International Society of Innovation Methods

MANIPAL ACADEMY of HIGHER EDUCATION (Institution of Eminence Deemed to be University)

The Society of Systematic Innovation

國立清華大學 NATIONAL TSING HUA UNIVERSITY

The Joint Conference of
17th International Conference on Systematic Innovation (ICSI & GCSI) and
3rd International Conference on Data Science &
Exploration in Artificial Intelligence (CODE AI-2026)

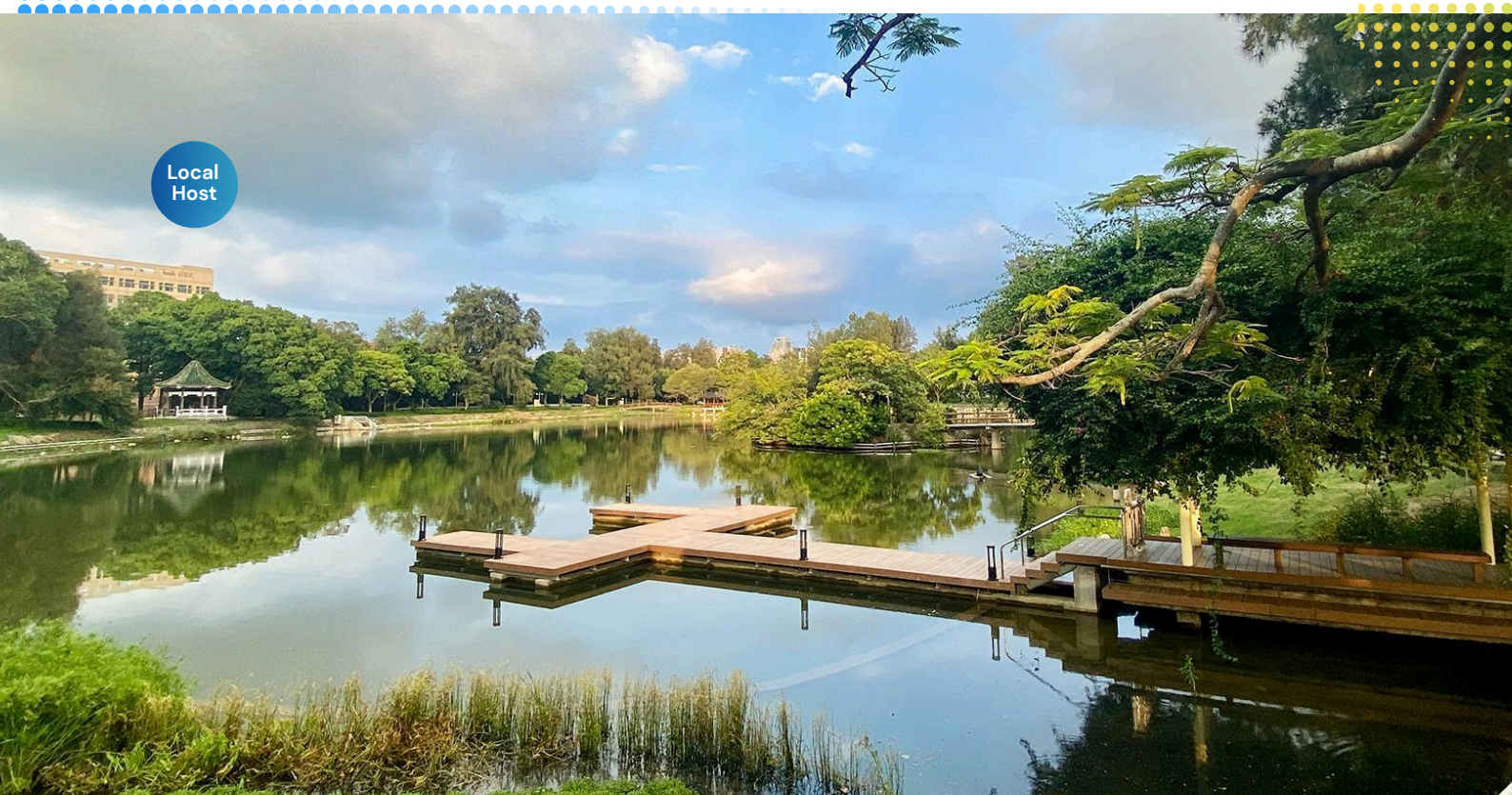
ICSI & GCSI
CODE AI-2026

Program Brochure

July 17-19, 2026

Conference Venue:
National Tsing Hua University, Hsinchu, Taiwan
(On-site & On-line Meetings)

ISBN:978-626-97046-7-5



ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

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2026 Joint International Conference of 17th ICSI and 3rd CODE AI

Venue: National Tsinghua University, Engineering Building I

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	15:00-16:40	Parallel Technical Sessions (2) & GCSI Project Competition (1)	
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Note: All times are in Taipei time which is GMT+8, 8 hours ahead of Greenwich time.

Wi-Fi Access. Name: NTHU_IEEM，Account: ieem1150015，Password: Aa123456

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The conference links

Find the meeting rooms of your interesting sessions and locate the corresponding internet links here. Click on the corresponding link or invoke **Microsoft Teams Meeting** and enter Meeting Number to enter each session. Local participants are encouraged to participate on-site while remote participants are to meet on-line.

All Sessions & Project reports - online meeting links:

Meetings Room	**Participant/Author Meetings link - Microsoft Teams Meeting https://www.microsoft.com/en-us/microsoft-teams/join-a-meeting**	
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**Plenary Sessions: Opening Ceremony/Keynote/Special Talk/Closing Ceremony

Download: 2026 ICSI Program Brochure
(Password: IcSi2026)
https://dsm.systematic-innovation.org/sharing/Y9oxmT6tV

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Forward

The organizers of the Joint Conference of **17th International Conference on Systematic Innovation (ICSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026)** are pleased to present the Proceedings of the conference and the Program of Innovation Project Competition which include 5 distinguished plenary speeches, 66 papers and 9 finalist innovation projects. Authors and participants are from 11 countries/regions. The conference theme is AI+IM. The integration and synergy of AI and Innovation Methods are pronounced in many talks of the conference.

This conference is co-organized by International Society of Innovation Methods (I-SIM), Manipal Institute of Technology Bengaluru (MITB), Society of Systematic Innovation (SSI), Tsing Hua University, and the International Journal of Systematic Innovation (IJoSI). Whether the papers included in the proceedings are work-in-progress or finished products, the conference and proceedings offer the authors opportunities to disseminate the results of their research and receive early feedback from colleagues, without the long waiting associated with publication in peer-reviewed journals. On the other hand, the presentations and the proceedings do not preclude the option of submitting the work in an extended and finished form for publication in any peer-reviewed journal. In-scope awarded papers and projects from the conference will be invited to submit full papers to one of the 4 supporting indexed Journals/Proceedings toward publication.

The organizers from I-SIM and MITB are greatly indebted to a number of people who gave their time and efforts to make the conference a reality, especially the faculty and staff of Tsing Hua University. The list of organizations and working team who have contributed tremendously to create this conference are acknowledged at the end of this program brochure. There are more contributors who are beyond the list.

The conference is a leading international conference in the world in the field of innovation methods/SI/TRIZ, especially the synergy between AI and Innovation Methods, typically having one of the best quality programs in the fields - especially the distinguished keynotes and special talk by world-leading experts. We are confident that you will find this conference very rewarding.

This conference is held with both modes of on-line and on-site operations to allow more participation for people who may have problem traveling. If there is anything needing assistance, please feel free to communicate with the Secretariat at icsi@i-sim.org. We are here to serve you.

With best regards,

D. Daniel Sheu, General Chair,
President, International Society of Innovation Methods
Honorary President, Society of Systematic Innovation
Editor-in-Chief, International Journal of Systematic Innovation (IJoSI)
Area Editor, Computers and Industrial Engineering
Professor Emeritus, National Tsing Hua University
2026.7.17-19

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Keynote Speech (A)

How Much Confidence Do We Have for GenAI-Based Reasoning – A Perspective from Reliability Inference

Speaker Name: Steven Li, PhD, Professor

Western New England University

Speaker Biography:

Professor Steven Li is a full professor with the Department of Industrial Engineering and Engineering Management at Western New England University, Springfield, MA, USA. His research expertise includes AI/ML, data analytics, reliability/resilience engineering, and the trustworthiness and security of agentic AI. He earned his Ph.D. in Industrial Engineering from the University of Washington. Prof. Li currently serves as Editor-in-Chief of IEEE Transactions on Reliability, the flagship journal of the IEEE Reliability Society. Prof. Li served as the president of IEEE Reliability Society 2022-2024. He is the President-Elect of IEEE Systems Council 2026.

Abstract/Outline:

This talk discusses the trust and confidence of using GenAI-based models in quantitative reliability reasoning. Using synthetic datasets generated from classic reliability models, we design multiple experimental factors, including sample sizes, prompts, and various AI models (Claude, DeepSeek, Gemini, ChatGPT, and xAI) to examine how various factors affect the accuracy in reliability estimations. The confidence levels and robustness of each AI model's performance are assessed through a factorial experimental design framework, and it is interesting to observe the estimates of unknown parameters under the classic Weibull reliability model do not converge over increasing sample size as what is commonly observed in the traditional statistics-based reliability inference. We also observe that ChatGPT and Deepseek perform the best in reliability estimation compared with other AI models. ChatGPT and Deepseek also show robustness in predicting reliability regardless of the types of prompts being used. The findings shed light on the reliability and confidence of using GenAI models for inferential reliability predictions and reasoning.

Desired Learning Outcomes from the talk

- Applications of GenAI in new product design for performance and reliability improvement;
- Implications of using GenAI in real-life engineering and product design process;
- Trust and confidence of GenAI reasoning in general

Target Audience

GenAI researchers, Industry professionals focusing on systems engineering, reliability practitioners, job seekers in GenAI and prompt engineering

Topics and keywords: *AI, GenAI, Trust of AI reasoning, AI confidence assessment, High-impact decision making*

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Keynote Speech (B)

A Proposed Closed-Loop Agentic AI Framework for Effective Academic Workflows: Experiences and Lessons Learned

Speaker Name: Wei-Chang Yeh, PhD

ASPEED, NTHU, and CYCU Chair Professor, National Tsing-Hua University

Speaker Biography:

Dr. Wei-Chang Yeh is the ASPEED Chair Professor and Chair Professor in the Department of Industrial Engineering and Engineering Management at National Tsing Hua University (NTHU), Taiwan, and also serves as Chair Professor at Chung Yuan Christian University. He received his M.S. and Ph.D. degrees in Industrial Engineering from the University of Texas at Arlington. His research focuses on algorithm design, exact solution methods, soft computing, network reliability, and NP-hard optimization problems.

Dr. Yeh has published more than 300 SCI-indexed journal papers and holds more than 70 patents. He has been listed among Stanford/Elsevier's Top 2% Scientists worldwide for both career-long and single-year impact since 2020. His honors include two Outstanding Research Awards, one Distinguished Scholars Research Project Award, and two Overseas Research Fellowships from Taiwan's MOST/NSTC.

He serves as an Associate Editor for IEEE Transactions on Reliability, IEEE Access, and Reliability Engineering & System Safety. He is the proposer of Simplified Swarm Optimization (SSO) and the Binary-Addition-Tree (BAT) framework. Dr. Yeh is also an NVIDIA University Ambassador for the Deep Learning Institute and has received NVIDIA research grant support.

Abstract/Outline:

This keynote presents a generalizable, closed-loop agentic AI framework for transforming academic work. Instead of treating AI as a single assistant, the proposed framework organizes multiple cooperating agents to support the repetitive operational loops behind teaching, grading, thesis supervision, peer review, student guidance, and laboratory coordination. Each agent follows a structured, self-correcting cycle of perceiving, planning, acting, evaluating, and revising until defined quality goals are met. Framed as an exercise in systematic innovation, complex academic workflows can be decomposed into traceable, improvable, and reusable components.

The talk focuses less on any specific hardware platform and more on the design logic of academic agent systems. Five agents are introduced: a NarratorAgent for narrated slide generation, a ReviewerAgent for peer-review support, a ThesisAgent for longitudinal thesis feedback, an OrchestratorAgent for task routing, and a TeachingAgent for adaptive instruction. Rather than presenting them as a feature list, the keynote examines the key design questions behind real deployment: how responsibilities are divided, how agents hand work to one another, how disagreements are detected and resolved, how model routing is managed, and where human judgment remains essential.

Drawing on deployment experience, the keynote shares transferable lessons on architecture, reliability control, privacy-aware operation, and human-AI collaboration. The central message is that academic AI should augment rather than replace professors, reviewers, and mentors. Cooperating agents can absorb invisible academic labor, while scholars retain responsibility for interpretation, ethical judgment, mentoring, and final decisions.

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Keynote Speech (C)

Automating ARIZ with Large Language Models: Toward AI-Assisted Inventive Problem Solving

Speaker Name: Prof. Denis CAVALLUCCI

Professor in Engineering of Innovation at INSA Strasbourg - France

Speaker Biography:
Denis Cavallucci is a Full Professor at INSA Strasbourg and a leading expert in TRIZ and AI-assisted innovation. For over 30 years, he has transformed systematic innovation into an engineering discipline combining TRIZ, AI, and large-scale knowledge analysis. His work bridges academia and industry through publications, patents, software systems, and collaborations with major industrial partners in defense, manufacturing, and consumer products.

Abstract/Outline:
Recent advances in Large Language Models (LLMs) are profoundly transforming how inventive problem solving can be supported in industrial R&D. While TRIZ has long provided a rigorous framework for addressing technical contradictions, its most advanced algorithm - ARIZ-85C - remains difficult to deploy in practice due to its complexity, required expertise, and time-consuming execution.
This keynote presents recent research from the AIARD (Artificial Intelligence Assisted R&D) at INSA Strasbourg on the automation of ARIZ using artificial intelligence. It originates from research activities carried out in the framework of the AIARD PhD program, particularly with Iliass Ayaou and Dr. Hicham Chibane under the supervision of Prof. Denis Cavallucci.
The work explores how LLMs can operationalize the complete ARIZ-85C process by combining structured inventive reasoning with patent-based contextual grounding.
The presentation introduces a novel AI-assisted workflow integrating:

- automated patent-context extraction,
- contradiction formulation,
- resource and IFR analysis,
- guided execution of ARIZ substeps,
- novelty assessment against prior art,
- and AI-supported synthesis of inventive concepts.

The proposed framework supports all nine parts of ARIZ-85C while allowing selective execution strategies to balance creativity, interpretability, computational cost, and industrial usability. The keynote will also discuss how patent retrieval systems and semantic embeddings can stabilize reasoning processes and reduce hallucinations in generative AI systems.
Experimental results demonstrate that explicit ARIZ guidance combined with contextual patent grounding significantly improves the novelty and inventiveness of generated solution concepts compared to baseline prompting strategies. Industrial case studies illustrate how AI-assisted ARIZ can support interdisciplinary knowledge transfer and accelerate upstream innovation activities.
Beyond technical demonstrations, this talk addresses a broader question: can AI become a true cognitive partner for inventive engineering rather than merely a text-generation tool? The presentation concludes with perspectives on the future of AI-assisted systematic innovation, including human-in-the-loop creativity, explainable inventive reasoning, and autonomous innovation agents.

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Keynote Speech (D)

Knowledge Wants to be Free. Wisdom Wants to be Expensive: AI, Systematic Innovation and the Coming Trough of Disillusionment

Speaker Name: Prof. Darrell Mann

CEO, Systematic Innovation Network

Speaker Biography:

Over the course of the last 30 years, TRIZ Master, Darrell has helped deliver over $6B in new value to clients across the world, and has served as the spark behind a dozen spin-out companies. He is the author of over 1200 innovation related papers and articles and a dozen TRIZ/SI-related books, the latest pair focusing on "1%er" innovators and innovation ethics. He is the chief architect and irritant at the Systematic Innovation Network.

Abstract/Outline:

Artificial Intelligence currently occupies the highest point on the technology hype cycle. Simultaneously, organisations everywhere are looking to AI to transform their innovation capability. Yet, despite extraordinary advances in generative AI, there is remarkably little evidence that innovation outcomes are improving. Indeed, there is a strong argument that, in the short term at least, AI may actually be making innovation harder rather than easier. This keynote argues that the apparent paradox is both real and temporary.

The central problem is that AI optimises for plausibility, whereas breakthrough innovation requires improbability. Today's AI systems are extraordinarily effective at exploring vast possibility spaces, but they explore far too much of the wrong space because they cannot reliably distinguish evolutionary dead ends from evolutionary breakthroughs. Systematic Innovation exists precisely because, over the past seventy years, TRIZ and its successors have sought to curate humanity's accumulated innovation experience, separating the enduring DNA of successful evolution from the overwhelming noise of failed attempts.

The keynote develops this argument in five acts. It begins by examining why current expectations surrounding AI and innovation are simultaneously understandable and unrealistic. It then explores why innovation has never been fundamentally constrained by access to knowledge, but by the quality of judgement. The third act considers how AI is making knowledge increasingly abundant, and therefore increasingly commoditised, while making wisdom correspondingly more valuable. The fourth argues that Systematic Innovation should be understood not as a knowledge technology, but as a wisdom technology: a disciplined means of navigating complexity by identifying which possibilities genuinely deserve attention. Finally, the keynote looks beyond today's inevitable period of disillusionment towards a future in which AI and Systematic Innovation become complementary partners rather than competing approaches – AI generating possibilities at unprecedented scale, Systematic Innovation determining which of those possibilities are most likely to shape the future.

The conclusion is optimistic. AI will undoubtedly transform innovation, but not in the way many currently expect. As knowledge becomes effectively free, wisdom becomes increasingly expensive. The fundamental challenge is no longer generating more ideas. The bottleneck has moved to deciding what not to do.

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Special Talk

Engineering Without Boundaries: Building Universities for a Next Generation Quantum-Ready future

Speaker Name: Dr. Iven Jose,
Director, Manipal Institute of Technology,
Manipal Academy of Higher Education, Bengaluru.

Speaker Biography:

Dr. Iven Jose currently serves as Director, Manipal Institute of Technology (MIT) Bengaluru, a constituent unit of the Manipal Academy of Higher Education (MAHE), India. An alumnus of Indian Institute of Technology (IIT) Bombay, with advanced executive leadership training from the Global Leadership Institute, Boston College (USA), he brings over 25 years of distinguished experience in higher education leadership, policy strategy, and institutional transformation including Previously the Founding Dean at Christ University (India). He was selected as the "United Board fellow" for academic leadership engagement at the Harvard University, USA and Melbourne School of Engineering, Melbourne University, Australia. His work spans academic governance reform, global partnerships, industry–academia integration, and next-generation curriculum design. A recipient of the Microsoft Research Lab India Young Scientist Award, he is a frequent speaker at national and international forums on higher education transformation and innovation ecosystems. He is currently spearheading strategic initiatives in Quantum Technologies, Autonomous Mobility, and Semiconductor Systems, positioning MIT-MAHE Bengaluru as a frontier institution aligned with India's deep-tech and innovation agenda.

Abstract:
As the world is moving toward quantum technologies, universities need to change the way engineering is taught. Traditional education alone may not be enough to prepare students for future challenges that combine quantum computing, artificial intelligence, cybersecurity, and advanced materials. Engineering without boundaries means creating learning environments where different subjects work together instead of staying separate. By encouraging interdisciplinary research, practical projects, industry collaboration, and ethical thinking, universities can help students become quantum-ready. This approach not only improves technical skills but also builds creativity, problem-solving, and adaptability, which are important for the next generation of engineers. Even though there are challenges like limited resources and lack of expertise, gradual changes in curriculum and teaching methods can make a big difference in preparing students for the future

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	D1S4-Room- 103	Yu-Gang Chen	Chih-Hsien Chen

2026/7/19 (Su)	Parallel Sessions	Session chairs:	
09:00-10:20	D2S1-Room-102	Hareesh K S	Manohara Pai M M
	D2S2-Room-103	Wei-Chang Yeh	Liang Hui Wang
	D2S3-Room-104	Shreyas J	Rajendra A. B.
10:40-12:00	D2S4-Room-102	Yu-Ming Fei	Liang Hui Wang
	D2S5-Room-103	Won-Shik Shin	Shu-Hsien Tai
	D2S6-Room-104	Hsin Rau	An-Jin Shie
13:00-14:40	D2S7-Room-102	De-Chih Lee	An-Jin Shie
	D2S8-Room-103	Yu-Ming Fei	Shu-Hsien Tai

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

ICSI Parallel Sessions (Presentation: 18 minutes; Q&A: 2 minutes.)

Date/time: 2026/7/18 (Sat)，PM 13:00-14:40; Sessions/ Location: D1S1-Room-102
Session chair: Hareesh K S ; Co-Chair: Manasa C M

ID	Paper Title	Author(s)
8	Study on the Relational Structure of the 40 Inventive Principles in the TRIZ Contradiction Matrix through Network Analysis	Won-Shik Shin
7	A Cross-Theoretical Framework for Selecting Training Methods for New Employees in Manufacturing Contexts	Shian Un Hung, Koichi Murata
34	Strategic Evaluation for Aviation's Net-Zero 2050: Integrating IATA Enabling Decisions and AHP-BN Model Analysis	Pei-Chieh Wu, Hsin Rau, ShangHung Yang
22	An Innovative Design on Intelligent Ecological Bird-Repelling System for Airports	Chenyang Qu
10	Is TRIZ Ready for Computational Inventiveness	Koray Altun

Date/time: 2026/7/18 (Sat)，PM 13:00-14:40; Sessions/ Location: D1S2-Room-103
Session chair: Madhura K ; Co-Chair: Snigdha Sen

ID	Paper Title	Author(s)
29	Fibrous Future: Transforming Abaca Pseudo-Stem Waste into Sustainable Industrial Fiber and Crafts	Herguim Al Mangaliwan, Joanne Sonido, Norvie Penas, Tien-Ting, Chiu
30	AGROVER: A SMART MICRO-MISTING CROP ROVER: EDGE-COMPUTING ROBOTICS FOR TARGETED HEAT-STRESS PROTECTION IN SMALL-SCALE SUBTROPICAL FARMS	Angelo Matibag, Daniela Erika Bravo, Althea Ocariz, Jeric Gementiza, Tien-Ting Chiu
35	Innovative Research on Fishing Hooks Based on TRIZ	Chen, Chih-Hsien, Chen, Mei-Hei, Lin, Wen-Yi
16	Analysis Models and Quantitative Analysis Methods of Flow Analysis	Liu Yongmou
18	A Novel Service Quality Diagnostic Method Based on CNN-Driven Facial Emotion Analysis	An-Jin Shie, Qilin Yang, Jialiang Chen, En-Min Xu, Ching-Hung Lee

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Date/time: 2026/7/18 (Sat)，PM 15:00-16:40; Sessions/ Location: D1S3-Room-102
Session chair: Hsin Rau ; Co-Chair: Shan-Yang Wang

ID	Paper Title	Author(s)
11	A GIS-Based Machine Learning Framework for Assessing the Relationship Between Urban Growth and Climate Change: A District-Level Zoning of Tehran Metropolis	Kheyroddin Reza, Ahmadnia Amirali
I-253	Dynamic Hyper-Personalization in Financial Services Using Deep Temporal Clustering and Reinforcement Learning	Ilham Huseyinov, Hassani Selemani Kanju, Rand Kouatly, Mhd Wasim
I-249	Token-RVFformer: A Token-Level Variational Fusion Transformer for Efficient Uncertainty-Aware Medical Time-Series Prediction	Ahmed Abeideh, Ilham Huseyinov, Rand Kouat-ly
I-183	Attention Guided dual CNN feature Extractor with Stacked Ensemble for the Weed Detection	Vishnesh Reddy Patlolla, Manasa C M
I-194	Variance-based XGBoost Framework for Transcriptomic Prediction of TCMR and ABMR in Kidney Transplantation	Kruthika G, Joshika K, Pooja G K, Manjunath B Talawar

Date/time: 2026/7/18 (Sat)，PM 15:00-16:40; Sessions/ Location: D1S4-Room-103
Session chair: Yu-Gang Chen ; Co-Chair: Chih-Hsien Chen

ID	Paper Title	Author(s)
31	PLANT-BASED PEST CONTROL USING TINOSPORA CRISPA: MINIMIZING CHEMICAL AND ENVIRONMENTAL HAZARDS	Lady Diane Logrono, Hezel Joy Diagdal, Leah Jane Candelario, Tien-Ting Chiu
32	SUSTAINABLE VALORIZATION OF RICE STRAW: ARTIFICIAL INTELLIGENCE-AUGMENTED GREEN BAGS	Rowena Dela Torre, Maria Rowella Rivera, Shara Gia Lampara, Tien-Ting Chiu
I-25	Systematic Identification of Flaky Test Case using CodeBERT based Hybrid Autoencoder	Sambit Kumar Mitra, Shreya Banerjee, Snigdha Sen
I-135	Machine Learning–Based Prediction of Functional Outcomes in Spontaneous Intracerebral Hemorrhage: Insights from a South Indian Cohort Study	Sandra Sony, Hareesha K. S., Girish Menon, Ajay Hegde, Sanjana Muthukumar and Shashank H
I-150	Sickle Cell Vision: Performance Evaluation of Deep Learning Models in Hematological Imaging	Dr. Madhura K, Ms. Arunima Manna, Dr. Shweta S Aladakatti

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Date/time: 2026/7/19 (Sun)，AM 09:00-10:20; Sessions/ Location: D2S1-Room-102
Session chair: Hareesh K S ; Co-Chair: Manohara Pai M M

ID	Paper Title	Author(s)
I-231	Hybrid Fuzzy Q-Learning Based Energy-Aware Duty Cycle Scheduling for Wireless Sensor Networks	Shivakumar M K and Dr. A B Rajendra
4	From Waste Identification to Contradiction Resolution: Integrating Lean Management and TRIZ for Manufacturing Process Improvement	Jeng-Ye Jung, Chia-Chen Yu, Yi-Ting Lin, Wen-Ting Dai, Ji-Chyuan Liou, Wei-Hung Chen, Chun-Tai Wang, Ying-Zhi Zhang
27	Methods to identify and analyze unaware failure modes	D. Daniel Sheu, Chun-Liang Hsu
25	From Estimation Bias to Intelligent Decision-Making: An AI-Based Risk Assessment Framework for Solar Power Systems	Ji-Chyuan Liou, Yu-Ming Fei, Wei-Yan Wang

Date/time: 2026/7/19 (Sun)，AM 09:00-10:20; Sessions/ Location: D2S2-Room-103
Session chair: Wei-Chang Yeh ; Co-Chair: Liang Hui Wang

ID	Paper Title	Author(s)
33	Behavioral Motivation Observations in Patients with Mild Dementia	Shan-Yang Wang
28	Application of Systematic Innovation Methods in the Design and Implementation of Festival Meals for the Elderly: A Case Study of Healthy Rice Dumplings for the Dragon Boat Festival	Shu-Hsien CHANG, Shu-Yen YANG
6	Integrating Semantic Analysis and TRIZ Characteristics into a Problem-Solving and Patent Knowledge Extraction Framework	Tien-Lun Liu, Sheng-Kai Yang, Chien Lin
3	Coupled Crystallization-Phase Separation and Upper Critical Solution Temperature Behavior of Zwitterionic Monomers in Biodegradable Polymer Blend Systems	Nina Hsieh
37 (Chinese)	Synergistic Mechanism of Ganoderma lucidum as "King of Herbs" and "Guide to Medicinal Herbs" in Multi-Target Regulation and Pharmacokinetics: A Biomedical Deconstruction Based on the Principles of Systematic Innovation and Invention	Xiao- Xu Wen, Sheng-Zhou Xu, Li-Yuan Chen, Hong-Rui Chen

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Date/time: 2026/7/19 (Sun)，AM 09:00-10:20; Sessions/ Location: D2S3-Room-104
Session chair: Shreyas J ; Co-Chair: Rajendra A. B.

ID	Paper Title	Author(s)
15	Resolving Design Contradictions in Airway Management Devices: Development of a Channeled Miniature AI Videolaryngoscope Using TRIZ Evolutionary Principles	Ya-Ying Hsiao, Yu-Ming Fei
13	Research on an AI-Assisted Employee Health Management System	Sin-Yi, Lin
12	A Comparative Study of Rule-Based and AI Chatbots: Taking Graduate Administrative Affairs as the Application Scenario	Wei-Xiang Liao, Yu-Min Fei
14	A Three-Layer AI Voice Verification Pipeline for Game-Based Corrective-Rule Production in TOEIC Grammar Learning: A Pilot Feasibility Study	Dang, Ngoc Kien

Date/time: 2026/7/19 (Sun)，AM 10:40-12:00; Sessions/ Location: D2S4-Room-102
Session chair: Yu-Ming Fei ; Co-Chair: Liang Hui Wang

ID	Paper Title	Author(s)
I-180	Enhanced State of Health Prediction for Lithium-Ion Batteries Using BiLSTM with Multihead Attention	Shreya Nayak, Manohara Pai M M, Pravallika Srinivas Gajul, Rohint R Rao, Radhika M Pai
24	Establishing predictors of physical and mental functionalities of the aged by their heart rate variability	Yuan-Ping Chang, De-Chih Lee
17	A Proactive Elderly Long-Term Care Allocation Framework via Substance-Field Analysis and Multi-Level Metamodeling	Wan-Chiao Chen, Hsin Rau
9	Constructing a Value Co-Creation Writing System Integrating Generative AI and Human Wisdom	Koichi Murata, Hung Shian Un, D. Daniel Sheu
I-221	DWT-Based Deep Learning Framework for Osteoporosis Image Classification using X-ray Femur Bone	Anusha K L and Chetana Srinivas

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Date/time: 2026/7/19 (Sun)，AM 10:40-12:00; Sessions/ Location: D2S5-Room-103
Session chair: Won-Shik Shin ; Co-Chair: Shu-Hsien Tai

ID	Paper Title	Author(s)
36	BAT-Refined LLM-TRIZ: Structural Verification and Content-Claim Risk Assessment for Reliable TRIZ Reasoning	Wei-Chang Yeh, D. Daniel Sheu
I-78	Hybrid Cox–DeepSurv Framework for Interpretable Survival Prediction in Clinical Data	Muthulakshmi K, Gopalakrishnan T, Rashmi S
I-97	A Novel Cross-Modal Attention Fusion Framework for Multimodal Healthcare Diagnosis Using Swin Transformer V2	Karthik S A, Shreenidhi B S, Chaitra P C, Sarath Chandra, Priya Nandihal, Navya Lakshmanna
I-34	Enhancing Colorectal Cancer Diagnosis Using Deep Learning: A Comprehensive Review	Kusum Rajput, Vamshi Krishna B, Dr. Pamela Vinitha Eric

Date/time: 2026/7/19 (Sun)，AM 10:40-12:00; Sessions/ Location: D2S6-Room-104
Session chair: Hsin Rau ; Co-Chair: An-Jin Shie

ID	Paper Title	Author(s)
26	Automated Sustainability Report Generation System Based on Fine-Tuning Large Language Models	Yao-Lun Xuu, Yu-Kai Huang, Kai-An Tsai, Shu-Hsien Tai
21	AN ANALYSIS OF TAIWANESE DISTILLERY TOURISM EXPERIENCES USING LDA AND TRIZ	Tsai-Chieh Lee, Yu-Ming Fei
I-226	Hybrid Edge-Cloud AI Framework for Real-Time Electro-Thermal Monitoring and Predictive Maintenance in Electric Vehicle Powertrain Systems	Bharath S, Gireesh Babu C N, Shoba M, Sagargouda Patil
I-201	Temporal Triangulation: A Network-Theoretic Framework for Source Identification in the Ethereum DevP2P (Execution Layer)	Tanmay Vemuri, Dr. Ignisha Rajathi G
I-222	FPGA-Based Secure Image Encryption using Multi-layer Reversible Computing Algorithm	POOJA S BAGALI, SAPNA P. J

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Date/time: 2026/7/19 (Sun)，PM 13:00-14:40; Sessions/ Location: D2S7-Room-102
Session chair: De-Chih Lee; Co-Chair: An-Jin Shie

ID	Paper Title	Author(s)
I-230	Rule-Based Optimal Energy Harvester Selection for Sustainable Wireless Sensor Networks	Priyanka Mohan, A B Rajendra
I-153	AI-Powered ECG Signal Denoising using Residual Variational Autoencoder with Dual Attention	Thanuja M, Soumyashree M Panchal, Prasanna Lakshmi G. S
I-208	Intelligent Border Surveillance System: Machine Learning Approaches to Intrusion Detection, Threat Level Scoring, and Sensor Integrity Monitoring	Nayandeep Mohanty, Ashwitha A, Anitha P, Ambika B J, Pavithra N
I-175	Disc-level 3D Multi-Task Learning for Degenerative Spine Disease Using Volumetric MRI	Kiran P S, K. Chandan

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Session chair: Yu-Ming Fei ; Co-Chair: Shu-Hsien Tai

ID	Paper Title	Author(s)
I-57	Enhancing Stroke Diagnosis: A Deep Learning Approach to Analyze Neuroimages	Pavithra N, Charan Arunkumar Raikar, Sharath Kumar Y H, Nandeesh S Mysore Matt
I-73	YOLO-based Models for Breast Cancer Detection using Ultrasound Imaging	Rajesh Natarajan, Sujatha Krishna, Anitha P, Ashwitha A, Kshama S B
I-301	Predictive Digital Twin model for accounting and achieving minimal carbon emission for urban residential buildings	Dr. Sudaroli Dhananjeyan, Alexander R, R. Reni Hena Helan, Vanidha Sri R
I-302	A Phase-Aware Microscaling Datapath for FPGA-Accelerated Reinforcement Learning from Human Feedback	Aditya Patel

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper Abstracts

Paper ID: 3

Coupled Crystallization-Phase Separation and Upper Critical Solution Temperature Behavior of Zwitterionic Monomers in Biodegradable Polymer Blend Systems

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Abstract

This study investigates the upper critical solution temperature (UCST) behavior and the coupling between crystallization and phase separation in blend systems composed of poly(ε-caprolactone) (PCL), poly (lactic-co-glycolic acid) (PLGA), and the zwitterionic monomer DMAPS. The results show that DMAPS exhibits a dual effect on PCL crystallization and a pronounced plasticizing effect on PLGA, reducing its Tg from 44.2 °C to 25.7 °C. In the ternary PCL/PLGA/DMAPS system, DMAPS functions as an ionic compatibilizer, enhancing interfacial miscibility while lowering crystal perfection. Overall, the ionic–dipolar interactions introduced by DMAPS simultaneously regulate chain mobility and crystallization dynamics, leading to morphology-dependent UCST transitions and offering design guidance for thermoresponsive, biodegradable biomedical coatings.

Keywords: Zwitterionic materials、Biodegradable polymers、Polymer blends

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 4

From Waste Identification to Contradiction Resolution: Integrating Lean Management and TRIZ for Manufacturing Process Improvement

Jeng-Ye Jung, Chia-Chen Yu, Yi-Ting Lin, Wen-Ting Dai, Ji-Chyuan Liou, Wei-Hung Chen, Chun-Tai Wang, Ying-Zhi Zhang

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Abstract

This study investigates the application of an integrated Lean Management and TRIZ framework for manufacturing process improvement, using Spider Extrusion Co., Ltd. as an empirical case to construct a systematic problem-solving approach. In a customized production environment, firms often face critical operational challenges, including excessive setup time, prolonged waiting time, and high inventory levels, which negatively affect overall production performance. The study first applies Lean management tools to identify sources of waste within the manufacturing process and employs the Six Sigma DMAIC methodology to conduct problem analysis and process improvement. Subsequently, TRIZ is introduced to transform improvement needs into technical contradictions. By utilizing the contradiction matrix and inventive principles, structured analysis and solution design are systematically carried out. The empirical results demonstrate that the integrated Lean–TRIZ approach significantly improves operational performance. Spider Extrusion Co., Ltd. achieves notable improvements in setup time, waiting time, and inventory management, with setup time reduced by 16.7% and waiting time shortened by approximately 50%. Inventory levels and operational costs are also effectively reduced. The findings indicate that Lean management and TRIZ are highly complementary. While Lean facilitates systematic problem identification, TRIZ enables structured contradiction resolution, thereby extending process improvement from waste elimination to innovative problem-solving and enhancing both the systematic and innovative aspects of manufacturing process optimization.

Keywords: Lean Management, TRIZ, Manufacturing Process Improvement, Technical Contradiction, Process Optimization

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 6

Integrating Semantic Analysis and TRIZ Characteristics into a Problem-Solving and Patent Knowledge Extraction Framework

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Abstract

Traditional patent search and interpretation processes are inherently lengthy and heavily reliant on user experience, often requiring a labor-intensive, and case-by-case analysis to identify suitable engineering solutions. To address this inefficiency, this study leverages TRIZ theory—which systematically categorizes historic patent characteristics—to establish objective criteria for analyzing engineering problems. By constructing a semantic vector database based on U.S. patents, we propose a novel three-stage patent search and analysis framework that integrates TRIZ characteristics to screen viable reference solutions. In the first stage, the full text of a target engineering problem is processed using PatentBERT semantic vectors to retrieve the top 100 candidate patents with the highest similarity. The second stage utilizes Sentence-BERT semantic vectors to align the engineering problem description with TRIZ-defined functions, attributes, and engineering parameters; the top three most similar elements from each category are extracted to establish a weighted screening relationship, narrowing the pool down to the top 10 patents. In the third stage, the functions and attributes of these 10 selected patents are deconstructed, allowing for back-tracing to the original texts based on functional and attribute similarity to extract specific knowledge paragraphs as conceptual ideas for problem-solving. This methodological architecture significantly strengthens the correlation between engineering problems and patent retrieval results while establishing robust traceability back to the source patent texts.

Keywords: Patent Search, Natural Language Processing, Problem-Solving, TRIZ

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 7

A Cross-Theoretical Framework for Selecting Training Methods for New Employees in Manufacturing Contexts

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Abstract

Effective training of new employees is a critical challenge in high-complexity manufacturing environments that require mastery of both codified procedures and tacit knowledge. In Taiwan's PCB manufacturing industry, task characteristics and learning requirements vary substantially across production settings. However, existing studies have mainly examined training methods from isolated theoretical perspectives, providing limited guidance for systematically aligning training approaches with task and knowledge requirements.

This study aims to develop a cross-theoretical framework for systematically selecting and combining training methods according to task characteristics and knowledge types.

To construct the framework, a two-stage literature review was conducted on studies published between 2014 and 2024. First, four theoretical domains relevant to employee training were identified: knowledge transfer, organizational learning, task design, and training transfer. Second, training approaches and core concepts within these domains were comparatively analyzed across task characteristics, knowledge types, and learning objectives. Based on this analysis, the study organized the relationships between training requirements and instructional approaches into an integrated training design framework for manufacturing contexts.

Based on this analysis, the study organized training methods into four functional roles: knowledge transfer, experiential learning, task structuring, and workplace application. The resulting model supports training design by linking training needs analysis with the selection and combination of appropriate training methods.

The proposed model provides a structured framework for aligning training methods with task characteristics and knowledge requirements in manufacturing settings. It also offers a cross-theoretical conceptual foundation for future empirical research on training-method effectiveness across different production contexts.

Keywords: New Employee Training, Training Design, Organizational Learning.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 8

Study on the Relational Structure of the 40 Inventive Principles in the TRIZ Contradiction Matrix through Network Analysis

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Abstract

This study investigates the relational structure among 40 Inventive Principles(40IPs) embedded in TRIZ Contradiction Matrix (CM) through a network analytic approach. In CM, up to four IPs are suggested at each intersection of improving and worsening parameters for resolving a technical contradiction, implying that multiple IPs may be jointly applicable to a single problem. Despite the practical significance of this configuration, the relationships among co-occurring IPs have rarely been examined quantitatively. To address this gap, this study transforms 40IPs from attribute-based categorical data into relational data by identifying co-occurrence ties among IPs appearing within the same intersection box and by assigning weights based on the frequency of their connections. On this basis, a weighted network was constructed in which IPs were represented as nodes and their relational strength as edges. The analysis employed Degree Centrality, Betweenness Centrality, Closeness Centrality, Eigenvector Centrality, and Modularity to identify structurally important IPs and cohesive subgroups. The findings show that the structural importance of IPs differs from their simple frequency-based ranking, and that Weighted Degree Centrality provides a more discriminating representation of relational differences among IPs. In addition, several IPs were found to occupy hub-like or bridging positions in the overall network, while Modularity Analysis revealed stable subgroups of principles with strong internal cohesion. These findings suggest that 40IPs should be understood not as isolated IPs, but as an interconnected relational structure embedded in CM. From a statistical analysis perspective, this study demonstrates that the nominal-scale 40IPs can be transformed into ratio-scale indicators through network-based measures, thereby extending the scope of quantitative analysis in TRIZ research and providing a foundation for future data-driven modeling and comparative analysis.

Keywords: Contradiction Matrix, Network Analysis, TRIZ, 40 Inventive Principles

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 9

Constructing a Value Co-Creation Writing System Integrating Generative AI and Human Wisdom

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Abstract

Product descriptions in current e-commerce platforms often exhibit a structural imbalance. They focus heavily on Product-oriented Values, such as functional and conceptual attributes, while frequently overlooking Consumer-oriented Emotional Values. Consequently, this study aims to develop a Human-AI Co-Writing System. This system leverages AI to visualize and correct this value imbalance, integrating both types of values while protecting human proactive creativity.

To systematize human wisdom, this research extracted fifteen value definitions from seven literature sources and inductively aggregated them into eight core values. Furthermore, these criteria were categorized into Product-oriented Values and Consumer-oriented Emotional Values. This framework was then integrated into a generative AI model via prompt engineering. Consequently, a backend system was developed to quantitatively analyze value imbalances in input texts, utilizing a radar chart for visualization.

The proposed system successfully detected deficiencies in Consumer-oriented Emotional Values via preliminary analysis. In designing the user interface (UI), displaying raw quantitative scores directly imposes psychological pressure on users. To bypass this issue, this study introduces a Subtractive UI that intentionally hides calculated scores from the UI. This design choice maintains user flow and blocks psychological friction.

In conclusion, the developed system establishes interface requirements that position AI not as an autonomous generator, but as a Reflective Mirror. This approach effectively helps users regain empathy for consumers. This research provides a novel pathway for AI applications in emotional areas, where most existing models have remained ineffective. Future work will accumulate empirical data to analyze how system suggestions transform the human writing process and measure the specific effects of the score-hiding mechanism.

Keywords: Generative AI, Human-AI Co-Writing, Subtractive UI, Algorithmic Aversion, Integrated Consumer Values.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 10

Is TRIZ Ready for Computational Inventiveness

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Abstract

Can inventiveness itself be computed? While TRIZ has long provided systematic support for inventive problem solving, its contradiction matrices remain fundamentally recommendation-based, offering inventive principles for isolated pairwise conflicts rather than a computational mechanism for complex contradiction networks involving multiple interacting contradictions. This study introduces "Computational Inventiveness" as a new paradigm that transforms TRIZ inventive principles from static heuristic recommendations into computable design entities. Through a matrix-driven architecture, logical operators, including Union (∪), Intersection (∩), Subtraction (\), AND (∧), OR (∨), and NOT (¬), are used to systematically combine, filter, eliminate, evaluate, and prioritize inventive principles for resolving multiple simultaneous contradictions. This enables the construction of structured inventive solution pathways beyond traditional contradiction-by-contradiction reasoning. By shifting TRIZ from recommendation-based contradiction handling toward computational inventive reasoning, the proposed approach extends conventional contradiction matrix logic into a scalable and repeatable methodology for complex problem solving. The methodology is demonstrated through an engineering design case involving multiple interacting contradictions, illustrating how inventive reasoning can be operationalized as a computational process.

Keywords: Computational inventiveness, inventive principles, multi-contradiction reasoning.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 11

A GIS-Based Machine Learning Framework for Assessing the Relationship Between Urban Growth and Climate Change: A District-Level Zoning of Tehran Metropolis

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Abstract

Assessing the impacts of urban growth on climate change is essential for sustainable urban development. However, previous studies have largely relied on linear assumptions or aggregate city-level data, and as a result, this goal cannot be adequately achieved using conventional methods alone. these traditional approaches tend to oversimplify the complex interactions between urbanization and climate, failing to provide accurate assessments. Moreover, no existing research has proposed a predictive framework that directly links municipal building permit data and new building floor area to climate outcomes. Integrating traditional methods with modern data-driven tools—particularly artificial intelligence algorithms (machine learning)—offers a promising pathway toward accurate present-day assessment and low-error future predictions. As a consequence, this study proposes a GIS-based, machine learning-driven framework to quantify the nonlinear relationship between urban growth and climate change. Specifically, the model determines the relative influence of various urban growth factors on climate change. The model takes as input: (1) building permit data and new building floor area issued by the municipality (as proxies for urban growth), and (2) precipitation and temperature data (as climate indicators). Based on the predicted climate vulnerability of each district, the model produces a zoning map of the 22 districts of the Tehran metropolis. Compared with a multiple nonlinear regression model, the fitted model significantly improves both assessment and prediction accuracy. The preliminary findings demonstrate that the proposed model can capture complex, nonlinear relationships between urban growth and climate. This research could provide policymakers and urban planners with a reliable and scalable tool to support sustainable urban development.

Keywords: climate change, GIS, machine learning, urban growth.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 12

A Comparative Study of Rule-Based and AI Chatbots: Taking Graduate Administrative Affairs as the Application Scenario

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Abstract

From the perspective of systematic innovation, this study focuses on the information-seeking challenges and associated anxiety experienced by graduate students within higher education environments regarding complex graduation procedures, credit thresholds, and multi-stage thesis forms. As Okonkwo and Ade-Ibijola (2021) noted, the application of chatbots in the educational field has received widespread attention, demonstrating significant practical value in administrative consultation and student support. To address these administrative pain points, this research independently designed and implemented a task-oriented, web-based campus chatbot system embedded in the sidebar entry of the university website. Developed with an HTML, CSS, and JavaScript front-end and powered by Google Sheets paired with Google Apps Script as the dynamic Q&A data source, the system allows administrative staff to maintain the question bank autonomously without modifying source code. The system core integrates Chinese voice input via the Web Speech API, self-developed keyword fuzzy matching, a similar-teacher prediction function, and a MutationObserver mechanism for keyboard accessibility focus handling, alongside an intuitive progress tracker for the "Four Stages of Master's Thesis Progress".

Caldarini et al. (2022) indicated in their literature review that chatbot architectural design must weigh the clarity of requirements against the application scenario: rule-based chatbots operate on predefined scripts and keywords, offering advantages such as low development costs, fully controllable content, and zero hallucination, yet failing to handle open-ended queries beyond the script; conversely, AI-driven chatbots provide natural dialogues but incur high deployment costs and risk generating factual hallucinations. To overcome the technical limitations of traditional rule-based systems in handling open-ended questions, and referencing the discourse on hybrid architectures by Adamopoulou and Moussiades (2020), this study further proposes a hybrid Q&A solution that is "rule-based primarily, supplemented by generative AI". This serves as a concrete integration of AI methods into educational service innovation, significantly enhancing semantic understanding and dialogue flexibility while ensuring campus administrative information remains absolutely accurate and fully controllable.

To quantitatively validate the practical effectiveness of the system, a real-time five-star satisfaction feedback mechanism was built-in at the end of dialogues. Drawing on the educational chatbot evaluation methodologies of Smutny and Schreiberova (2020), a user perception questionnaire utilizing a Likert Five-Point Scale and the System Usability Scale (SUS) was designed to evaluate core users. Quantitative scoring ranged from "Strongly Agree (5 points)" to "Strongly Disagree (1 point)". Evaluation results demonstrate stable performance in typo tolerance and accessibility operations. Questionnaire data also confirms that the system significantly reduces the time cost for administrative staff repeating baseline responses while effectively enhancing information accessibility and procedural transparency for graduate students, thereby providing an empirically supported, innovative practical model for small-to-medium-scale campus units systemically integrating AI methods into educational service innovation.

Keywords: AI Assistant, Educational Service Innovation, Hybrid Rule-Based and AI Architecture, Likert Five-Point Scale, System Usability Scale (SUS), Systematic Innovation

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 13

Research on an AI-Assisted Employee Health Management System

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Abstract

With the rapid development of smart manufacturing, wearable physiological sensing devices have gradually been introduced into factory environments to monitor employees' heart rate, body temperature, and other physiological data in real time. However, most current systems mainly focus on physiological abnormality alerts while paying limited attention to employees' mental health conditions. This study proposes an AI-assisted employee health management framework that integrates both physical and psychological healthcare needs.

This research is based on the Biopsychosocial Model and integrates information such as heart rate and work-related stress to establish an employee health management framework. Through AI technologies, the system can provide stress reminders, health recommendations, and preliminary psychological support functions, assisting occupational health nurses and enterprise managers in identifying potential risks at an early stage and improving the efficiency of employee healthcare management.

This study discusses the feasibility of applying smart healthcare systems in manufacturing environments, as well as issues related to data privacy, employee autonomy, and technology ethics. The findings are expected to serve as a reference for future smart workplace health management and contribute to corporate sustainability and employee well-being.

Keywords: AI Health Management, Employee Health, Mental Health, Occupational Safety, Smart Manufacturing.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 14

A Three-Layer AI Voice Verification Pipeline for Game-Based Corrective-Rule Production in TOEIC Grammar Learning: A Pilot Feasibility Study

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Abstract

Mobile language learning applications have substantially expanded access to English test preparation; however, most existing systems rely on passive error correction in which learners simply read the correct answer after a mistake. This design may encourage shallow processing, contribute to the illusion of competence, and fail to leverage principles of active production and game-based engagement at the post-error corrective feedback phase.

This paper presents the design and pilot feasibility evaluation of a TOEIC Active-Recall System integrating AI-supervised vocalization within a game-based learning (GBL) framework. After each incorrect answer, learners are required to read the LLM-generated corrective rule explanation aloud before progression is permitted. Overt vocal production is verified by a three-layer pipeline: (1) a real-time decibel intensity gate (≥ 60 dB SPL); (2) Whisper Speech-to-Text transcription; and (3) cosine semantic similarity checking against the gold-standard rule embedding (threshold ≥ 0.80, ROC-calibrated; AUC = .91). GBL mechanics — including gated progression, immediate point rewards (+5–10 pts), and a streak system — are applied specifically to the post-error corrective phase. A Bypass mechanism (text-input verification after two consecutive audio failures) preserves usability under adverse acoustic conditions.

The system architecture was formally validated using Axiomatic Design (AD), confirming that five functional requirements are independently satisfied (design matrix reorders to strictly lower-triangular form). Failure risk was quantified via Failure Mode and Effects Analysis (FMEA) across seven failure modes by two independent expert raters (ICC = .84), yielding a total Risk Priority Number reduction of 85.1% (from 1,409 to 210) relative to traditional passive feedback.

A two-group pilot feasibility study with N = 24 university students (12 per condition) is designed to address three pre-specified Feasibility Objectives: (FO1) technical performance within target parameters (< 200 ms latency; dB gate pass rate ≥ 85%; cosine threshold SD < 0.05); (FO2) participant adherence and attrition adequate for full-scale RCT planning (session completion ≥ 80%; attrition ≤ 15%); and (FO3) preliminary retention and cognitive load trends to provide effect size estimates to power a subsequent confirmatory RCT. No efficacy conclusions will be drawn from pilot-scale data.

This study addresses a gap at the intersection of GBL design for motivationally structured corrective feedback, Production Effect theory applied to CALL, AI-mediated scaffolding through verified ASR with intensity gating, and systematic design accountability through AD and FMEA, providing the empirical and design foundation for a confirmatory RCT targeting N ≥ 92.

Keywords: Corrective Feedback, Decibel Gating, Game-Based Learning, Mobile Language Learning

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 15

Resolving Design Contradictions in Airway Management Devices: Development of a Channeled Miniature AI Videolaryngoscope Using TRIZ Evolutionary Principles

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Abstract

Clinical airway management is undergoing a paradigm shift from traditional direct laryngoscopy to video laryngoscopy. However, in developing markets such as the ASEAN region, conventional cart-based video laryngoscopes impose severe capital expenditure (CAPEX) burdens. Furthermore, novice medical personnel frequently experience hand-eye coordination barriers during emergency intubations, potentially leading to airway trauma due to excessive levering forces. To systematically address these clinical and structural dilemmas, this paper presents a data-driven product innovation framework that integrates consumer text mining with the Theory of Inventive Problem Solving (TRIZ). Initially, a web scraping algorithm was deployed to extract global user reviews of leading video laryngoscope brands from Google Maps, capturing critical customer complaints regarding device bulkiness, screen glare, and tube advancement failures. These real-world pain points were translated into standard technical contradictions. To resolve the conflict between functional intelligence and system portability, TRIZ Principle 1 (Segmentation) and Principle 24 (Intermediary) were applied to downscale the system into a 250-gram handheld device embedding a lightweight, edge-AI computer vision algorithm for real-time glottis localization and gamified crosshair alignment. Concurrently, to eliminate the user-dependent coordination barrier without escalating manufacturing costs, TRIZ Principle 17 (Another Dimension) and Principle 34 (Discarding and Regenerating) guided the design of an over-molded, channeled polymer disposable blade, transforming three-dimensional manual advancement into a foolproof single-handed guide. Preclinical evaluations and human factors analysis demonstrate that the developed prototype, DivoScope™, minimizes task workloads (NASA-TLX score of 29.1) and achieves a 100% first-attempt intubation success rate within an average of 14.3 seconds. This study successfully validates a systematic design methodology that bridges big-data user feedback with TRIZ contradiction resolution to achieve healthcare de-skilling and affordable decentralized medicine.

Keywords: Airway management, Big-data mining, Design contradiction, Edge-AI, Medical device innovation, TRIZ evolutionary principles

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 16

Analysis Models and Quantitative Analysis Methods of Flow Analysis

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Abstract

In response to the problems of subjective nature, static expression, lack of quantitative means, and potential omission of defects in traditional Functional Analysis of TRIZ, this paper proposes a quantitative model and analysis method for flow analysis based on Functional-Flow coupling. It systematically reviews the development history of Functional Analysis and Flow Analysis, defines the types and defect characteristics of material, energy, and information flows, constructs a complete analysis process consisting of four steps: component analysis, contact analysis, functional modeling, and system flow analysis, the paper also proposes three flow Trimming rules. Finally, through four typical cases such as part painting, blast furnace gas purification, hammer striking, and vertical furnace reduction for verification, the quantitative identification and optimization solution of flow defects are achieved. The study shows that this Functional-Flow coupling method can effectively integrate the intuitiveness of functional analysis and the objectivity of flow analysis, precisely quantify harmful flows, waste flows, and inefficient flows, etc., providing reusable theoretical and methodological support for the innovation and optimization of engineering systems.

Keywords: Flow analysis, quantitative model, Function-Flow coupling, Trimming

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 17

A Proactive Elderly Long-Term Care Allocation Framework via Substance-Field Analysis and Multi-Level Metamodeling

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Abstract

With the rapid onset of a super-aging society, traditional elderly long-term care systems, such as in-home respite care, often face reactive resource allocation. They also struggle to match the hidden needs of elderly individuals. This study proposes a proactive, smart resource-matching framework based on preventive gerontechnology to address growing, inflexible demands for long-term care. The framework combines TRIZ Substance-Field Analysis (SFA), advanced Uncertainty Quantification (UQ), and a multi-level machine-learning pipeline. This study uses SFA as a structural feature engineering tool. It draws on historical long-term care records and elderly health data, mapping these as "substances" and "fields" to define deficits or harmful interactions. To address small data samples and cold-start issues at launch, the platform SmartUQ is used. Using Gaussian Process Metamodeling and Global Sensitivity Analysis, the framework quantifies uncertainty and extracts strong SFA features. Then, a multi-level decision pipeline sends these features into a knowledge-guided prior association matrix. This process filters long-term care services and smart assistive facilities to create resilient modular care packages.

The computational logic of the framework is validated through numerical simulations. The results demonstrate that the proposed architecture maintains highly rational resource-matching decisions even under extreme data-sparsity constraints. Furthermore, once large-scale field data is incrementally ingested, it has a scalable evolutionary mechanism to initiate autonomous learning via association rule mining. This study provides an explainable, robust engineering solution for dynamic healthcare resource dispatching in remote island communities and smart cities, demonstrating a concrete pathway for integrating intelligent decision-support technologies into the long-term care industry.

Keywords: Gerontechnology, Substance-Field Analysis, Uncertainty Quantification, Multi-Level Machine Learning, Autonomous Modular Design.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 18

A Novel Service Quality Diagnostic Method Based on CNN-Driven Facial Emotion Analysis

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Abstract

Elder care services involve long service chains, multiple actors, and dense touchpoints. Yet, existing diagnosis approaches often remain outcome-oriented and rely heavily on retrospective reports, which makes it difficult to localize failures to actionable process nodes and to capture older adults' real-time experience changes. This study proposed an emotion-informed service failure diagnosis framework that integrates the service blueprint with Convolutional Neural Network (CNN) based facial expression recognition to link process structure with nonverbal affective evidence. The study first used a service blueprint to decompose the service process into customer actions, front-stage actions, and back-stage actions, and to identify potential service failure nodes through interviews and voting in three rural elder care institutions in Fujian Province. It then conducted on-site video collection for nodes F1–F11 over 221 days with 108 older adults, extracted frame-level data, and applied a trained CNN facial expression recognition model. Node-level negative emotion proportions were computed to quantify the potential risk of negative experience and to rank nodes. Results show that F5, F6, and F9 had markedly higher negative emotion proportions, and expert review and follow-up verification further confirmed them as key service failure nodes. The proposed framework enables interpretable localization of service failures and provides a practical basis for targeted service optimization in emotionally sensitive elder care settings.

Keywords: Elder care services, Facial expression recognition, Affective computing, Service blueprint, CNN model, Service failure diagnosis

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 21

AN ANALYSIS OF TAIWANESE DISTILLERY TOURISM EXPERIENCES USING LDA AND TRIZ

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Abstract

This study proposes an integrated, data-driven framework to deconstruct the key driving factors influencing consumer experiences in distillery tourism, aiming to establish an innovative paradigm for optimizing tourist services. Adopting a two-phase research design, this paper presents the first-phase baseline study focusing on Taiwanese industrial distilleries, while establishing an extensive international benchmarking blueprint for subsequent validation. First, web crawling was employed to collect user-generated online reviews from representative Taiwanese distilleries. Text mining via Latent Dirichlet Allocation (LDA) topic modeling, optimized by semantic coherence evaluation, successfully extracted two core dimensions of the consumer experience: Core Product Value & Basic Service, and Destination Tourism & Leisure Perception. Sentiment analysis was integrated with these textual patterns to model the causal trade-offs underlying visitor satisfaction.

Furthermore, this research synthesizes the TRIZ innovative methodology, utilizing the contradiction matrix to systematically diagnose systemic service bottlenecks and formulate non-compromised experience engineering solutions. To overcome local operational limitations, the second-phase blueprint has been structured to scale this framework across a massive international benchmarking corpus (N=26,590) encompassing world-class distilleries across Japan, the UK, the USA, and France (e.g., Yamazaki, Macallan, Buffalo Trace, and Hennessy). The baseline empirical results demonstrate the robust capability of this integrated LDA-TRIZ engine to bridge diagnostic big data with prescriptive service design, offering actionable insights for global tourism service optimization.

Keywords: Benchmarking, Consumer loyalty, Latent Dirichlet Allocation (LDA), TRIZ, Winery tourism

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 22

An Innovative Design on Intelligent Ecological Bird-Repelling System for Airports

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Abstract

To address the limitations of existing airport bird-repelling devices, including bird habituation, limited coverage, insufficient device coordination, and prominent ecological disturbance, this paper proposes an intelligent ecological bird-repelling system for airports by integrating a function-decomposition-based conceptual design method with theory of inventive problem solving (TRIZ). First, according to the bird-repelling requirements in airport clearance areas, the overall system function is decomposed into several sub-functions, including mobile patrol, height adjustment, acoustic repelling, optical deterrence, bionic flapping-wing repelling, and communication-based scheduling. Then, to solve problems such as the habituation caused by fixed devices, the limited effectiveness of single-mode deterrence, and the conflict between repelling height and structural stability, TRIZ inventive principles including dynamization, merging, universality, and copying are adopted. Combined with a morphological matrix, key schemes such as a mobile chassis, multimodal bird-repelling integration, a lifting execution platform, and a bionic flapping-wing mechanism are generated and optimized. The proposed system reduces the habituation risk caused by single stimuli through the multimodal coordination of sound, light, and bionic flapping wings, improves spatial adaptability through height adjustment, and enables remote control, device coordination, and task scheduling through mobile patrol and communication. It improves the eco-friendly and intelligent performance of bird-repelling operations and provides an innovative design reference for airport bird-repelling equipment.

Keywords: Systematic Design; Innovative Design; Intelligent Bird Repelling

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 24

Establishing predictors of physical and mental functionalities of the aged by their heart rate variability

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Abstract

Objectives: To conduct a systemic literature review and meta-analysis to understand the interrelationship among physiological parameters such as heart rate variability, depression, and physical activity for the construction of appropriate care models in the future.

Methods: Seven databases, including Airiti Library, Cochrane, PubMed, CINAHL, Medline, Cochrane Chinese version, and Google scholar, were used in mining the keywords of depression, elderly, heart rate variability, and physical activity. As a result, 13 full-text articles were evaluated by systemic review and 12 research data sets for meta-analysis.

Results: A total of 13 full-text works of literature were included in systematic literature review, of which only one was an experimental study published in Chinese. Twelve research datasets were then used to conduct the meta-analysis. The correlation coefficient of all data integration results was 0.15 ($p<0.000$) and the 95% confidence interval was [0.105, 0.195]. Conclusions: The results confirm that HRV-related data are significantly positively related to physical activity function, suggesting that HRV is statistically useful for predicting daily life function indicators.

Keywords: Depression, Elderly, Heart rate variability, Physical activity

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 25

From Estimation Bias to Intelligent Decision-Making: An AI-Based Risk Assessment Framework for Solar Power Systems

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Abstract

Accurate estimation of solar power generation is critical for investment appraisal, operational planning, and risk management in renewable energy projects. However, increasing climate variability has raised concerns regarding the reliability of conventional generation estimation methods that are commonly employed during project evaluation and financial planning. This study examines the discrepancy between expected and actual power generation and proposes an AI-based risk assessment framework to support more informed decision-making in solar energy systems. Using a rooftop photovoltaic installation in central Taiwan as a case study, this research integrates six years of operational generation records with meteorological observations, including sunshine duration, temperature, rainfall, and humidity. A paired-sample t-test was first conducted to evaluate whether significant differences existed between estimated and actual generation outputs. Subsequently, three artificial intelligence models—Artificial Neural Network (ANN), Random Forest (RF), and Support Vector Machine (SVM)—were developed and compared to assess their forecasting performance.

The results reveal a statistically significant gap between estimated and actual generation, indicating that conventional estimation approaches may systematically overestimate energy production under conditions of climate uncertainty. Among the forecasting models, SVM achieved the highest predictive accuracy, with a Mean Absolute Percentage Error (MAPE) of 6.19%, substantially outperforming ANN and RF models. The findings suggest that AI-driven forecasting can effectively reduce prediction uncertainty and provide a more reliable basis for risk assessment. This study contributes by reframing generation forecasting from a purely technical prediction task to a decision-support problem. Building on the concepts of estimation bias, decision risk, and AI-enabled risk mitigation, the proposed framework offers practical implications for investment planning, operational management, and strategic energy decision-making in the renewable energy sector.

Keywords: Artificial Intelligence, Climate-Induced Uncertainty, Decision Support, Risk Assessment, Solar Power Systems.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 26

Automated Sustainability Report Generation System Based on Fine-Tuning Large Language Models

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Abstract

In recent years, government authorities promoting the institutionalization of sustainability information disclosure by listed companies, sustainability reports have gradually become an annual task that businesses must undertake. However, the production of sustainability reports involves cross-departmental data collection, content organization, chapter planning, and text writing, often requiring companies to invest significant manpower, time, or incurring high outsourcing costs. Therefore, improving the efficiency of sustainability report production has become a crucial issue for companies facing sustainability disclosure requirements.

This research focuses on an automated sustainability report generation system centered on fine-tuning a large language model. By collecting publicly released sustainability reports from listed companies, a training dataset with a consistent sustainability report context was established. Model fine-tuning techniques were then employed to enable the large language model to learn common chapter structures, formal tones, and content expression styles found in sustainability reports. In terms of system design, users can input basic company information and sustainability-related data through a front-end form. The fine-tuned model then generates corresponding chapter content, which is integrated into a sustainability report draft using an AI Agent tool. Agile development methodologies and a business model nine-box grid were used throughout the research process to aid in user needs assessment and application feasibility evaluation.

This study verifies the feasibility of applying large language models to the automatic generation of sustainability reports and provides enterprises with a more time-saving, cost-effective, and practically applicable report production assistance method.

Keywords: Large language models, model fine-tuning, agile development, sustainability reports, ESG

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July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 27

Methods to identify and analyze unaware failure modes

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Abstract

Failure Mode and Effect Analysis (FMEA) in is a popular and effective risk analysis, handling, and prevention tool. However, FMEA can only help the users deal with failure modes which has occurred before. However, there is no known methods which can help users identify those never-happened-before potential failure modes. It is this kind of unknown and unaware failure modes which are most difficult to identify and trouble shoot. This paper proposes a systematic approach to identify potential unaware failures by examining various elements of TRIZ Functional Model to identify potential unaware failures conducive for users to design-in mechanism to design out future possible failures. This is a new realization algorithm for Pre-emptive problem avoidance and failure handling concept proposed as a new TRIZ problem solving philosophy. The contributions of this research include: (1) using Function Analysis to identify and analyze potential failure modes which has never happened before. Patterns of failure modes can be identified systematically and comprehensively from function/attribute/component viewpoints; (2) Designing systematic forms to facilitate usage of the proposed processes. (3) Proposing a new TRIZ problem-handling philosophy.

Keywords: TRIZ, Function Analysis, Failure Mode, unaware failure, Pre-emptive problem solving

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 28

Application of Systematic Innovation Methods in the Design and Implementation of Festival Meals for the Elderly: A Case Study of Healthy Rice Dumplings for the Dragon Boat Festival

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Abstract

Taiwan has entered an aging society, and the accompanying elderly population faces multiple challenges regarding their dietary needs. Their requirements not only necessitate a balance of nutrition, health, and variety but also consider taste and palatability. However, many elderly individuals experience a decline in chewing and swallowing functions, leading to nutritional imbalances. Consequently, adjusting the hardness and elasticity of food to ensure that the elderly can accept dietary changes becomes a crucial issue for addressing their nutritional deficiencies. For traditional festive foods that they have enjoyed throughout their lives, the inability to savor these dishes often leaves them with a sense of regret, highlighting the increasing importance of diversifying traditional cuisine while ensuring ease of chewing.

Rice dumplings, a beloved traditional delicacy during the Dragon Boat Festival, are particularly favored by the elderly. However, the texture and hardness of the fillings and glutinous rice can significantly affect their chewing ability. To overcome the limitations of traditional cooking methods, this study introduces the TRIZ systematic innovation approach, employing contradiction resolution and main value parameter analysis to accurately identify the needs of the elderly. The research combines professional physical property analysis instruments with survey questionnaires to conduct quantitative tests and interviews, ensuring that the developed products meet international swallowing difficulty dietary standards, thereby transforming the useless into the useful and providing a theoretical basis for developing health-oriented meals for the elderly.

The results of this study not only enhance the dietary experience of the elderly but also promote their health and well-being. Through a systematic innovation approach, we can meet the specific needs of the elderly while preserving traditional culture, offering practical references and theoretical support for the development of future related products. Furthermore, this research provides valuable insights for policymakers, fostering attention to the dietary needs of the elderly and guiding the rational allocation of social resources, ultimately achieving the goal of healthy aging.

Keywords: International Swallowing Difficulty Diet Standards, TRIZ Systematic Innovation Method, Contradiction Resolution, Main Value Parameter Analysis, Healthy Rice Dumplings

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 29

Fibrous Future: Transforming Abaca Pseudo-Stem Waste into Sustainable Industrial Fiber and Crafts

Sustainable & Development Goal: Goal 12: Responsible Consumption and Production.

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Abstract

Global environmental challenges demand a strategic shift toward sustainable materials by maximizing agricultural waste valorization. This research establishes a localized engineering framework to transform discarded abaca pseudo-stems from the high-yield agricultural plantations of Davao del Norte and Tagum City into high-quality industrial fibers and premium eco-crafts. To address the traditional linear "Take, Make, Dispose" post-harvest model, this study implements a systematic industrial engineering approach. A 6W1H1G framework is utilized for initial problem definition, followed by an Ishikawa cause-and-effect analysis to isolate root processing inefficiencies. To resolve critical engineering trade-offs between maximizing structural tensile strength and minimizing material weight, the Theory of Inventive Problem Solving (TRIZ) Contradiction Matrix is applied. Through the execution of specific inventive principles—including Segmentation, Biomimicry, and Composite Materials—the product design was optimized across three technical iterations, evolving from a foundational hexagonal mesh structure into a smart, bio-active performance system. The extraction methodology involves mechanical processing via specialized crushing and scraping machinery, coupled with physical testing for tensile strength, water absorption, and biodegradation rates. The empirical results demonstrate that processed fibers from abaca waste retain superior mechanical durability comparable to virgin materials while remaining fully biodegradable. Furthermore, by establishing an ethical supply chain in collaboration with the Mandaya Tribe in Mati City, this paper proposes a sustainable "Waste-to-Wealth" business model. This comprehensive framework directly aligns with United Nations Sustainable Development Goal 12 (Responsible Consumption and Production). Ultimately, this study proves that integrating systematic product design optimization with circular bioeconomy principles can successfully clean up agricultural waterways, mitigate open-field biomass hazards, enhance indigenous community livelihoods, and provide a high-performance alternative to synthetic industrial materials.

Keywords: Abaca pseudo-stem, TRIZ Contradiction Matrix, Circular bioeconomy, Waste-to-Wealth, Sustainable industrial fiber, Mandaya Tribe.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 30

AGROVER: A SMART MICRO-MISTING CROP ROVER: EDGE-COMPUTING ROBOTICS FOR TARGETED HEAT-STRESS PROTECTION IN SMALL-SCALE SUBTROPICAL FARMS

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Abstract

Extreme summer heatwaves and an aging rural population are creating a massive crisis for smallholder fruit farms in Taiwan. With the average farmer now nearly 64 years old , managing fields manually is becoming physically impossible just as climate-induced crop damage peaks. High-value crops like wax apples are highly prone to sunburn necrosis, which ruins the fruit completely once its skin temperature hits roughly 52°C. While massive commercial orchards overseas use heavy overhead sprinklers or huge shading nets to fight heat stress , these systems are too expensive and physically too large for Taiwan's small, tight orchards. They also waste water and trigger crop-killing fungal diseases. To bridge this gap, we designed and built "AgRover," a compact, low-cost (under $200 USD), track-driven robotic platform optimized for small-scale operations. Driven by a simple Raspberry Pi, the rover uses open-source computer vision to combine a standard RGB camera stream with an affordable AMG8833 thermal sensor array. This sensor fusion maps the actual surface temperature of the fruit in real time, effectively ignoring background soil and leaf heat to avoid false alarms. When a fruit cluster approaches its heat threshold, the rover activates automated electronic relays to deliver targeted, high-pressure micro-misting directly to the crop for 3 to 5 seconds. This localized pulse immediately cools the fruit through evaporation without soaking the entire canopy or wasting water. While our field testing phase is currently tracking metrics like thermal observation accuracy and inspection frequency in local orchards , this project already demonstrates a scalable blueprint for affordable, domestic automation. By aligning with UN Sustainable Development Goals 2 and 9 , AgRover shows how accessible, student-built robotics can relieve the physical burden on older farmers while saving high-value harvests from a warming climate.

Keywords: Precision agriculture, sensor fusion, crop sunburn, wax apples, smallholder farms, micro-misting, edge computing.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 31

PLANT-BASED PEST CONTROL USING TINOSPORA CRISPA: MINIMIZING CHEMICAL AND ENVIRONMENTAL HAZARDS

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Abstract

Modern agriculture's heavy reliance on synthetic chemical pesticides poses severe risks to human health, animal safety, and environmental ecosystems, causing soil and water contamination, respiratory illnesses in farmers, and a decline in biodiversity. To mitigate these hazards, this study explores the development of a sustainable, cost-effective botanical pesticide prototype utilizing bioactive extracts from Tinospora crispa. Implementing a structured, multi-lens design methodology—including Human Factor Analysis, Design for All Five Senses, and a Nine Windows lifecycle diagram—the project ensures high usability and safety, resulting in a non-corrosive, distinctly colored formulation with a natural bittering agent to prevent accidental ingestion. To refine the product, a TRIZ Contradiction Matrix successfully resolved the engineering trade-off between maximizing pest control effectiveness and reducing environmental hazards by applying the principles of Combination, Cushion in Advance, Segmentation, and Feedback. Ultimately, this Tinospora crispa prototype offers an affordable, community-centered solution that simplifies the extraction process for local farmers without requiring complex laboratory equipment, successfully promoting residue-free biodegradation, ecosystem restoration, and long-term stakeholder safety.

Keywords: Tinospora crispa, Botanical pesticide, TRIZ contradiction matrix, Sustainable agriculture, Human factors engineering, Eco-friendly design.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 32

SUSTAINABLE VALORIZATION OF RICE STRAW: ARTIFICIAL INTELLIGENCE-AUGMENTED GREEN BAGS

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Abstract

Plastic pollution and improper agricultural waste disposal remain critical environmental concerns in both the Philippines and Taiwan. This study explores rice straw, an abundant agricultural byproduct, as a sustainable material for eco-friendly packaging, including biodegradable containers and green bags. A research and development (R&D) descriptive-experimental design was employed, using analytical tools such as 6W1H1G, Fishbone Diagram, Mind Mapping, and Situation Mapping to define the problem and guide solution development. The TRIZ Contradiction Matrix supported the design process by applying principles such as Segmentation, Mechanical Vibration, Transformation of Properties, and Thermal Expansion to enhance strength, water resistance, and biodegradability. Artificial intelligence was integrated into the design optimization process, improving structural configuration and material layering. This resulted in a multi-layer rice straw eco-bag featuring reinforced handles, a magnetic closure, and improved waterproof performance. A preliminary patent search suggests the novelty of the design. Overall, the study demonstrates that AI-augmented rice straw valorization offers a sustainable and commercially viable alternative to single-use plastics, supporting circular economy practices and contributing to SDGs 9, 12, 13, and 15.

Keywords: Rice straw, Sustainable packaging, Agricultural waste, Artificial Intelligence

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 33

Behavioral Motivation Observations in Patients with Mild Dementia

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Abstract

As society advancing toward an ultra-aged demographic, the prevalence of dementia is steadily increasing. The behavioral manifestations of individuals with dementia often diverge from societal norms, frequently resulting in communication breakdowns and leading the public to perceive them as irrational. When families can no longer sustain the caregiving burden, patients are often institutionalized. However, dementia care demands considerable resources; consequently, some facilities resort to physical restraints, inflicting severe psychological distress on patients. Drawing from firsthand caregiving insights, this study reveals that the behavioral motivations of individuals with dementia fundamentally stem from a profound sense of insecurity. Driven by this anxiety, patients exhibit recurring behavioral patterns—behaviors that are, in fact, analogous to those found in healthy populations. By deciphering these underlying motivations, caregivers can foster greater empathy and develop more effective care strategies. Ultimately, validating and accepting the behaviors of individuals with dementia can facilitate their reintegration into everyday life.

Keywords: Dementia, Neuro-Linguistic Programming, TRIZ

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 34

Strategic Evaluation for Aviation's Net-Zero 2050: Integrating IATA Enabling Decisions and AHP-BN Model Analysis

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Abstract

Background: Aviation contributes approximately 2.5% of global greenhouse gas emissions and faces the dual challenge of achieving net-zero by 2050 while maintaining profitability. While the ReFuelEU Aviation mandate requires SAF blending to reach 70% by 2050, current ASTM D7566 standards restrict blending to 50% due to safety concerns regarding engine seal compatibility. This conflict between regulatory targets and technical safety limits creates risk propagation across the supply chain, leading to severe compliance liabilities and asset impairment risks on airline balance sheets.

Methodology: This study integrates the 37 IATA enabling decisions across policy, energy, technology, manufacturing, airports, and airlines. The methodology employs a hybrid AHP-BN (Analytic Hierarchy Process and Bayesian Network) framework. AHP is used to determine decision weights, while the Bayesian Network simulates the propagation of technical uncertainties into financial impacts. From a balance sheet perspective, "Economic Risk" is defined as the core weighted dimension (approximately 55%). Technical Readiness Levels (TRL) serve as proxies for investment risk, and the 50% safety limit is established as a critical transition constraint for optimized decision pathways.

Results: The analysis confirms that Cost Impact is the most critical dimension, with Regulatory Compliance Cost acting as a dynamic weight that increases over time. Simulations indicate that without the timely approval of 100% Drop-in SAF technologies and the development of retrofitted aircraft, airlines face a compliance cliff after 2040. As mandates exceed safety thresholds, the risk of massive fines or aircraft grounding significantly intensifies. The study identifies the 2035–2045 window as the peak period for asset transformation, where early investment in high-weight actions disproportionately mitigates long-term legal and financial liabilities. Conclusion: This study provides a quantitative risk management tool that bridges financial logic with a supply chain perspective, offering vital insights for Asset-Liability Management. By highlighting the impact of the contradiction between regulatory goals and safety limits on airline stability, the model assists stakeholders in identifying economically viable technical pathways and provides practical guidance for achieving the 2050 net-zero target.

Keywords: Aviation Fuel (SAF), Analytic Hierarchy Process (AHP), Bayesian Network (BN), Risk Propagation, Sustainable IATA Enabling Decisions

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 35

Innovative Research on Fishing Hooks Based on TRIZ

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Abstract

Taiwan, being surrounded by the sea, has developed a thriving aquaculture industry. In recent years, with the rapid growth of the leisure industry, recreational shrimp-fishing ponds have consequently emerged. Twenty years ago, there were more than 300 shrimp-fishing ponds in Taiwan. Despite the global pandemic and social changes, more than 250 shrimp-fishing ponds still remained in operation as of 2026. To enhance the entertainment value and sense of accomplishment generated by shrimp fishing, this study investigates innovations in shrimp-fishing hooks and conducts an analysis of their designs to improve the predicament of visitors who failing to catch shrimp. However, studies related to shrimp fishing are relatively scarce, and research focusing specifically on shrimp-fishing hook is even rarer. Therefore, this study applies TRIZ and its associated tools to conduct a systematic analysis of the improved patented shrimp hook, Patent M330744. The analyses include functional analysis, cause-and-effect conflict chain analysis, identification of physical contradictions, and separation principles. Subsequently, an innovative solution was further developed and patented, resulting in the acquisition of a second patented shrimp hook, Patent M665049. Finally, a comparative analysis of the two patented designs demonstrates that Patent M665049 exhibits improvements in operationality, stability, and catching rate. In addition to initiating academic research on innovations in shrimp-fishing hooks, the results of this study can also serve as a reference for practical applications.

Keywords: Shrimp Fishing hook, TRIZ, Patent, Performance, Catch Rate.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 36

BAT-Refined LLM-TRIZ: Structural Verification and Content-Claim Risk Assessment for Reliable TRIZ Reasoning

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Abstract

Large language models (LLMs) are increasingly used for engineering ideation, but their reliability in applying the Theory of Inventive Problem Solving (TRIZ) remains insufficiently quantified. Existing LLM-TRIZ studies mainly show that LLMs can generate TRIZ-inspired ideas, while less attention has been paid to whether the generated reasoning is TRIZ-consistent, technically feasible, and reproducible. To address this gap, this study proposes BAT-Refined LLM-TRIZ, a reasoning reliability framework for evaluating and improving LLM-assisted TRIZ reasoning. The framework introduces an eighteen-error LLM-TRIZ reasoning error taxonomy and a three-level Binary-Addition-Tree verification architecture. mBAT performs monotonic candidate-level screening, gBAT verifies group-independent reasoning components, and nBAT enumerates and scores dependent non-monotonic reasoning paths. A staged reasoning reliability score evaluates answer-level TRIZ reliability, while a threshold-based acceptance indicator estimates empirical reliability across test cases. On a ten-case AutoTRIZ benchmark evaluated with claude-sonnet-4-6 at temperature 0, single-pass BAT-guided refinement raises answer-level reasoning reliability by $+0.109 \pm 0.009$ and increases the strict-threshold acceptance rate (RTRIZ) at (τ=0.8) from 0.10 to 0.56 over five independent runs, while the deterministic-only component improves by $+0.039 \pm 0.015$.

Keywords: Large language model; TRIZ; Binary-Addition-Tree; reasoning reliability; inventive problem solving; contradiction identification; inventive principle selection; prompt refinement; reliability assessment; AI-assisted innovation

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: 37

Synergistic Mechanism of Ganoderma lucidum as "King of Herbs" and "Guide to Medicinal Herbs" in Multi-Target Regulation and Pharmacokinetics: A Biomedical Deconstruction Based on the Principles of Systematic Innovation and Invention

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Abstract

Traditional Chinese Medicine (TCM) positions Ganoderma lucidum as a dual core component, possessing both the function of strengthening the body's resistance (the king of herbs) and enhancing efficacy while reducing toxicity (the guiding herb). Since ancient times, Ganoderma lucidum has been regarded as a historical paradigm of "systematic innovation" in TCM prescriptions and Eastern health preservation due to its ability to simultaneously address multiple technical conflicts within complex physiological systems. A systematic theoretical analysis of this classic paradigm not only unlocks the "black box" of macroscopic regulation in ancient medicine but also holds significant paradigm shift and research value in contemporary biomedical research and multi-target drug development.

This article, combining the Theory of Inventive Problem Solving (TRIZ) and inventive principles, explores the biological performance of Ganoderma lucidum's core active components—polysaccharides and triterpenoids—at the cellular and molecular levels. Research has found that the biomedical mechanism of Ganoderma lucidum, as both a "king of herbs" and a "guide drug," highly corresponds to the core invention principles of TRIZ, including segmentation, asymmetry, dynamization, universality/multi-functionality, and prior counter-action.

Keywords: Systematic innovation, invention principles, Ganoderma lucidum, biomedicine

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-25

Systematic Identification of Flaky Test Case using CodeBERT based Hybrid Autoencoder

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Abstract

Flaky tests present crucial challenges within the domain of software testing. Continuous Integration (CI) cycles are often hampered severely due to flakiness feature of several test cases. Hence, identification of flaky test cases is a key requirement to deliver the software project timely. However, in this context, existing traditional approaches such as test isolation, logging and debugging, code review, failure analysis are costly, time-consuming, and require expert domain knowledge. To mitigate this issue, detection process of flaky test cases need to be automated. With the aim of addressing this issue, this paper has proposed a Large Language Model (LLM) based approach to detect the flaky test cases. LLMs are proven their capability to handle the large amount of data. In the proposed approach, a pretrained language model CodeBERT is fine-tuned to learn the latent features of the source code of normal test cases to classify test cases between the two classes– Flaky and non-flaky test cases. Sequence-to sequence learning, dual loss optimization, and threshold-based anomaly detection have enabled the proposed approach to learn the structural and semantic features of non-flaky test cases and thus have helped to remove the need for manual feature engineering.

Keywords: Flaky Test Cases, Large Language Model, Anomaly Detection, Automated Testing

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-34

Enhancing Colorectal Cancer Diagnosis Using Deep Learning: A Comprehensive Review

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Abstract

In past few years, numerous Deep learning models had been developed for the diagnosis of Colorectal cancer (CRC). Colorectal cancer, which is prevalent in the elderly population, is the ubiquitous type of cancer found in present world; nearly 10% of the world population suffers from it. Recent advancements in deep learning and image processing have totally enhanced the diagnostic capabilities of medical imaging for the diagnosis of CRC. Most of these models focus on data segmentation, classification, and multiclassification using open-source datasets, while others create real-time datasets. This comprehensive survey reviews different Deep learning models which help in the advance detection of polyps in the colon, leading to early diagnosis and treatment of the cancer. The review thoroughly analyzes the strengths, limitations, and methodological approaches of different deep learning architectures, emphasizes research gaps and provides insights into future directions for clinical adoption.

Keywords: Colorectal Cancer, Deep Learning, Segmentation, Classification, Polyps, Medical Image Analysis, Convolutional Neural Networks, Vision Transformers, Transfer Learning.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-57

Enhancing Stroke Diagnosis: A Deep Learning Approach to Analyze Neuroimages

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Abstract

Stroke remains the leading cause of death and disability globally, affecting millions of individuals annually. Rapid and accurate identification of stroke subtype, whether ischemic or hemorrhagic, is critical for effective treatment due to limited therapeutic windows and fundamentally different treatment protocols. Interpretation of MRI with respect to diagnosis is a time-consuming and resource-intensive process, prone to inter-observer variability when done manually by human experts. In this work, we present a high-performance automated diagnostic system based on a modified VGG16 CNN architecture employing transfer learning. We discuss the whole creation of a web-based platform that uses deep learning inference and a Flask backend to classify MRI scans as ischemic stroke, hemorrhagic stroke, or normal brain tissue. The suggested model has a classification accuracy of 92.74% and the inference time for each image is 0.7 s. Apart from classification, the system equipped with clinical decision support, features including emergency facility locators and precautionary guidelines, which suggest high potential for the real-time applications in resource-limited settings.

Keywords: Stroke Diagnosis, Deep Learning, VGG16, Medical Imaging, MRI Classifi cation, Transfer Learning, Convolutional Neural Networks, Healthcare AI.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-73

YOLO-based Models for Breast Cancer Detection using Ultrasound Imaging

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Abstract

Breast cancer is the leading cause of mortality in women worldwide, and its early detection can significantly improve survival. A deep learning-based approach to breast cancer classification utilizing ultrasound images is proposed in this study. The Breast Ultrasound Image dataset was used with several classes of tumour status. This paper trained and evaluated classification performance for several state-of-the-art YOLO (You Only Look Once) models, including YOLOv8n, YOLOv8s, YOLOv11n, and YOLOv11s. Model performance was evaluated in terms of accuracy, precision, recall, and F1 score. Experimental results show that the YOLOv8s model obtained an accuracy of 98.37%, a precision of 98.39%, a recall of 98.37, and an F1 Score of 98.38%, outperforming all other models. YOLOv8 provides promising models for medical image classification tasks, particularly in recognizing breast cancer. The proposed method is a robust and efficient tool for aiding clinicians in the early detection process, thus helping to improve clinical outcomes. Ultimately, the final and most performant model was collated into a Streamlit-based app for continuous prediction and human interaction.

Keywords: Breast Cancer Detection, Ultrasound Imaging, Deep Learning, YOLOv8, Medical Image Classi-fication, Streamlit Application

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-78

Hybrid Cox–DeepSurv Framework for Interpretable Survival Prediction in Clinical Data

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Abstract

Clinical decision-making in effective lung cancer treatment is highly dependent on early patient survival. In order to increase the accuracy of patient risk categorization and prognosis, a hybrid survival analysis paradigm based on statistical modeling and deep learning is proposed in this research. To handle noise and multicollinearity, Principal Component Analysis, imputation, normalization, and dimensionality reduction were performed on the clinical data. In order to handle linear correlations between clinical factors and survival outcomes, a Cox Proportional Hazards model was used, and a DeepSurv-based neural network was used to handle non-linear correlations, and the predictions from the two models were fused to generate a hybrid risk score. To ensure consistent convergence and pre- vent overfitting, the model was developed using the Cox partial likelihood loss as well as the stopping. Using survival analysis, the two group's separation was also examined. In comparison to the standalone Cox model, the suggested hybrid model's Concordance Index (CI) was greater, at roughly 0.68. The feature contributions were further examined using the SHapley Additive Explanations (SHAP) approach. This improved the suggested model's interpretability and clinical relevance. All things considered, the suggested framework offers a trustworthy and intelligible method for survival prediction.

Keywords: Survival Analysis, Cox Proportional Hazards, Hybrid Model, PCA, SHAP, Risk Stratification

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-97

A Novel Cross-Modal Attention Fusion Framework for Multimodal Healthcare Diagnosis Using Swin Transformer V2

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Abstract

Multimodal healthcare diagnosis aims to learn medical representations from heterogeneous data sources, such as medical images, clinical text, and structured records, for downstream diagnosis tasks. Existing methods adopt correlation-based fusion techniques that do not model causal relationships and are neither uncertainty-aware nor robust to missing modalities. In this paper, we present SwinV2-MedX, a new multimodal framework that utilises causal cross-modal attention (CCA) and uncertainty-aware adaptive fusion (UAF) modules to produce robust and interpretable predictions. The framework uses a hierarchical Swin Transformer V2 as an encoder to learn image representations, while transformers and attention-based mechanisms are utilised to encode clinical text and tabular data, respectively, to capture complementary cross-modal information. Contrastive alignment and dynamic modality gating techniques are further utilised to achieve semantic alignment between modalities and to handle partial-input scenarios. Extensive experiments on benchmark datasets show that our model achieves an accuracy of 96.8%, an F1-score of 95.9%, a false alarm rate of 4.85%, a robustness score of 91.25% and an AUROC of 97.3%, surpassing current multimodal and Transformer-Based approaches by a wide margin.

Keywords: Swin Transformer V2, Multimodal Learning, Cross-Modal Attention, Clinical Metadata, Medical Imaging, Healthcare AI.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-135

Machine Learning–Based Prediction of Functional Outcomes in Spontaneous Intracerebral Hemorrhage: Insights from a South Indian Cohort Study

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Abstract

Spontaneous intracerebral hemorrhage (sICH) is a serious type of stroke with high mortality and morbidity rates, especially in developing countries. The purpose of this study is to create machine learning models capable of predicting the functional outcome at discharge and three months in a cohort of 1255 sICH patients from South India. In the current study, the clinical, neurological, laboratory and radiological parameters were considered as predictors and mRS was categorized as good (0–2) and poor (3–6) functional outcomes.

For the evaluation of machine learning models, five different algorithms were used, including Random Forest, Support Vector Machine (SVM), k Nearest Neighbors (KNN), Logistic Regression and XGBoost. It was possible to achieve great performance with Random Forest algorithm as its accuracy was 88.9% in discharge outcome prediction and 86.5% in three months outcome prediction. Hematoma volume from CT, GCS on admission, NLR emerged as important predictors of poor outcomes according to feature selection results.

Keywords: intracerebral hemorrhage · machine learning · random forest · outcome prediction · modified Rankin scale.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-150

Sickle Cell Vision: Performance Evaluation of Deep Learning Models in Hematological Imaging

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Abstract

Sickle Cell Disease (SCD) is a genetic disorder caused by red blood cells which makes them become rigid and abnormally shaped, leading to severe health problems when not identified early. Existing diagnosis depends on manual microscopic inspection, which is slow, subjective, and varies from one expert to expert. These constraints make large scale and dependable examination complicated when the resources are limited in healthcare field. The objective of the proposed research work is to introduce an automated system that understands the patterns from microscope images of red blood cells to recognize SCD. The study involves assessment of four models; a basic Convolutional Neural Network (CNN) and three transfer learning models- VGG16, ResNet50 and EfficientNetB0. All models were trained using identical preprocessing and data augmentation procedures to ensure a fair and reliable comparison, following established practices in SCD and medical imaging research.

The pretrained models performed better than basic CNN, making the improvement clear and consistent. The transfer learning models not only achieved higher accuracy but also showed remarkable reliability in their predictions. VGG16 and ResNet50 correctly classified all the test samples, while EfficientNetB0 achieved the highest validation accuracy of 99.1%, proving its strong ability generalize to new, unseen data. This study proves that on pretrained models, deep learning de-livers fast, precise and dependable detection of SCD. Adding automation into the medical field has the higher potential to support healthcare professionals by enabling large-scale screening and improving early diagnosis in resource limited clinical environments.

Keywords: Sickle Cell Disease (SCD), Artificial Intelligence (AI), Deep Learning (DL), Convolutional Neural Network (CNN), Transfer Learning, VGG16, ResNet50, EfficientNetB0, Medical Image Classification.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-153

AI-Powered ECG Signal Denoising using Residual Variational Autoencoder with Dual Attention

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Abstract

Electrocardiogram (ECG) signals are crucial in the diagnosis and monitoring of cardiovascular diseases (CVD), but the noise contamination often ruins the clinical interpretation of these signals. Noises were produced during the recording and transmission of the signal. The ECG waveform is distorted by artifacts that include baseline wander (BW), muscle artifacts (MA), and electrode motion (EM), which can mislabel or misinterpret critical components of the ECG signal to the clinician. To solve these issues, this study presents a Residual Variational Autoencoder with Dual Attention (RVAE-DA) to robustly and reliably denoise the ECG signal. Proposed architecture (PA) incorporates residual learning in stabilizing deep feature extraction, variational latent modeling in enhancing generalization in unseen noise settings and a dual attention mechanism in adaptively focusing on information-bearing feature channels and time-spatially significant regions of the waveform. Evaluation of the PA is done based on ECG records in the MIT-BIH Arrhythmia Database, which are artificially corrupted with BW, MA and EM noise on a selection of signal-to-noise ratio (SNR) levels of -10 dB to 10 dB. Pearson Correlation Coefficient (PCC), Mean Squared Error (MSE), coefficient of determination (R^2), and SNR improvement are used to evaluate the performance quantitatively. Experiment results demonstrate that PA has high reconstruction fidelity, values of PCC are 0.9819, 0.9715 and 0.9653, values of MSE are 0.0038, 0.0046 and 0.0055, and of R^2 are 0.9613, 0.9415 and 0.9344 with BW, MA, and EM noise, respectively. PA achieved substantial SNR gains of 27.78 dB for BW, 25.94 dB for MA, and 24.87 dB for EM noise. than the traditional filters, signal decomposition models, and standard autoencoders. This demonstrates the efficiency, strength, and applicability of the presented model in terms of ECG denoising in practical settings of real-world monitoring.

Keywords: Electrocardiogram, Denoising, MIT-BIH Arrhythmia Database, Residual Variational Autoencoder, Dual Attention Mechanism, Signal-to-Noise Ratio,

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-175

Disc-level 3D Multi-Task Learning for Degenerative Spine Disease Using Volumetric MRI

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Abstract

Lumbar spinal degenerative diseases are among the most common, major sources of chronic pain and disability worldwide. Thus, diagnostic assessment must be performed accurately and efficiently. As a result of these factors, MRI is the preferred means of evaluating spinal anatomy; however, the large amount of anatomical data produced by MRI (volumetric data), and the complexity of the spinal anatomy, makes manual, subjective interpretation of these data time-consuming. Existing deep learning methodologies for automated spinal analysis show promise but are limited by their use of either 2D images alone or single-task models, which limit their ability to capture three-dimensional (3D) anatomical relationships and multi-pathology. To address these issues, this work presents a unified 3D multi-task deep learning architecture for automatic analysis of lumbar spine MRI, using the SPIDER multi-center database. The proposed system will create a disc-centered volumetric representation of each lumbar disc and use this representation for simultaneous segmentation of each of the four indicators Disc Narrowing, Disc Bulging, Modic changes, Pfirrmann grading. By maintaining the spatial context and allowing for joint learning across the four indicators, the proposed multi-task architecture will provide improved robustness and increased diagnostic accuracy compared to the current methods. Experimentally derived results show that the multi-task learning approach to discern complex spinal pathologies has produced strong results for each of the classification tasks evaluated with scores of 0.9161 (Disk Bulging), 0.8706 (Disk Narrowing), 0.8772 (Modic changes), and 0.7267 (Pfirrmann Grading). These results demonstrate the ability of the 3D multi-task learning approach to effectively describe complex spinal pathology, to improve the overall accuracy of diagnostic decisions and to reduce the workload of Radiologists.

Keywords: Lumbar Spine · Magnetic Resonance Imaging (MRI) · 3D Deep Learning · Multi-Task Learning · Disc Narrowing · Disc Bulging · Pfirrmann Grading · Modic Changes · Medical Image Segmentation

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-180

Enhanced State of Health Prediction for Lithium-Ion Batteries Using BiLSTM with Multihead Attention

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Abstract

Accurately predicting the State of Health (SOH) of lithium-ion batteries is essential for ensuring reliability and longevity in electric vehicles. This study utilizes discharge data across cycles, incorporating multiple features including time, voltage, current, temperature, and cycle to forecast SOH using various deep learning models. Several architectures, including LSTM, BI-LSTM, GRU, BI-GRU, Conv LSTM, DNN, BiLSTM with Multihead Attention, were evaluated for their predictive performance. Among them, the BiLSTM with Multihead Attention model achieved the best results, with an RMSE of 0.0365 and a MASE of 0.0301. The findings demonstrate that attention mechanisms enhance SOH prediction accuracy, contributing to more effective battery health management.

Keywords: Lithium-Ion battery, State of Health, BiLSTM with Multihead Attention.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-183

Attention Guided dual CNN feature Extractor with Stacked Ensemble for the Weed Detection

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Abstract

Accurate weed classification is a required for effective and high yielding agriculture, as weed infestation significantly reduces crop yield and increases herbicide usage and production costs. Accurate identification of weed species from the images is difficult because the species share visually similar features and the presence of many background objects. CNN-based methods tend to rely primarily on a single backbone and lack the capabilities necessary to take advantage of complementary feature representation and improve the ability to discriminate among classes in a real-world agricultural setting. This work presents a dual-backbone attention-aware feature fusion architecture and stacked ensemble classification strategy to perform robust weed classification. The proposed architecture utilizes EfficientNetV2S and DenseNet121 as parallel feature extraction backbones and integrates fusion based mechanism to highlight the important spatial and channel-based representation of features. In addition, the proposed architecture includes auxiliary classifiers to provide deep supervision for the stabilization for learning each feature representations. Once the features have been deep-fused, Principal Component Analysis (PCA) is performed to reduce the dimensionality of features prior to using a stacked ensemble with logistic regression as a meta-classifier for weed identification. The proposed framework was evaluated on the DeepWeeds dataset and compared with several baseline CNN models, including ResNet50, DenseNet121, EfficientNetB0, MobileNetV2, and InceptionV3. The proposed model achieved and accuracy of 97.14% outperforming all baseline architectures across multiple evaluation metrics such as Precision, Recall, F1-score, and Cohen's Kappa.

Keywords: Weed Classification, Dual-Backbone CNN, Attention Based Feature Fusion, Ensemble Learning, Precision Agriculture, Deep Learning

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-194

Variance-based XGBoost Framework for Transcriptomic Prediction of TCMR and ABMR in Kidney Transplantation

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Abstract

Immune rejection remains a primary factor of graft failure in kidney transplantation, while the biopsy-based diagnostic technique is invasive, expensive, and time-consuming. This study highlights a transcriptomic-driven machine learning structure for predicting immune rejection using gene expression profiles. In the solution, optimized Extreme Gradient Boosting (XGBoost) classifiers are utilized to predict immune-mediated rejection independently regarding T cell-mediated rejection (TCMR) and antibody-mediated rejection (ABMR). Dimensionality reduction is accomplished through gene selection based on gene variance, which selects the top 2000 genes. The Synthetic Minority Oversampling Technique (SMOTE) is then adopted to address class imbalance. The optimized ABMR model achieved approximately 81% classification accuracy during evaluation. The proposed framework proves the potential of machine learning for minimally invasive kidney transplant rejection evaluation.

Keywords: Kidney Transplantation, Immune Rejection, Machine Learning.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-201

Temporal Triangulation: A Network-Theoretic Framework for Source Identification in the Ethereum DevP2P (Execution Layer)

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Abstract

Ethereum's Execution Layer (EL) spreads transactions vis ibly through the nodes participating in the network. We study whether the arrival times at observer nodes in multiple regions expose enough information to infer roughly where a transaction originates from. We study this through the combination of a NetworkX simulator where we program in the MLE-based locator and clustering tendencies of the real world, along with deploying 10 geographically distributed observer nodes (excluding the injector) on the Sepolia testnet; each, an Azure node, running a combination of Nethermind (EL) and Lighthouse (CL). Empirical evaluation uses certain measures to combat leakage such as masked self-channel delays, partial observer subsets, time-difference-of arrival (TDOA) relative timing, and train/test separation across runs. Simulation shows that a modest number of spread observers suffices for almost perfect regional identification under $\sigma = 8$ms noise, while exact node recovery remains weak. On Sepolia, region accuracy goes from 18% with one external observer (reasonably above random chance) to 74% with 2 and >90%at$K \geq 5$observers selecting among 6 candidates, match ing the simulation's coarse-triangulation story without trivial injector self-observation.

Keywords: Ethereum source identification · P2P deanonymization · TDOA localization · Mempool privacy · Transaction propagation

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-208

Intelligent Border Surveillance System: Machine Learning Approaches to Intrusion Detection, Threat Level Scoring, and Sensor Integrity Monitoring

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Abstract

Intelligent sensing technologies are increasingly used for border surveillance, but realising reliable machine learning systems in such challenging environments is a difficult task. In the real world, the conditions at the borders are noisy, data is distributed across multiple sites with overlaps, observation is not guaranteed, and there might be damaged or manipulated sensors. Therefore, a single predictive model is not enough to cover the multiple applications of intrusion detection, threat prioritization and sensor reliability monitoring.

In this paper, a three-stage machine learning system for automated border monitoring and security analysis is presented that is modular in design. Dedicated datasets and learning approaches are used throughout each stage, to solve a different operational problem.

Task (TC-1) is concerned with intrusion detection with the use of six sensing channels mounted on the fences: motion detection, thermal activity detection, acoustic activity detection, temporal activity detection, proximity detection, and visibility detection. Multiple binary classification models were trained to identify the possibility that an event is associated with normal environmental activity or if it is an attempt to intrude.

The second task (TC-2) is related to the analysis of aerial surveillance based on the observation of the border crossing groups with the use of drones. Multi-class classification algorithms use tactical characteristics of groups (e.g., group size, movement speed, nighttime activity ratio) to classify each observation as Low, Medium, or High threat level.

The third task (TC-3) focuses on the reliability of the sensors and identifying anomalies resulting from physical tampering or from degradation of the sensor hardware. This is the most challenging stage

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

as it includes bot-h supervised and unsupervised methods of anomaly detection on a very imbalanced dataset (where the number of faults (anomalies) is a small percentage of the total number of records).

Three synthetic data sets with almost 3,700 labelled samples were generated to mimic realistic operating conditions. Different datasets were intentionally chosen with slight overlaps in class distribution, to ensure that the difference between the class means was 1-2 standard deviations. About 3% of samples at class boundaries were also given intentionally 'flipped' labels to add ambiguity and to minimise overfitting. This was done so that algorithms were tested under difficult and realistic conditions instead of easy algorithms.

Experiments were conducted using nine machine learning and anomaly detection techniques. These encompassed Logistic Regression, Decision Trees [7],[19], K-Nearest Neighbours [4], Gaussian Naïve Bayes [6], Random Forest [2], Isolation Forest [3] and statistical Z-Score based thresholding methods [20]. The models have been implemented by using the Scikit-learn framework [1] with the help of the following analytical packages: NumPy [16], Pandas [17], Matplotlib [14] and Seaborn [18].

The experimental assessment proved to be very promising in the field of intrusion detection and threat classification. The accuracy of the classification in TC-1 varied between 95.2% and 98.8% for different algorithms. The accuracy values produced by TC-2 were between 94.0% and 99.7% with under noisy conditions, which means it provides good threat categorization. The challenge of TC-3 was much more difficult as anomaly detection is still difficult under class imbalance and overlapping distributions. Anomaly detection methods had a range of F1-scores from 0.486 to 0.767.

Logistic Regression had the most consistent performance in TC-1, Random Forest [2] the best performance in TC-2, and Isolation Forest [3] the best performance in TC-3. Overall, the proposed framework shows the potential use of modular machine learning pipelines for intelligent border security systems that are also operationally realistic.

Keywords: Border Security, Intrusion Classification, Threat Scoring, Anomaly Detection, Isolation Forest, Random Forest, Logistic Regression, K-Nearest Neighbours, Naïve Bayes

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-221

DWT-Based Deep Learning Framework for Osteoporosis Image Classification using X-ray Femur Bone

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Abstract

The timely detection of bone degradation and the evaluation of bone mineral density (BMD) are essential factors in mitigating the risk of fractures due to osteoporosis, particularly in the femoral area, and in enhancing the prognosis of affected patients. The dual-energy X-ray absorptiometry (DEXA) imaging technique is regarded as the best tool for evaluating the quality of the bone. Nevertheless, it is not always readily available, particularly in resource-constrained clinical environments. This paper proposes a comprehensive approach for the classification of osteoporosis in trabecular femur bone microarchitecture X-images by applying the Discrete Wavelet Transform (DWT) technique and a deep learning approach. The approach starts with the extraction of denoising and registration regions of interest (ROIs) from the femoral neck and the greater trochanter area of the femur bone. The approach continues with the application of the multi-resolution analysis of the features of the image and the classification of normal and abnormal medical images by the intelligent selection of features and the provision of numerous evaluation metrics for the clinical environment. Experiments conducted on a dataset of hip radiographs yield a classification AUC of 0.99 for distinguishing between osteoporosis and a normal image. The proposed spectral-domain framework offers a low-cost and accurate approach for opportunistic osteoporosis screening from X-rays.

Keywords: Deep Learning, Discrete Wavelet Transform, Evaluation Metrics · Feature Extraction, Image Classification, Neural Network.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-222

FPGA-Based Secure Image Encryption using Multi-layer Reversible Computing Algorithm

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Abstract

Advanced cryptographic techniques play a crucial role in securing data transmission. This work aims on implementing a multi-layer Reversible Cellular Automata (RCA), based encryption algorithm on a Kintex-7 FPGA platform to evaluate its effectiveness in securing image data. The algorithm operates on an input image which is processed through multiple RCA-based transformation layers to enhance data diffusion and security. The suggested architecture includes Rule-based evolution, local neighbourhood parameters to establish a reversible system. The encryption process including the setup procedure, operational coordination performs forward iteration of the system. The parallel nature of cellular automata matches the FPGA architecture making them well suited for implementing this encryption technique. The results demonstrate that the proposed approach provides strong data security, efficient hardware performance, and reliable image recovery, making it suitable for real-time secure communication applications.

Keywords: Reversible Cellular automata, multi-layer, Rule, Kintex-7, Secure communication

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-226

Hybrid Edge-Cloud AI Framework for Real-Time Electro-Thermal Monitoring and Predictive Maintenance in Electric Vehicle Powertrain Systems

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Abstract

Thermal changes in electric vehicle (EV) powertrain systems, generated by different load conditions and electric stress are highly critical, and can cause a reduction in efficiency and hasten degradation of components when the temperature in a motor, battery pack or inverter system rises excessively. This paper introduces a hybrid framework of edge-cloud AI that enables real-time electro-thermal monitoring and predictive maintenance of an EV powertrain system in real-time. The design includes ESP32 IoT telemetry acquisition, cloud data synchronization, AI thermal analysis (with minimal complexity), and dashboard with real-time visualization. A thermal and electrical parameter measurement system was designed to collect thermal and electrical parameters, which included motor temperature, battery temperature, inverter temperature, voltage and current measurement of the dynamic system, and transmitted them to the remote end via WiFi network using a telemetry framework. Subsequently, these parameters are processed using an artificial intelligence backend based on FastAPI to generate the thermal trend, severity of the situation and fault analysis of the dynamic system. A Dashboard in a React-based application allows the real-time visualization of the status of the telemetry and operational alerts. Furthermore, a charge/discharge electro-thermal model is added according to Thermal Stress Index (TSI) to assess the dynamic electro-thermal performance of various EV subsystems. Experimental results confirm stability of telemetry synchronization, response to prediction (actions) and robustness against the lack of telemetry (under realistic conditions), for efficient monitoring in real-time. The suggested system architecture is simple, scalable, and deployable and can be easily implemented for intelligent EV thermal monitoring and predictive maintenance for hybrid edge-cloud automotive systems.

Keywords: Electric Vehicles · Edge AI · Cloud-Integrated IoT ·Predictive Maintenance · Electro-Thermal Monitoring · ESP32 ·Real-Time Telemetry · Thermal Fault Prediction · Hybrid Edge-Cloud Architecture · Intelligent Transportation Systems.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-230

Rule-Based Optimal Energy Harvester Selection for Sustainable Wireless Sensor Networks

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Abstract

Wireless sensor networks have become an integral part of modern infrastructure, enabling continuous environmental monitoring across a wide range of domains. Each node within such a network can collect data from its surroundings, performing lightweight computations, and relaying information to neighboring nodes. Sensors themselves serve as the interface between the physical world and the digital system, capturing variables such as light intensity, ambient temperature, wind speed, and humidity, and converting them into electrical signals for downstream processing. These nodes are organized into a self-configuring wireless architecture known as a Wireless Sensor Network (WSN), built to observe physical phenomena including temperature fluctuations, fire detection, and pressure changes in application-specific environments. Since most sensor nodes rely on battery power to carry out their functions and maintain communication, energy availability is a persistent constraint for WSN researchers and designers. Developing effective energy conservation strategies is therefore essential to prolonging network lifetime and sustaining overall system performance. In response, this paper introduces a rule-based harvester selection strategy that leverages temperature, wind, light, and humidity sensor readings to optimize energy usage and sustain long-term WSN operation.

Keywords: Sensor node, Wireless Sensor Network, Energy Harvesting, Cooja Simulator, Light, Temperature, Humidity, Wind sensor.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-231

Hybrid Fuzzy Q-Learning Based Energy-Aware Duty Cycle Scheduling for Wireless Sensor Networks

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Abstract

The drive for energy saving continues to be one of the most important challenges in Wireless Sensor Networks (WSNs) because of the limited battery capacity of the sensor nodes. The battery replacement problem is hard in remote deployments. Fixed duty-cycle scheduling mechanisms are traditional approaches. Are unable to adjust to changing traffic patterns; operate inefficiently in changing environment Economy of the use of energy and network life time. Although Reinforcement Learning (RL) based approaches provide adaptive scheduling capabilities, when the energy is low, they might make unhelpful exploratory decisions, tying up conditions. Similarly, fuzzy logic based approaches provide stable decision making also producing but not with the ability to adapt. In this paper, a proposal is put forward. Energy-aware Adaptive Hybrid Fuzzy Q-Learning based on AI. Introduction to tive dutycycle scheduling in Wireless Sensor Networks. The proposed Framework combines fuzzy state classification and Q-learning based ac Centralized Boss–Worker selection algorithm for tions. Worker nodes report periodically the status of batteries and the number of batteries in the queue a centralised Boss node that makes intelligent scheduling decisions Issues duty cycle commands appropriate to the situation. A mecha designed for safety. A safety override mecha. The nism flag is included to avoid undesirable changes to a node's scheduling when If there is a deficiency of energy, it is a critical one. The framework is delivered by the following: The Contiki-NG OS and tested on the Cooja simulator For normal, burst and hotspot traffic scenarios. Experimental results prove that the proposed mixed model is preferable in terms of network life. In terms of time and packet delivery performance compared with fixed scheduling, standalone fuzzy logic, and pure Q-learning approaches. The results indicate that "adaptive learning combined with safety-aware fuzzy reasoning" for the control of the tank is problematic. provides an effective solution for intelligent energy management in Wireless Sensor Networks.

Keywords: Wireless Sensor Networks · Fuzzy Logic · Q-Learning · Verification Learning · Energy-Aware Scheduling · Duty Cycle Schedul Continental Engineering cycle · Contiki-NG · Cooja Simulation · Artificial Intelligence.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-249

Token-RVFformer: A Token-Level Variational Fusion Transformer for Efficient Uncertainty-Aware Medical Time-Series Prediction

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Abstract

Providing reliable and efficient predictions of medical time series is a crucial task in modern patient care, especially in environments such as Intensive Care Units (ICUs), where medical time-series data are inherently noisy and heterogeneous, posing a challenge for deep learning models to produce uncertainty-aware predic-tions. Existing methods for uncertainty quantification, such as Monte Carlo Dropout (MCD) and Deep Ensembles, are computationally expensive for high-stakes use. This paper proposes a novel Token-Level Variational Fusion Trans-former (Token-RVFformer), designed to provide efficient, uncertainty-aware predictions. The Token-RVFformer encodes each clinical observation as a sto-chastic latent representation, allowing the model to directly represent aleatoric un-certainty. These stochastic latent tokens are combined using gated weight confi-dence fusion, which assigns higher weights to more informative modalities based on their learned confidence. The Token-RVFformer was evaluated on two clinical benchmarks: the PhysioNet 2019 Sepsis dataset and the PTB-XL ECG dataset. The proposed model achieved the best AUROC and AUPRC compared to base-line models on the PhysioNet 2019 dataset. On the PTB-XL dataset, Token-RVFformer achieved competitive predictive performance while achieving the lowest calibrated ECE, Brier, and NLL among baseline models. Compared to MCD-GRU, the Token-RVFformer is 10.83 times faster on PhysioNet 2019 with competitive calibrated ECE, Brier, and NLL. On the PTB-XL dataset, the proposed model is 4.10 times faster than MCD-GRU while producing better un-certainty estimates. The proposed architecture demonstrated reliable and efficient uncertainty-aware predictions across datasets.

Keywords: Medical Time Series, Uncertainty Quantification, Token-RVFformer, Variational Tokenization, Gated fusion, Monte Carlo Dropout.

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-253

Dynamic Hyper-Personalization in Financial Services Using Deep Temporal Clustering and Reinforcement Learning

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Abstract

Customer segmentation and tailored suggestions are complementary strategies used primarily in marketing and business decisions. Most traditional methodologies depend on static demographics and transactional features, overlooking important sequential insights from customer behavior. This article proposes a bridge between segmentation and recommendation by extracting temporal insights from the customer transactional life cycle to improve both clustering and recommendation. The project is built around a Bidirectional Long Short-Term Memory autoencoder for generating latent embeddings and LinUCB for recommendation.BLSTM performed well on segmentation, with a Silhouette score above 0.8, and achieved 91% Triplet Accuracy on embeddings, outperforming other sequential models such as GRU, TCN, and transformers, as well as traditional clustering methods like KMeans, Agglomerative, and GMM. On the NBA-LinUCB, total rewards were more than 30% higher than those of the Rule-based approach.

Keywords: Machine learning, Temporal Clustering, Bidirectional-LSTM, GRU, GMM NBA, LinUCB, UMAP

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-301

Predictive Digital Twin model for accounting and achieving minimal carbon emission for urban residential buildings

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Abstract

Sustainable development of technologies has become globally relevant owing to rising environmental concerns. The evolution of technology demands “green computing”, as it is a direct contributor to the amount of carbon emissions. Although carbon emissions arise across sectors ranging from power generation and industrial processes to agriculture, it is estimated that more than 40% of carbon emissions result from construction and building operation activities. Traditional carbon emission calculations are static in nature, as they are accounted for using manually entered historical data. However, carbon emissions are generated continuously throughout the construction process, and these must be minimized to the greatest possible extent for creating an environment-friendly construction. Thus, the need for the construction activity is to account for real-time data and make carbon emission accounting a dynamic, proactive activity.

This frames the context of the framework, which presents a digital twin-based construction framework that accounts for and makes real-time decisions regarding carbon emissions. This accountability is achieved through the integration of models, material data, logistics, and sensor data. The framework starts with data collection from multiple sources connecting real-world assets to the virtual digital twin, enabling predictive analytics to make fruitful decisions regarding operations and construction activities. The usability of the proposed framework was validated using a case study, thus providing evidence for its adoption in the real world.

Keywords: Digital twin, carbon emission, Net Zero Energy Building (NZEB), Building Information Modelling (BIM), Life Cycle Assessment (LCA).

The Joint Conference of 17th International Conference on Systematic Innovation (ICSI & GCSI) and 3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026).
July 17-19, 2026

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Paper ID: I-302

A Phase-Aware Microscaling Datapath for FPGA-Accelerated Reinforcement Learning from Human Feedback

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Abstract

Reinforcement learning from human feedback (RLHF) has become the standard method for aligning large language models, yet its hardware acceleration remains underexplored. The core challenge is that a single proximal policy optimization (PPO) step interleaves three numerically distinct phases—rollout, reward scoring, and gradient accumulation—each exhibiting varied tolerance for reduced precision. This paper investigates an FPGA accelerator designed to exploit this phase structure via runtime-selectable microscaling (MX) formats. We first characterize a deployed INT8 baseline on an AWS F2 instance, revealing a severe memory-bound bottleneck: 99.99% of measured cyclesper 16×16 tile launch are consumed by host-side overhead and PCIe/AXI transfers, limiting processing element utilization to a mere 15 cycles. Consequently, our design shifts focus from arithmetic throughput to byte transfer minimization. We profile 169 quantizable layers in Qwen2.5-0.5B under MXFP4 and MXFP8 formats. While MXFP8 maintains parity across all layers, MXFP4 succeeds on 158 layers, with structurally sparse failures localized to early/late MLP blocks and the language model head. Guided by these insights, we propose a dual-precision SystemC datapath featuring explicit mode-switching and flush semantics, subsequently mapped to a synthesizable HLS design. Under a measured bandwidth dominated baseline, our balanced precision policy (MXFP4 for tolerant layers, MXFP8 otherwise) reduces transferred bytes by 40.2% and FPGA dynamic energy by 21.5% relative to the INT8 baseline, achieving 1.8× higher effective throughput. This work demonstrates that layer and phase-adaptive quantization offers a highly viable, energy-efficient pathway for RLHF acceleration without degrading generative quality.

Keywords: Reinforcement Learning from Human Feedback (RLHF) · FPGA Acceleration · Microscaling Formats · Mixed-Precision Quanti zation · Proximal Policy Optimization (PPO) · Hardware-Software Co design.

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

GCSI Project Presentation Sessions

GCSI Competition Chairs: William Wu
Judges: Gururaj H L, Koichi Murata, D. Daniel Sheu, W.C. Yeh
Sessions: GCSI Project, Location: Room 104
GCSI Project Presentation: 18 minutes; Q&A: 2 minutes.

Date/time: 2026/7/18 (Sat)，PM 13:00-14:40

ID	Project Title	Team member(s)
G-1	Design and Implementation of a CONWIP-Based Pull System for Truck Parts Manufacturing: An Integrated Approach Using LSS, TRIZ, and Digital Twin	Li Ting Lin, Chen Han Chen, Shih Hsien Tseng, Yi Fei Chen
G-2	All you can see - Smart Workstation Design	Tien-Lun Liu, Kang-I Liu, Hsiang-Yun Chen
G-4	A sustainability report generation system based on a large language model	Yao-Lun Xuu, Yu-Kai Huang, Kai-An Tsai, Shu-Hsien Tai
G-5	A Two-Degree-of-Freedom Stretching Assistive Device for Frozen Shoulder Rehabilitation	Yu-Gang Chen, Chang-Yuan Chen
G-6	Human–AI Interaction in English Education: A Task-Based Learning Framework	Chia-Chien Liao, Chia-Chun Wang, Chih-Chen Hsu, Li-Ling Liao, Wan-Jhen Jhuei, Yu-Ching Hsu, Liang Hui Wang

Date/time: 2026/7/18 (Sat)，PM 15:00-16:40

ID	Project Title	Team member(s)
G-7	Remember Together: Student Co-Creation of Reminiscence Activities to Promote Communication and Healthy Aging Among Older Adults	Liang Hui Wang, Chi-gin Chen, Yun Shiuan Lin, Wan Yu Chou, Jing Han Qiu
G-8	A TRIZ-based Systematic Innovation Approach to Improving the Oral Functional Care Brush for Older Adult Care	Jo-Peng Tsai, Liang-Hui Wang, Chien-Hsin Yeh, Kazuaki Harada, Su-Chihi Kue, Yan-Ru Lin, Hsiu-Wen Wang, Shenghan Wang
G-9	A Systematic Innovation Process for Developing Elder-Friendly Wagashi Using TRIZ, Texture Analysis, and Sensory Evaluation	Jo-Peng Tsai, Wan-Jung Chou, Mei-Ling Chang, Charlie Wu, Su-Chih Kuei, I-Tyne Cheng, Jia-Yun Li, Hsiu-Wen Wang, Yan-Ru Lin, Hsiu-Wen Wang, Shenghan Wang
G-10	Applying systematic innovative technology to the research of fever mask design	Li Yuan Chen, Hong Rui Chen, Thi Hieu Phan
G-3	A Novel Service Quality Diagnostic Method Based on CNN-Driven Facial Emotion Analysis	An-Jin Shie, Qilin Yang, Jialiang Chen, En-Min Xu

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Organization & Acknowledgment of Contributions

(2026 Joint Conference of 17th ICSI/GCSI & CODE-AI)

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- Manipal Institute of Technology Bengaluru, Manipal Academy of Higher Education (Co-sponsor)
- The Society of Systematic Innovation (SSI) (Co-sponsor)
- National Tsing Hua University (NTHU). (local host)

Supporting journal for publications:

- Int. J. of Systematic Innovation (IJoSI) (SCOPUS and Google Scholar indexed) (Link)
- Sustainability Special Issue (SSCI/SCIE, IF 3.3, Environmental Sciences 178/376, Q2) (Link)
- Journal of Nursing Management (SSCI/SCIE, IF 4.0, NURSING 6/193, Q1) (Link)
- CCIS Springer Proceedings (SCOPUS index）

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Supporting Staff: Chiaoling Ni, Ming Chan, Fish Shih, and NTHU supporting team.

ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

Campus map

Venue:Engineering Building I, National Tsinghua University
(No.101, Sec. 2, Guan-FU Road, Hsinchu)

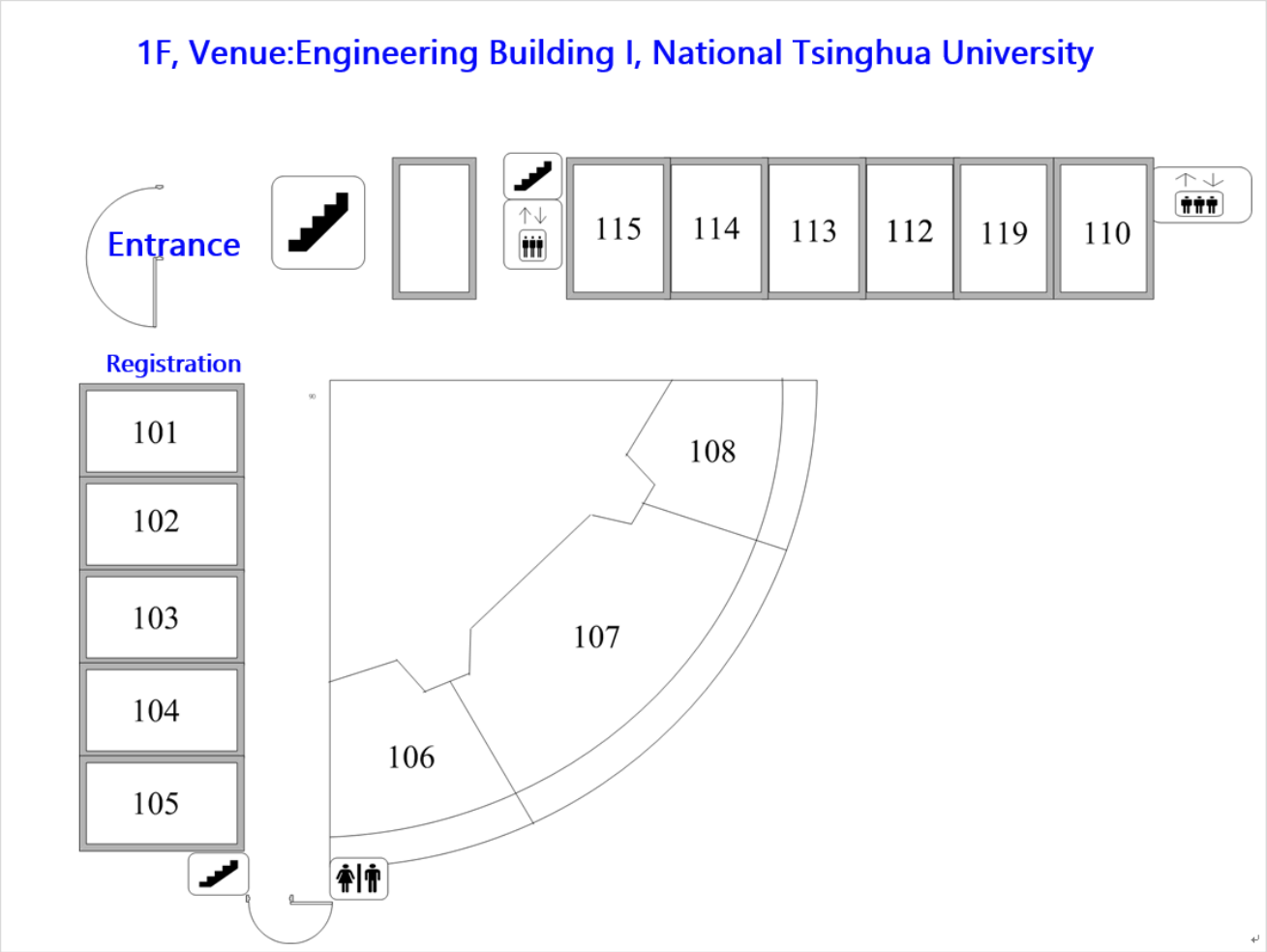
ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

7/18 Opening Ceremony/Keynote/Special Talk:107

Parallel Sessions & GCSI Room :102，103，104

7/19 Keynote/ Closing Ceremony: 106

Parallel Sessions :102，103，104



ISBN: 978-626-97046-7-5
ISSN: 2519-5166 (Online)
ISSN: 2519-1691 (Print)

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The 17th International Conference &Global Competition on Systematic Innovation (ICSI & GCSI)

3rd International Conference on Data Science & Exploration in Artificial Intelligence (CODE AI-2026)

Program Brochure

Editors	International Journal of Systematic Innovation & The Society of Systematic Innovation
Publisher	The Society of Systematic Innovation
TEL	+ 886-3-572-3200
FAX	+ 886-3-572-3210
Address	6F, No.352, Sec. 2, Guan-Fu Rd, Hsinchu, Taiwan 30071, R.O.C.

ISBN: 978-626-97046-7-5

ISSN: 2519-5166 (Online)

ISSN: 2519-1691 (Print)

July, 2026

Organizers:

- International Society of Innovation Methods
- Manipal Institute of Technology Bengaluru, Manipal Academy of Higher Education
- The Society of Systematic Innovation
- National Tsing Hua University

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