is of great significance for identifying images generated by artificial intelligence, and provides strong support for ensuring the authenticity of digital images in the future.

T240200

Evaluation of Peltier Cooled Vest Capabilities

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Keywords: Peltier, Cooled Vest, Bluteooth, GUI

Abstract:

This study investigates the development of wearable cooling technology by incorporating Peltier cooling systems into vests, with a particular emphasis on advancing personal comfort and applications in various workplaces. The study has three main goals: design and test a Peltier-cooled vest, integrate temperature sensors for precise monitoring, and evaluate the vest's performance in real-world scenarios. The proposed water-cooled vest, which includes thermoelectric cooler modules, seeks to improve cooling efficiency and comfort by taking advantage of water's superior heat transfer and thermal conductivity. The study uses empirical testing and subjective assessments to establish the effectiveness of the wearable cooling system and its potential for widespread adoption. Furthermore, the development of intelligent control algorithms to maintain target temperatures is discussed. This study found that that the built-in temperature sensor coincided with the measurement of the commercial grade temperature sensor. From the built-in temperature sensor, the temperature stability was also measured, and the deviation resulted to be miniscule in relation to the set temperature. In addition, the cooling response time of the Peltier cooled vest gained an average of 9.42 minutes from the three predetermined temperature ranges. It was also found in this study that lower temperature range (16-degrees to 24-degrees) tends to be more accurate in relation to the target temperature. Furthermore, there is an indirect correlation between temperature level and power consumption. Finally, a considerable amount of sample population experienced a scanning and connecting issue with the built-in Bluetooth system. However, the GUI is deemed favorable according to the data from the sample population. Overall, this study advances wearable cooling technology which intends to improve user comfort and potential applications in medical and industrial settings.

T240201

Pseudo-footless domino circuit based: design of Hamming (7, 4) encoding/decoding CMOS circuit

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Keywords: Pseudo-footless domino circuit, Hamming code, dynamic circuit, bit error self-correction

Abstract:

Based on pseudo-footless domino circuit, Hamming (7, 4) code (seven output bits, four input data bits) encoding/decoding CMOS circuit is studied in this paper. This paper refers to other researcher's static circuit design and modifies it into a dynamic circuit. This circuit is implemented using United Microelectronics Corp. (UMC) 0.18-μm 1P6M CMOS process. The circuit functionality was simulated using HSPICE, and the encoding/decoding circuits, self-error detection, and self-correction functions operate correctly. The circuit operates at a maximum frequency of 800 MHz.

T240202

Bloodstain Pattern Recognition using YOLOv8

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Keywords: YOLOv8, Orange Pi 5, Webcam, Image preprocessing, Bounding Boxes

Abstract:

There are handful of computer vision research regarding bloodstain patterns and uses legacy algorithms such as Cascade-Forward Neural Network (CFNN), K – Nearest Neighbors (KNN) and Convolutional Neura Network (CNN). This research uses a modern computer vision algorithm known as You Only Look Once, or YOLO, and its current version of YOLOv8. Orange Pi 5 controls image preprocessing and the program that uses YOLOv8 processes, such as bounding boxes and image identification. It uses webcam for capturing images. Identification of bloodstain patterns will only be limited to six patterns: Droplet, Pool, Bloodflow, Swiping, Wiping, and Pattern. The creation of the prototype has been successful that is within the scope of this research. Nonetheless, shapes and sizes of the bloodstain patterns can have an insignificant impact on the prototype's accuracy because of its 3.43% error rate. With an accuracy rate of 96.57%, this can identify all the six bloodstain patterns correctly.

T240206

Cotton T-Shirt Size Estimation using Convolutional Neural Network

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Keywords: Convolutional Neural Network, PoseNet, Body Contour Detection, Upper Body Measurements, Cotton T-Shirt Size

Abstract:
Online shopping has become a popular method for purchasing goods due to its convenience and potential cost savings. However, one persistent concern is sizing accuracy, particularly when buying shirts. Many shoppers base their size choice on what they currently wear, leading to uncertainty about fit. This study aims to estimate shirt size using calculated upper body measurements to assist users in selecting the correct size when purchasing t-shirts online. Computer vision algorithms, including YOLO, PoseNet, and body contour detection, along with a trained convolutional neural network (CNN) model, were employed to estimate shirt sizes from 2D images. The model was tested using images of 30 respondents standing 180-185 cm away from a Raspberry Pi camera, achieving an overall accuracy of 70%. Inaccurate predictions were attributed to factors such as inconsistent lighting, distance from the camera, and variations in the respondent's height.

T240207

Loka: A Cross-Platform VR streaming Framework for the Metaverse

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Keywords: Metaverse, Virtual Reality, Cloud gaming, Internet of Things

Abstract:

As the concept of the Metaverse evolves, Virtual Reality (VR) plays a pivotal role in creating immersive, socially interactive environments that form the backbone of this interconnected digital universe. However, VR technology often faces significant challenges, including hardware limitations, platform incompatibilities, and difficulties supporting seamless multiplayer experiences. VR streaming offers a potential solution by offloading computational tasks to remote servers, enabling high-quality VR experiences on lower-end devices and enhancing accessibility to a broader audience. In this paper, we present Loka, a versatile and extensible VR streaming framework designed to address these challenges, providing the necessary infrastructure to support social interactions and real-time collaboration in virtual environments—the key components of the Metaverse.

Loka is built on Unity Engine and WebRTC, enabling seamless cross-platform VR experiences without the need for device-specific SDKs. It also supports real-time integration of custom data streams, such as motion capture and physiological signals from IoT devices, which can enhance user interaction and personalization in virtual environments, and provide a more convenient platform for research. Furthermore, Loka's native multiplayer and multicast capabilities facilitate collaborative and interactive social experiences, aligning with the core goals of the Metaverse.

By leveraging cloud-based rendering for low-latency streaming, Loka allows users to engage in immersive VR environments on a wide range of devices, without requiring high-end hardware. Its modular architecture ensures extensibility, allowing researchers and developers to integrate new data types and experimental setups more easily. With its ability to set up an immersive VR scene that supports social interaction and handles complex virtual environments, we believe our proposed work can foster the development and research of the Metaverse.

T240208

YOLOv8-Based Cattle Identification based on Muzzle Print Pattern using ORB and FLANN Algorithms

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Keywords: Cattle Muzzle, YOLOv8, Feature Matching, Raspberry Pi

Abstract:
Cattle identification is an important task in livestock management, and advanced techniques are required to identify the cattle without ear tagging, branding, or any identification method that harms the cattle. This study utilizes computer vision techniques that identify the cattle based on their unique muzzle print features. The proposed methodology employs the YOLOv8 object detection model to detect the cattle's muzzle. Following the detection, the captured muzzle image will undergo image processing; Contrast Limited Adaptive Histogram Equalization (CLAHE) will be applied to the captured image to enhance the image quality, resulting in a prominent and detailed image of the muzzle print. A feature extraction algorithm Oriented FAST and Rotated BRIEF (ORB) will then be applied to extract key points and detect descriptors which are crucial for the cattle identification process. The Fast Library for Approximate Nearest Neighbors (FLANN) identifies individual cattle by comparing descriptors of query images from those stored in the database. To further validate this approach, the described system will be integrated into a working prototype powered by Raspberry Pi 4 Model B. To test the effectiveness of this approach, an evaluation was conducted on 25 different cattle, 22 out of 25 were correctly identified resulting in an overall 88% accuracy. It demonstrated the effectiveness of the method.

T240209

Molding Characteristics and Impact Strength of Polypropylene with Different Recycling Times

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Keywords: Circular Economy, Impact Strength, Viscosity Factor

Abstract:
In recent years, net-zero carbon emission has become a global trend. How to connect the upstream and downstream of the proposed five net-zero technologies from the beginning to the end is a major challenge for the injection industry. In addition, the manufacturing of plastic products needs to consider the quality, efficiency and energy consumption and other objectives, through the intelligent optimization of the process technology, and install sensing elements in the machine, combined with material/mold/machine data and experimental methods, to reduce defective products, as well as the ability to identify the rheological properties of plastic materials, and to observe the impact of the viscosity factor of the material on the molding characteristics of the product.

The purpose of this research is to analyze the changes in the molding properties of PP resin in the process of recycling, after multiple mixing, injection, and crushing, and to analyze the changes in the material properties and impact characteristics with the ASTM-D256 impact test specimen, with the focus on the number of times of recycling. After the material is injected and crushed, it is recycled to produce the material required for re-injection, and a pressure sensor is installed at the nozzle position to observe the effects of material properties and impact characteristics.

The results show that PP recycled material has been injected and pulverized several times resulting in looser molecular spacing, which leads to an increase in the fluidity of the material. After several recycling cycles, the fluidity of the material gradually calms down. The crystallinity results show a decreasing and then increasing trend, which also affects the crystallinity and crystallization rate of the material. And recycled PP materials with the variation of molding processing include melt temperature, screw speed, back pressure and injection speed will affect nozzle pressure and impact strength; among them, as the melt temperature increases, the effect on the nozzle pressure and impact strength is more obvious.

T240210

Real-Time Detection of Terrain Surface Types and K-Factor for Path Profiling using Drone and YOLO v7

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Keywords: Detection, Terrain Type, K-Factor, Path Profiling, Drone

Abstract:
This study explores the development of a real-time terrain detection system using drones and the YOLO v7 deep learning algorithm to classify terrain types for path profiling and microwave communication optimization. The system identifies and classifies various terrain surfaces, such as urban areas, bodies of water, forests, and roads, enabling improved path profiling accuracy by dynamically adapting signal propagation based on real-time terrain data. The integration of YOLO v7 with drone technology allows for the efficient processing of image data at a high frame rate, delivering rapid terrain classification even in challenging environments. Additionally, this research assesses the K-factor for different terrain types, which is essential for predicting microwave signal behavior and improving communication reliability. By advancing the speed and accuracy of terrain detection, this project contributes greatly to telecommunications, with potential applications in agriculture, urban planning, and environmental monitoring.

T240211

Design of Laptop Antenna for Wi-Fi 6E

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Keywords: WiFi-6E, MIMO antenna, parasitic element

Abstract:
This paper proposes a Multiple-Input Multiple-Output (MIMO) multi-band antenna suitable for WiFi-6E band. The planar size of the proposed antenna is 40 x 7.6 mm^2 and it is built on a FR4 substrate with a thickness of 0.8 mm. By utilizing a 3 x 3.8 mm^2 L-shaped parasitic element, additional resonant modes are introduced through coupling and resonance. The operating frequency bands are WLAN 2.4 GHz (2.4GHz-2.8 GHz) and Wi-Fi 6E (5.06 GHz-7.13 GHz). The average antenna gain is 4.2 dBi, with an ECC less than 0.020 and radiation efficiency between 70% and 92%.

T240213

Iot-Based Smart Indoor Aquaponics System for Urban Agriculture

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Keywords: Smart Indoor Aquaponics, Internet-of-Things (IoT), Automation, Water and Air Quality Parameters, Nile Tilapia

Abstract:

This study presents the development of a smart indoor aquaponics system utilizing Internet-of-Things (IoT) technology and automated controls to promote sustainable urban agriculture. The system integrates sensors to monitor and regulate water and air quality parameters such as nitrate, pH, dissolved oxygen (DO), electrical conductivity (EC), water temperature, water level, turbidity, air temperature, and humidity. It employs an Arduino Mega 2560, a Raspberry Pi 3, and a web-based application to continuously send information regarding the aquaponics' status and to automatically adjust when parameters exceed their ideal range through automated components, including a pH Up adjuster, water changer, and refiller, thereby ensuring optimal conditions for plant and fish growth. Additionally, the integration of solar energy for specific components further enhances energy efficiency. The study compared the growth of Nile Tilapia, Grand Rapid Lettuce, and Pechay in the smart aquaponics system with traditional fishkeeping and soil-based systems. Statistical analysis conducted using one-tailed t-tests revealed significant improvements in growth outcomes for the smart aquaponics system compared to traditional methods. While the results demonstrate the system's effectiveness in controlled environments, further research is recommended to validate its scalability in diverse real-world settings. Overall, the smart aquaponics system represents a promising solution for optimizing management and sustainability in urban agriculture.

T240214

Real-Time Object Detection in Tap Water Utilizing YOLOv8 for Comprehensive Contamination Monitoring

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Keywords: YOLOv8, image processing, contaminants, monitoring, real-time

Abstract:
This academic work presents the development of an advanced approach for real-time object detection in tap water, employing the YOLOv8 deep learning model specifically designed to identify contaminants such as algae, ants, and sand. As the safety and quality of water remain critical issues in urban settings, this study focuses on implementing a robust system that utilizes high-precision object detection to effectively monitor these specific contaminants. The proposed system integrates advanced image processing techniques to capture and analyze real-time water samples, aiming to detect foreign objects and potential contaminants with high accuracy. A carefully curated dataset is utilized to train the YOLOv8 model, enabling it to achieve reliable performance across diverse environmental conditions. By leveraging real-time analysis, the system provides immediate feedback on the presence of contaminants, which is essential for the proactive management of water quality risks. The performance of the YOLOv8 model is rigorously evaluated through testing, employing metrics such as precision, recall, and inference speed to ensure its effectiveness in practical applications. This research highlights the importance of targeted object detection technologies in safeguarding public health. The findings advocate for the integration of machine learning solutions into existing water management frameworks, promoting sustainable and safe urban water supplies.

T240215

Biomechanical Analysis of Different Bone Screw Configurations for Distal Femoral Plate Fixation in Osteoporosis

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Keywords: Distal Femoral Plate Fixation, Screw Configurations, Osteoporosis, Biomechanics

Abstract:

When treating osteoporotic patients with fracture fixation surgery, ensuring the stability of bone plates and screws is crucial to the success of the procedure. In this study, a finite element model was developed to simulate distal femoral bone plate implantation in a transverse femoral fracture. By varying the cortical bone thickness and adjusting the material properties of cancellous bone, the model replicated the effects of different degrees of osteoporosis on bone structure. Additionally, various screw configurations were examined to explore how these changes influenced the stability of the bone plate fixation system. The results revealed that, denser screw configurations did not always provide greater stability in osteoporotic conditions. In fact, increased screw density sometimes led to higher stress concentrations, potentially causing screw loosening or failure. These findings offer valuable insights for developing more effective surgical strategies tailored to the specific bone quality of osteoporotic patients, improving fracture fixation outcomes.

T240216

Multi-Feature LSTM Facial Recognition for Real-Time Automated Drowsiness Observation of Automobile Drivers with Raspberry Pi 4

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Keywords: EAR, MAR, Head Pose Angles, LSTM, NTHU-DDD

Abstract:
This paper details the development and evaluation of a multi-feature drowsiness detection model employing eye aspect ratio (EAR), mouth aspect ratio (MAR), and head pose angles (Yaw, Pitch, and Roll) for real-time applications utilizing a Raspberry Pi 4. The model, trained on the NTHU-DDD dataset and optimized using LSTM deep learning algorithms, demonstrated robust drowsiness detection capabilities at a frame rate of 10 frames per second (FPS). The study encompassed the design of a hardware prototype for live image capture, meticulous calibration of camera placement for optimal positioning, and assessment of various feature combinations under diverse conditions (day, night, with and without glasses). Training results yielded high accuracy (95.23%), with evaluation accuracies ranging from 91.81% to 95.82% across categories. Real-time testing revealed notable differences between stationary and moving vehicle setups, with stationary configurations achieving higher accuracy. In contrast, moving vehicle testing showed accuracy levels fluctuating between 51.85% and 85.71%. Single-feature configurations exhibited accuracy ranging from 51.85% to 72.22%, while dual-feature combinations showed improved performance, achieving accuracies between 66.67% and 75%. The highest accuracy, from 80.95% to 85.71%, was attained with the comprehensive integration of all features. Challenges identified included diminished accuracy with MAR alone and increased prediction delays during transitions from non-drowsy to drowsy states. These findings underscore the model's potential applicability in driving environments while highlighting the necessity for further refinement. Future research should prioritize algorithm optimization, dataset expansion, and the integration of additional features and feedback mechanisms to enhance real-world performance and reliability.

T240217

ENHANCING REAL ESTATE LISTINGS THROUGH IMAGE CLASSIFICATION AND ENHANCEMENT: A COMPARATIVE STUDY

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Keywords: image classification, image enhancement, real estate, deep learning, large language models

Abstract:

This paper presents a comprehensive study on image classification and enhancement to enhance property listings on an online real estate platform. The research aims to improve both the accuracy of image classification and the visual appeal of listings. A dataset of 3,000 labeled images was utilized to perform a comparative evaluation of different image classification models, including Convolutional Neural Networks (CNN), VGG16, RESNET, and the LLaVA large language model (LLM). The performance of each mode was benchmarked to identify the most effective approach for real estate image classification.

In addition to model comparisons, image enhancement was integrated using Contrastive Unsupervised Representation Learning (CURL) to preprocess the images before classification. This method was employed to assess the impact of improved image quality on both classification accuracy and the overall attractiveness of property listings. The performance of each classification model was evaluated under two conditions: with and without the application of CURL.

The results demonstrate that applying image enhancement with CURL not only enhances image quality but also improves classification performance, particularly in models such as CNN and RESNET. This enhancement resulted in better visual representation of real estate properties, leading to more accurate and engaging listings for users. The study underscores the importance of combining advanced image processing techniques with powerful classification models to optimize image presentation and categorization in the real estate sector.

This research offers valuable insights into the role of machine learning models and image enhancement methods in real estate technology, providing a scalable solution that can be integrated into smart property listing systems to improve user experience and information accuracy. The contributions of this study align with broader goals in artificial intelligence and advanced communication systems, paving the way for future innovations in the real estate sector and intelligent marketplace platforms.

T240218

Experimental Investigation of a Flat Loop Heat Pipe

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Keywords: Two-phase flow, Flow patterns, Loop heat pipes

Abstract:

Loop heat pipe (LHP) is a two-phase heat transfer device widely used in electronic products as thermal control systems. This paper presents an experimental investigation of a loop heat pipe with a square flat evaporator which operates for a heat load range of 20-120W in horizontal orientation. In addition, the two-phase flow pattern based theoretical LHP modeling is also presented to predict thermal performance and two-phase flow patterns within the LHP's condenser. The difference between the predicted and the experimental temperatures of the flat LHP shows a mean absolute percentage error (MAPE) of 2.29-3.3%. The flow patterns in the condenser of flat LHP are also obtained from the theoretical modeling.

T240219

Investigation into an Advanced System for Monitoring Driver Fatigue Utilizing Human-Machine Hybrid Enhancement

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Keywords: human-machine hybrid, driver fatigue levels, driver fatigue detection

Abstract:

Aiming to enhance current driver fatigue detection methods with limited single fatigue feature, low accuracy, and poor resilience, this study unveils an advanced driver fatigue monitoring intel-ligent system integrating human-machine hybrid enhancement. To reframe these obstructions, we have devised a human-machine hybrid fatigue driving experimental platform utilizing a hard-ware in the loop system. This platform amalgamates human and machine systems to deliver pre-cise evaluation of driver fatigue levels. Subsequently, we compared three preprocessing methods for driver facial images and vehicle driving status data, establishing a driver human-machine hy-brid fatigue driving database. This database encompasses a broad spectrum of data, including fa-cial images, steering wheel angle, and acceleration pedal pertinent information, useful in identify-ing subtle behavioral changes indicating fatigue levels. Lastly, we utilized variance analysis to quantify the significant difference levels of human-machine hybrid fatigue feature parameters at varying fatigue levels. Based on this analysis, we constructed a neural network-based hu-man-machine hybrid enhanced driver fatigue monitoring intelligent system that accurately detects driver fatigue levels with accuracy of 95.5%, 91.5%, 94.7%, and 95.0% for differentiating four driver fatigue stages: wakefulness, mild fatigue, fatigue, and severe fatigue. Our empirical out-comes affirm the efficacy of our proposed system in distinguishing driver fatigue levels and sug-gest its potential to significantly enhance transport system safety and efficiency.

T240221

Calibrating the accelerometer with the Levenberg-Marquardt Algorithm for Robotics Applications

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Keywords: Levenberg-Marquardt Algorithm, accelerometer

Abstract:

In order to obtain accurate accelerometer values, the values need to be corrected. This article uses the Levenberg-Marquardt (LM) Algorithm to perform corrections, using the values obtained by placing the three-axis accelerometer at 0° and 180° to calculate the correction parameters of each axis. The results show that the correction effect is better for the axis that measures gravity. Although the other two axes are slightly different from the ideal values, they are much better than other correction methods, fast and highly accurate.

T240222

Applying deep learning remote sensing to identify ecological land characteristics

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Keywords: ecological land, neural network, water body

Abstract:

The rapid development of artificial intelligence and computer vision technology, using deep learning algorithms to extract water bodies from remote sensing images, has become one of the research hotspots. Water extraction from remote sensing images has essential application value in environmental monitoring, water resources management, urban planning, and other fields. However, traditional methods based on rules and feature engineering are limited when processing remote sensing images and cannot accurately extract complex water body boundaries and types. This study used a convolutional neural network semantic segmentation to carry out high-resolution satellite remote sensing data on water bodies. The deep learning model can effectively learn complex regular features in high-resolution remote sensing images and improve image classification accuracy. Based on remote sensing data, a large-scale sample set is constructed, and a detection model with higher accuracy is trained through a deep learning model, which can be used for ecological land surveys.

T240224

Adoption of ESG Principles in Taiwan: Achievements, Obstacles, and Future Outlook.

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Keywords: ESG, sustainability, governance, environmental management, social responsibility

Abstract:

ESG has emerged as a significant aspect of Taiwan's economic framework, influenced by both local policies and global developments. The government has established a regulatory foundation that promotes sustainability, while investors and stakeholders advocate for improved corporate practices. This paper discusses the main initiatives, challenges encountered by Taiwanese businesses, and possible approaches to further strengthen ESG efforts within the country. Taiwan's commitment to ESG is driven by its desire to align with international sustainability standards and enhance its global competitiveness. Key sectors such as technology and manufacturing are taking steps to reduce environmental impacts and improve governance. However, the challenge of standardizing ESG reporting across industries remains a critical issue. Smaller businesses, in particular, face difficulties in fully integrating ESG practices due to limited resources. By addressing these challenges and fostering greater collaboration, Taiwan can continue to advance its ESG landscape and contribute to a more sustainable future.

T240225

Defining a Platform Based Smart 12 Lead ECG Machine by Using MCDM Methods

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Keywords: Smart Telemedicine, Multiple criteria decisions making (MCDM), Platform-Based Design

Abstract:

"Smart Telemedicine" represents an innovative application of information and communication technology within the healthcare sector, encompassing healthcare delivery, disease management, public health surveillance, education, and research. The commercialization of 5G and the extensive adoption of the Internet of Things (IoT) enable Smart Telemedicine devices to mitigate geographical and transmission delays, hence enhancing the quality of treatment provided to individuals. Although intelligent medicine is significant, most existing literature emphasizes the implementation and adoption of systems or technologies, with few study conducted on the platform of Smart Telemedicine equipment. This study aims to address the research gap by forecasting future developments and delineating Smart Telemedicine device designs utilizing platform-based design. We introduce a hybrid multi-criteria model that delineates the components of the intelligent medical platform. This research used a portable twelve-lead electrocardiogram

T240226

Developing a TOE HOT-fit Model for Introducing Industry 5.0 by Electronic Manufacturing Service Providers

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Keywords: Industry 5.0, Electronic Manufacturing Service (EMS), Technology-Organization-Environment (TOE) Framework and the Human-Organization-Technology Fit (HOT-fit) model, Partial Least Squares Structural Equation Modeling (PLS-SEM)

Abstract:

Industry 5.0 has emerged as a new paradigm that builds on Industry 4.0, emphasizing human-centric values and enhancing production efficiency in the Electronic Manufacturing Service (EMS) industry. This shift aims to optimize existing facilities while developing a skilled workforce to drive sustainable manufacturing. However, the EMS sector faces significant challenges, including increased competition and a market trend toward small-volume, diversified demand. Coupled with a shortage of skilled labor in green energy and technical fields, the transition to Industry 5.0 presents new complexities. The EMS industry must navigate a complex decision-making process when adopting new technologies, influenced by factors such as customer orders, supply chain management, and the need for stakeholder support. Despite the importance of these factors, there is limited scholarly research on the interplay between industry and education in the context of Industry 5.0. This research proposes a two-phase approach, integrating the Technology-Organization-Environment (TOE) Framework and the Human-Organization-Technology Fit (HOT-fit) model, resulting in the TOE HOT-fit model. This model, which encompasses four dimensions—human resources, organization, technology, and environment—along with eleven criteria, is applied to case studies in the EMS industry. Empirical analysis reveals that the environmental dimension is most critical, with factors like cost, complexity, expert resources, relative advantage, and perceived industry pressure significantly influencing the adoption of Industry 5.0 technologies.

T240228

Calculating the Percentiles of t-distribution by the Gaussian Integration Method

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Keywords: Statistical inference ; Percentile ; t-distribution ; Gaussian integration method

Abstract:

Statistical inference is to estimate the population parameters by the sample information and to quantify the sampling error by the probability narrative. As we have to infer the population mean by its sample mean but have to infer it according to the sample variance without the population variance, the quantitative analysis of sampling error will involve the t-distribution. To determine the percentiles of the t-distribution is to find its cumulative probability density function. But the cumulative probability density function of the t-distribution does not have the analytic expression. Its values can be obtained through numerical integration. However, the percentiles of the t-distribution are not listed for the degrees of freedom over 30, and they are only listed every 10 data over 30 degrees of freedom in almost all books of probability theory or mathematical statistics. That will be very inconvenient for the rigorous researchers. In view of this, the cumulative probability density function of t-distribution is calculated through the Gaussian integration method. The results show that the percentiles of the t-distribution are very accurate by the algorithm in this paper.

T240229

The Indirect Measurement of Tensile Strength of Material by the Grey Prediction Models GMC(1,n) and GM(1,n)

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Keywords: GM(1,n) model, GMC(1,n) model, unit impulse response function, convolution integral, indirect measurement

Abstract:

Grey theory can be applied to research in forecasting, decision-making, and control, particularly suitable for predictive analysis. Incomplete information is a primary characteristic of grey systems, necessitating the supplementation of information to transform the relationships among various information elements from grey to white, thus improving the accuracy of predictive models. However, for the first-order grey prediction model with n variables, specifically the traditional GM(1,n) model, the model values are derived using a rather rough approximation method. This method assumes that the elements of the one-order accumulated generating series of each associated series are constant, leading to an unreasonable relationship between the forecast series and the associated series, which is fundamentally an incorrect model. The elements of a non-negative series's one-order accumulated generating series cannot be constants; even if they were constant series, this would not hold true. Consequently, the traditional GM(1,n) model can yield significant errors, and there have been very few papers addressing the errors of this model. In improved versions of the GM(1,n) model, such as those incorporating convolution algorithms or fitting system action quantities with basic functions to further derive particular solutions, correct algorithms are used. The modeling procedure of the grey convolution prediction model GMC(1,n) demonstrates that the traditional grey prediction model GM(1,n) is indeed incorrect.

T240230

Analysis of a One-Degree-of-Freedom Spring-Mass-Damper System with Nonlinear Spring by the Runge-Kutta Method

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Keywords: damping, nonlinear spring, spring-mass-damper system, Taylor series, Runge-Kutta method

Abstract:
Most engineering problems can be described using differential equations, yet only a few can be solved analytically, especially when it comes to nonlinear differential equations, which are generally difficult to solve. The goal of numerical analysis is to minimize the difference between the numerical solution and the exact solution as much as possible. The Runge-Kutta Method, particularly the fourth-order Runge-Kutta method (abbreviated as RK4), is a highly accurate numerical analysis technique. This paper studies the RK4 method and applies it to the analysis of a spring-mass-damper system with a nonlinear spring. The results show that the numerical solution of the displacement time response function of the spring-mass-damper system is extremely accurate, achieving precision up to six significant figures with ease.

T240231

An Innovative Turn-Boring Method for AA7050-T7451 with Multiple Performance Characteristic

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Keywords: turn-boring, AA 7050-T7451, surface roughness, roundness error, Taguchi grey relational analysis

Abstract:

The present study proposes an innovative turn-boring operation method and focuses on finding optimal turn-boring process parameters for AA7050-T7451 by considering multiple performance characteristics using the Taguchi orthogonal array with the grey relational analysis, the effect of cutting parameters such as feed rate, depth of cut and cutting speed are optimized with considerations of multiple performance characteristics, namely surface roughness, roundness error, material removal rate, and power consumption, the optimal values were found from the Grey relational grade. The result of the analysis of Variances (ANOVA) is proved that the most significant factor is cutting speed, followed by feed rate, and radial depth of cut. Finally, confirmation tests were performed to make a comparison between the experimental results. Experimental results have shown that machining performance in precision turn-boring process can be improved effectively through this approach.

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