JOINT CONFERENCE 2024

October 23-25 2024 | Bintang Bali Resort

BOOK OF ABSTRACTS

ICITEE 2024

The 16th International Conference on Information Technology and Electrical Engineering 2024

iBioMed 2024

The 5th International Conference on Biomedical Engineering 2024

EI.A 2024

Energy Informatics.Academy Conference 2024

Organized by:

IEEE SMC Indonesia Chapter
Systems, Man, and Cybernetics Society

Co-Organized by:

UNIVERSITAS GADJAH MADA
FACULTY OF ENGINEERING
DEPARTEMENT OF ELECTRICAL AND INFORMATION ENGINEERING

Faculty of Information Technology
King Mongkut's Institute of Technology Ladkrabang (KMITL), Thailand

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EIC
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BOOK OF ABSTRACTS

JOINT CONFERENCE 2024

BALI, OCTOBER 23-25, 2024

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WELCOME SPEECH

ICITEE

On behalf of the technical program committee (TPC), we are delighted to welcome you to the 2024 16th International Conference on Information Technology and Electrical Engineering (ICITEE) in Bali, Indonesia. This year, we have prepared an exciting technical program with the conference theme “Integrating Technology, Energy, and Health for a Sustainable Future.” ICITEE 2024 is hosted by Universitas Gadjah Mada (UGM), Yogyakarta, Indonesia, in collaboration with King Mongkut’s Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand. As an annual international event, ICITEE 2024 serves as an excellent platform for sharing innovative ideas, exchanging information, and fostering collaboration among researchers, engineers, practitioners, and scholars in the fields of information technology, communications, and electrical engineering.

All submissions from around the globe underwent a thorough review process, with each paper evaluated by at least two independent reviewers in accordance with the standard blind review procedure. This year, the paper acceptance rate was 45.7%, reflecting the high level of selectivity and quality. Accepted papers have been categorized into areas such as information technology, communications, power systems, electronics, signal processing, and control systems. In addition to the regular sessions, ICITEE 2024 will feature world-class keynote and plenary speeches, along with distinguished invited speakers who will highlight the latest trends and developments in these fields.

We owe a great debt of gratitude to our TPC members and reviewers, who dedicated their time and expertise to ensure a fair, rigorous, and timely review process. We also extend our thanks to the keynote and invited speakers for sharing their insights at the conference. Lastly, we are sincerely grateful to all authors for submitting their work, which has enabled us to compile a high-quality technical program. Welcome to Bali, and we hope you have a memorable experience on this beautiful Island of the Gods.

Bali, October 22, 2024
Ir. Roni Irnawan, S.T., M.Sc., Ph.D., SMIEEE.

iBioMed

It is with great pleasure that I welcome all delegates to Bali for the 2024 5th International Conference on Biomedical Engineering (IBIOMED), taking place from October 23-25, 2024. IBIOMED 2024 is organized by the Department of Electrical Engineering and Information Technology, Faculty of Engineering, Universitas Gadjah Mada, with the IEEE Indonesia Section as a co-sponsor.

The conference theme, “Integrating Technology, Energy, and Health for a Sustainable Future,” reflects the organizers’ belief in the significant contributions that biomedical engineering research can make to daily life. This field has the potential to bridge the gap between humans and technology, particularly in the medical field. As a rapidly growing discipline, biomedical engineering incorporates cutting-edge technology to enhance health and medical services. It applies engineering principles to medicine, focusing on diagnosis, monitoring, and therapy. This interdisciplinary field integrates knowledge from engineering, biology, physics, chemistry, and medicine, creating numerous opportunities for researchers across diverse scientific branches.

On behalf of the Organizing and Program Committees of IBIOMED 2024, I would like to extend our gratitude to all authors for their paper submissions and final versions, as well as to all participants for their valuable ideas and active engagement in the symposium. Our thanks also go to Universitas Gadjah Mada for their support in hosting the event, and to the sponsors, committee members, and everyone who has contributed their efforts in making this conference a highly anticipated gathering.

Finally, I warmly welcome you to IBIOMED and wish you a pleasant stay in Kuta, Bali. I sincerely hope that all participants will enjoy a rewarding experience, taking in the island’s rich cultural heritage, natural beauty, traditional Indonesian cuisine, and the warmth of its people. “Selamat Datang.”

Bali, October 22, 2024
Ir. Prapto Nugroho, ST, M.Eng., D.Eng., IPM.

EI.A

The Energy Informatics.Academy Conference 2024 (EI.A 2024) brought together a remarkable collection of contributions from researchers and practitioners across diverse scientific, technological, engineering, and social disciplines. The conference served as a platform to disseminate original research focused on applying digital technologies and information management to advance the global transition towards sustainable and resilient energy systems.

Thanks to the dedicated efforts of the technical program committee, a total of forty-eight (48) high-quality papers—including both full and short papers—were accepted and published in the Springer Lecture Notes in Computer Science. Additionally, fifty-one (51) insightful presentations were delivered during the conference.

These presentations spanned ten key themes, showcasing the extensive research and development occurring at the intersection of the energy sector and digital technologies:

- IoT, Edge Computing, and Software Innovations in Energy
- Energy Pricing, Trading, and Market Dynamics
- Digitalization of District Heating and Cooling Systems
- Energy System Resilience and Reliability
- Digital Twin Technology and Energy Simulations
- Big Data Analytics and Cybersecurity in Energy
- Demand Flexibility and Energy Conservation Strategies
- Optimization of Energy Systems and Renewable Integration
- Energy data and consumer behaviors
- Smart Buildings and Energy Communities

Each theme provided a rich source of knowledge and innovative ideas that are poised to influence the future trajectory of energy systems and their digital integration. From the exploration of cutting-edge technologies and methodologies to the discussion of practical challenges and forward-looking perspectives, the presentations significantly enriched the conference dialogue. The event thus became a vibrant forum for exchanging ideas, fostering collaborations, and driving future advancements in the energy sector.

Bali, October 22, 2024

Prof. Zheng Grace Ma
EI.A Chair

JOINT CONFERENCE 2024 IN NUMBERS

Conference Timeline

May 19, 2024	Full paper submission deadline I
June 30, 2024	Full paper submission deadline II
July 31, 2024	Full paper submission deadline (final)
June 19, 2024	Notification of acceptance I
July 30, 2024	Notification of acceptance II
August 31, 2024	Notification of acceptance (final)
October 07, 2024	Camera ready paper submission
October 22-25, 2024	Conference date

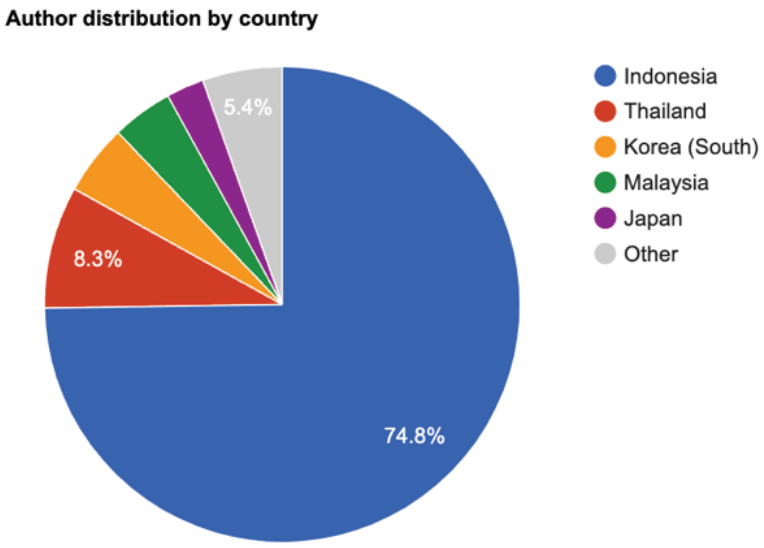
ICITEE

Authors by Country and Region (Accepted Papers)

All authors of accepted papers are counted, regardless of whether they are first, second, ... author. Authors that submitted more than paper are counted once for each paper.

Country	Authors	%	Papers (1st author)	%
Indonesia	234	74.08.00	65	72.02.00
Thailand	26	08.03	9	10.00
Korea (South)	15	04.08	4	04.04
Malaysia	13	04.02	3	03.03
Japan	8	02.06	4	04.04
Italy	4	01.03	1	01.01
Taiwan	3	01.00	0	00.00
Sri Lanka	2	00.06	1	01.01
New Zealand	2	00.06	0	00.00
United Kingdom (Great Britain)	2	00.06	1	01.01
India	2	00.06	1	01.01
Estonia	1	00.03	1	01.01
China	1	00.03	0	00.00
Total	313			

Accepted Papers



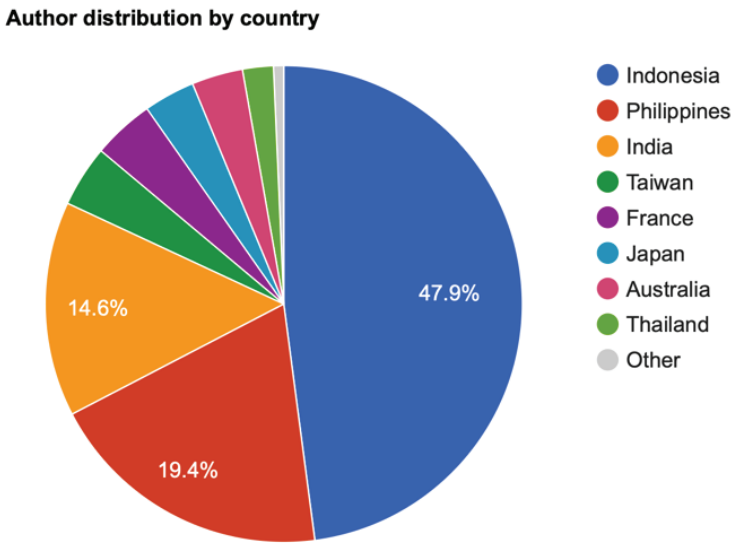
iBioMed

Authors by Country and Region (Accepted Papers)

All authors of accepted papers are counted, regardless of whether they are first, second, ... author. Authors that submitted more than paper are counted once for each paper.

Country	Authors	%	Papers (1st author)	%
Indonesia	69	47.09.00	18	48.06.00
Philippines	28	19.04	5	13.05.00
India	21	14.06	7	18.09
Taiwan	6	04.02	0	00.00
France	6	04.02	1	02.07
Japan	5	03.05	3	08.01
Australia	5	03.05	0	00.00
Thailand	3	02.01	2	05.04
Afghanistan	1	00.07	1	02.07
Total	144			

Accepted Papers



ALL KEYNOTE SPEAKERS

Dr. Lila Iznita Izhar
Universiti Teknologi Petronas, Malaysia

Prof. Masahiro Takei
Chiba University, Japan

Prof. Ryoichi Hara
Hokkaido University, Japan

Bo Nørregaard Jørgensen
University of Southern Denmark

Dr. Zainal Arifin
Executive Vice President of Renewable Energy at PT. PLN (Persero)

Dr. Ir. As Natio Lasman
National Energy Council

CONTENTS

CONFERENCE SCHEDULE

Wednesday, October 23, 2024

08.30 – 09.00	**Registration**
09.00 – 09.30	Opening Ceremony
09.30 – 09.45	Photo Session
09.45 – 10.45	Keynote Speech (Dr. Lila Iznita Izhar - University Teknologi Petronas, Malaysia)
	ICITEE Parallel Session Power Track
10.45 – 11.00	**Break**
11.00 – 12.00	Keynote Speech (Prof. Masahiro Takei - Chiba University, Japan)
	ICITEE Parallel Session Power Track
12.00 – 13.00	**Lunch Break**
13.00 – 15.00	Parallel Session (ICITEE & iBioMed) and Workshop (EI.A)
15.00 – 15.30	**Break**
15.30 – 17.30	Parallel Session (ICITEE & iBioMed) and Workshop (EI.A)

Thursday, October 24, 2024

08.30 – 09.00	**Registration**
09.00 – 10.00	Keynote Speeches (Dr. Zainal Arifin - Executive Vice President of Renewable Energy, PT PLN (Persero); Dr. Ir. As Natio Lasman - National Energy Council, Indonesia)
	IBioMed Parallel Session
10.00 – 10.15	**Break**
10.15 – 11.15	Keynote Speech es (Prof. Ryoichi Hara - Hokkaido University, Japan; Prof. Bo Nørregaard Jørgensen - University of Southern Denmark, Denmark)
	IBioMed Parallel Session
11.15 – 12.00	Q & A for Plenary Session
12.00 – 13.00	**Lunch Break**
13.00 – 15.00	Parallel Session (ICITEE, iBioMed, and EI.A)
15.00 – 15.15	**Break**
15.15 – 17.15	Parallel Session (ICITEE, iBioMed, and EI.A)
18.30 – 20.30	**Banquet/Gala Dinner**

Friday, October 25, 2024

08.30 – 10.10	Parallel Session (ICITEE and EI.A)
10.10 – 10.25	**Break**
10.25 – 12.05	Parallel Session (ICITEE, iBioMed, and EI.A)

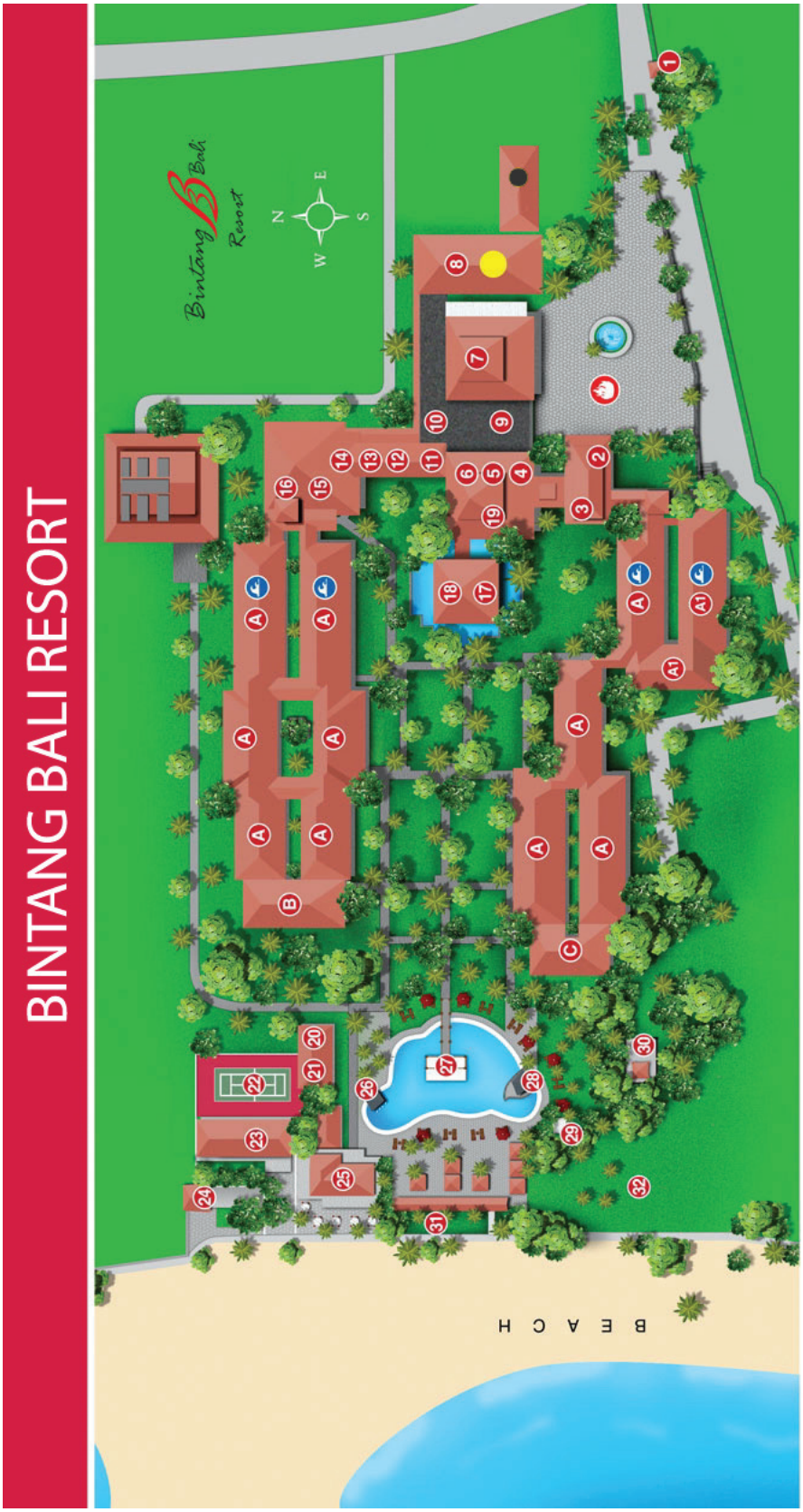
PARALLEL SESSION

		Bali Room	Flores Room	Komodo Room	Nias Room	Sawu Room
Wednesday, October 23, 2024	Session Chair	Yohan Fajar Sidik			Sandra Aditya K.	Aufa Hammam
	09.45-10.45	PS-23			PS-9	PS-8
		PS-2			PS-16	PS-7
		PS-3			PS-6	PS-5
	10.45-11.00	Break				
	Session Chair	Rian Fatah Mochamad			Darma Adi Guna Alfat	Herlambang S. Jatmiko
	11.00-12.00	PS-10			PS-15	PS-18
		PS-11			PS-14	PS-17
		PS-12				PS-13
	12.00-13.00	Lunch Break				
	Session Chair	Ridwan Wicaksono			Umi Proboyekti	Teguh B. Adji
	13.00-14.00	IB-1	EI.A: Workshop on Energy System Resilience (Bintang Ballroom, 13.00-15.00)		IT-2	SPMI-9
		IB-2			IT-3	SPMI-2
		IB-3			IT-5	SPMI-3
	Session Chair	Ahmad Ataka A.R.			Azkario R. Pratama	Indra Agustian
	14.00-15.00	IB-4			IT-4	SPMI-6
		IB-8			IT-7	SPMI-7
		IB-10			IT-22	SPMI-8
	15.00-15.30	Break				
	Session Chair	Adhistya Erna P.			Dhonan Nabil H.	Andi Shafira Dyah K.
	15.30-16.30	IB-11	EI.A: Workshop on Digitalisation of District Heating and Cooling (Bintang Ballroom, 15.30-17.30)		IT-15	SPMI-12
		IB-13			IT-9	SPMI-11
		IB-34			IT-23	SPMI-14
	Session Chair	Rika Favoria G.			Reinhart Siregar	Noor Siti Halimah
	16.30-17.30	IB-14			IT-14	SPMI-10
		IB-7			IT-13	SPMI-16
		IB-16				

		Bali Room	Nakula Room	Sahadewa Room	Nias Room	Sawu Room
Thursday, October 24, 2024	Session Chair	Ridwan Wicaksono			Azzamuddien Hanifa	Prapto Nugroho
	09.00-10.00	IB-15			IB-19	IB-22
		IB-17			IB-20	IB-21
		IB-25			IB-27	IB-24
	10.00-10.15	Break				
	Session Chair	Pandega Abyan Z.			Adhistya Erna P.	Sunu Wibirama
	10.15-11.15	IB-29			IB-26	IB-31
		IB-30			IB-29	IB-33
					IB-41	IB-38
	12.00-13.00	Lunch Break				
	Session Chair	Ignatius Gilbert			Avrin Nur W.	I Wayan Adiyasa
	13.00-14.00	IB-39	EI.A Parallel Session: IoT, Edge Computing, and Software Innovations in Energy (E-A1 - E-A6)	EI.A Parallel Session: Optimization of Energy Systems and Renewable Integration (EB-1 - E-B7)	PS-20	PS-27
		IB-35			PS-19	PS-25
		IB-40			PS-21	PS-28
	Session Chair	Attar Husna Fathiya			Rian Fatah Mochamad	Wijaya Yudha A.
	14.00-15.00	IB-36			PS-1	PS-26
		IB-37			PS-22	PS-30
					PS-24	
	15.00-15.15	Break				
	Session Chair	Muhammad Faqih			Ahmad Nasikun	Ahmad Ataka
	15.15-16.15	CS-2	EI.A Parallel Session: Digital Twin Technology and Energy Simulations (E-C1 - E-C6)	EI.A Parallel Session: Energy Pricing, Trading, and Market Dynamics (E-D1 - E-D5)	IT-16	SPMI-15
		CS-1			IT-20	SPMI-18
		CS-3			IT-21	SPMI-17
	Session Chair	Swadexi I.			Vallentina Wahyu F.	M. Naufal Hakim
	16.15-17.15	CS-4			IT-19	SPMI-13
		CS-5			IT-17	SPMI-20
					IT-8	IT-1

		Bali Room	Nakula Room	Sahadewa Room	Nias Room	Sawu Room
Friday, October 25, 2024	Session Chair	Iswandi			Ahmad Ataka	ECS
	08.30-09.30; 09.00-10.00*	CNT-2	EI.A Parallel Session*: Big Data Analytics and Cybersecurity in Energy (E-F1 - E-F5)	EI.A Parallel Session*: Smart Buildings and Energy Communities (E-G1 - E-G5)	ECS-9	ECS-1
		CNT-1			ECS-5	ECS-2
		CNT-7			ECS-7	ECS-3
	Session Chair	Yusriyadi			Krishna Laksheta	
	09.30-10.10; 10.00-10.40*	CNT-8			ECS-8	ECS-4
		CNT-5			ECS-6	
	10.10-10.25; 10.40-11.00*	Break				
	Session Chair	Dedi Triyanto			Azkario R. Pratama	
	10.25-11.25; 11.00-11.30*	CNT-3	EI.A Parallel Session*: Energy data and Consumer Behaviors (E-H1 - E-H4)	EI.A Parallel Session*: Demand Flexibility and Energy Conservation Strategies (E-I1 - E-I4)	IT-11	
		CNT-6			IT-12	
		PS-27			SPMI-19	
	Session Chair					
	11.25-12.05 11.30-12.00*					
	12.00-12.15*		Energy Informatics Academy Conference 2024 Closing (Bintang Ballroom)			

VENUE MAPS



Note: Bali Room, Nias Room, Sawu Room are located under Ballroom

1. Security
2. Bell Captain Desk
3. Alor Room
4. Reception Desk
5. Main Lobby
6. Grand Lobby Bar
7. Exhibition Center
8. Ballroom
9. Boardroom
10. Restrooms
11. Shopping Arcade
12. Photography Service
13. Tour & Travel Counter
14. Office
15. Health Club
16. Clinic

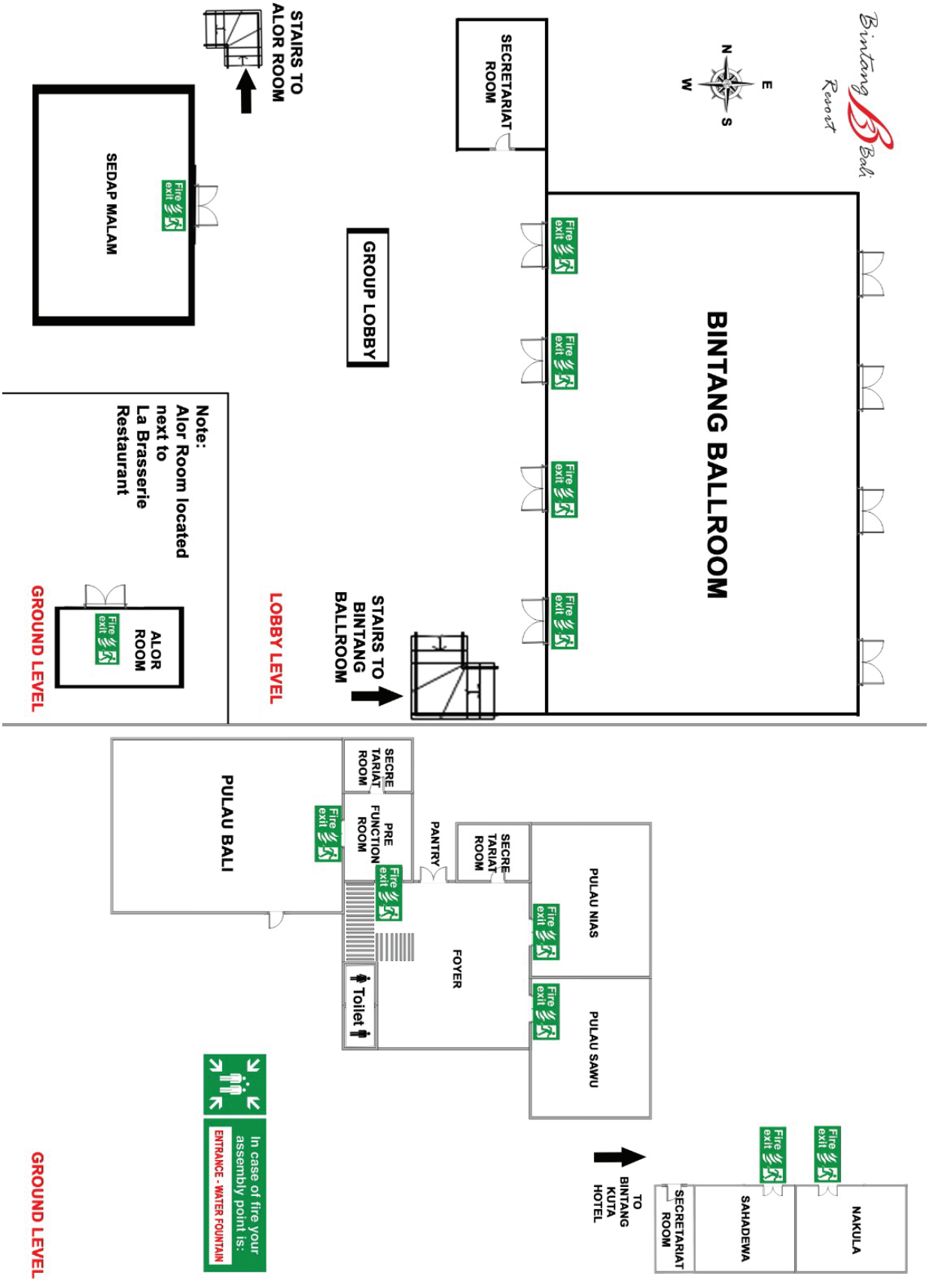
Note: Nakula Room & Sahadewa Room

17. Sedap Malam
18. Taman Sari (ground)
19. La Brasserie (ground)
20. Panda Kids Club
21. Pool Towel Counter
22. Tennis Court
23. Theta Spa by The Sea
24. Temple
25. The Wharf Restaurant
26. The Reef Bar
27. Pool Theatre
28. Jacuzzi
29. Children's Playground
30. Temple
31. Romantic Zone
32. Sunset Garden

A. Deluxe Room
A1. Family Room
B. Suites/Residences
C. Bintang Bali Suite / Suites

Fire Assembly Point

Tsunami Evacuation Point (3rd Floor)


Bintang Bali Resort
E
N
S
W
SECRETARIAT ROOM
BINTANG BALLROOM
Fire exit
GROUP LOBBY
STAIRS TO ALOR ROOM
SEDAP MALAM
STAIRS TO BINTANG BALLROOM
Note:
Alor Room located next to La Brasserie Restaurant
ALOR ROOM
LOBBY LEVEL
GROUND LEVEL
SECRE TARIAT ROOM
PRE FUNCTION ROOM
PULAU BALI
PANTRY
PULAU NIAS
PULAU SAWU
FOYER
Toilet
TO BINTANG KUTA HOTEL
NAKULA
SAHADEWA
SECRETARIAT ROOM
In case of fire your assembly point is:
ENTRANCE - WATER FOUNTAIN
GROUND LEVEL

LIST OF PAPERS

ICITEE

Paper Code	Paper ID	Title	Author(s)	Presenters
CNT-1	1571032576	Improving Machine Learning-Based Wi-Fi Fingerprint Technique with Feature Selection and Grid Search Methods	Olarn Wongwirat and Tanapol Nimnaul (King Mongkut's Institute of Technology Ladkrabang, Thailand)	Olarn Wongwirat
CNT-2	1571038093	Fairness-Driven Channel Allocation on Cognitive Radio with Moth Flame Optimization	Yusriyadi Yusriyadi and Nisa Intan Kumalasari (Universitas Gadjah Mada, Indonesia); Azkario Rizky Pratama (UGM, Indonesia); I Wayan Mustika (Universitas Gadjah Mada, Indonesia)	Yusriyadi
CNT-3	1571042022	Designing an XGS-PON Network to Support Large-Scale Radio Astronomy at the Timau National Observatory	Riyani Jana Yanti and Nurul Fadilah (Universitas Indonesia, Indonesia); Yus Natali (Universitas Telkom, Indonesia); Catur Apriono (Universitas Indonesia, Indonesia)	Riyani Jana Yanti
CNT-5	1571048291	A Secure Vehicular Communication Protocol Using Synchronization of Chen Chaotic System	Nur Afiqah Suzelan Amir (University of Malaya, Malaysia); Fatin Nabila Abd Latiff (University of Taylor, Malaysia); Wong Kok Bin (University of Malaya, Malaysia)	Nur Afiqah Suzelan Amir
CNT-6	1571056997	The Future of Submarine Cable: Research Topics and Emerging Technologies	Lesti Setianingrum (Universitas Indonesia & National Research and Innovation Agency, Indonesia); Muhammad Suryanegara (Universitas Indonesia, Indonesia); Nur Hayati (Universitas Muhammadiyah Yogyakarta, Indonesia)	Lesti Setianingrum

Paper Code	Paper ID	Title	Author(s)	Presenters
CNT-7	1571057728	Delay-Aware Task Offloading and Bandwidth Allocation Using Particle Swarm Optimization in Mobile Edge Computing	Dedi Triyanto and I Wayan Mustika (Universitas Gadjah Mada, Indonesia); Widy Widyawan (Gadjah Mada University, Indonesia)	Dedi Triyanto
CNT-8	1571058139	Comparison of Ship Tracking Algorithms on Dual Overlapping High Frequency Surface Wave Radars	Iswandi Iswandi and Sigit Basuki Wibowo (Gadjah Mada University, Indonesia); Risanuri Hidayat (Gadjah Mada University (UGM), Indonesia)	Iswandi
CS-1	1571031695	Rollover Prevention for Quadruped Tracked Mobile Robot by Legs Dynamics Control	Toyomi Fujita (Tohoku Institute of Technology, Japan)	Toyomi Fujita
CS-2	1571048568	Equation Discovery of KUKA 6-DoF Industrial Robotic Manipulator Dynamics with Backlash Using Lasso Model Selection Criteria	Swadexi Istiqphara (Institut Teknologi Sumatera, Indonesia); Oyas Wahyunggoro (UGM, Indonesia); Adha Imam Cahyadi (Universitas Gadjah Mada, Indonesia)	Swadexi Istiqphara
CS-3	1571057529	Multiple Model Approach of A Soft Robotic Arm	Agustinus Algusta Indrayanto, Ahmad Ataka and Adha Imam Cahyadi (Universitas Gadjah Mada, Indonesia); Vani Virdyawan (Institut Teknologi Bandung, Indonesia); Varell Ferrandy (Imperial College London, United Kingdom (Great Britain)); Yusuf Kurnia Badriawan (Gadjah Mada University, Indonesia)	Agustinus Algusta Indrayanto
CS-4	1571057538	Soft-Growing Robot Navigation in Unknown Environment via Deep Reinforcement Learning	Muhammad Faqih, Ahmad Ataka and Adha Imam Cahyadi (Universitas Gadjah Mada, Indonesia); Yusuf Kurnia Badriawan (Gadjah Mada University, Indonesia)	Muhammad Faqih

Paper Code	Paper ID	Title	Author(s)	Presenters
CS-5	1571058161	Speed Control of Coconut Grater Machine Using PID Based ANFIS Controller	Satria Muhammad Azis (Gadjah Mada University, Indonesia); Oyas Wahyunggoro (UGM, Indonesia); Adha Imam Cahyadi (Universitas Gadjah Mada, Indonesia)	Satria Muhammad Azis
ECS-1	1571042622	Development of Network Analyzer Sharing System with Multi-User Access	Sungtae Hwang, JangHoon Jeong and Jongsik Lim (Soonchunhyang University, Korea (South)); Jaebok Lee (ERANGTEK Co., Ltd, Korea (South)); Dal Ahn and Seong-Ho Son (Soonchunhyang University, Korea (South))	Sungtae Hwang
ECS-2	1571042637	RF Waveguide Filter Turning Method Using Simulated Annealing Optimization Technique	Dongwon Kwon, Hee-Jong Gil and Seong-Ho Son (Soonchunhyang University, Korea (South))	Dongwon Kwon
ECS-3	1571043139	Microwave Imaging Method for Object Localization Without Background Measurements	JangHoon Jeong, Jang-Moon Jo and Seong-Ho Son (Soonchunhyang University, Korea (South))	JangHoon Jeong
ECS-4	1571043158	Null-Power Point Analysis of Wireless Power Transfer Coupler and Improvement Method	Nahyun Hyeong (Soonchunhyang University, Korea (South)); SangMin Han (Soonchunhyang, Korea (South)); SangWook Park (Soonchunhyang University, Korea (South))	SangWook Park
ECS-5	1571043192	Design of High Speed Multipliers Using Counter Based 4:2 Compressor with Pre Processing	Pavitra YJ and Mahanta Talakal (PES University, India)	Pavitra YJ

Paper Code	Paper ID	Title	Author(s)	Presenters
ECS-6	1571043542	Complementary Reflectance and Carbon Dots Fluorescence Imaging Using Endoscopic Scanner	Yang Sing Leong (Universiti Kebangsaan Malaysia, Malaysia); Mohd Hafiz Abu Bakar (Universiti Tenaga Nasional, Malaysia); Mohd Hadri Hafiz Mokhtar and Norhana Arsad (Universiti Kebangsaan Malaysia, Malaysia); Mohd Saiful Dzulkefly Zan (UKM, Malaysia); Ahmad Ashrif A. Bakar (Universiti Kebangsaan Malaysia, Malaysia)	Mohd Hadri Hafiz Mokhtar
ECS-7	1571044015	Phase-Transition Investigation of Whipped Cream Agitation by Electrical Capacitance Measurement Assessed by Physical- Rheological Characteristics	Ryuichi Fukumoto (Chiba University, Japan); Prima Asmara Sejati (Chiba University & Universitas Gadjah Mada, Japan); Masahiro Takei (Chiba University, Japan)	Ryuichi Fukumoto
ECS-8	1571044628	Simulation of PCM/ FM Telemetry Data Encoder Based on IRIG-106 Standard in Matlab Simulink	Mirza Zulfikar Rahmat (Universitas Gadjah Mada, Indonesia & BRIN, Indonesia); Prapto Nugroho and Dzuhri Radityo Utomo (Universitas Gadjah Mada, Indonesia); Wahyu Widada and Ikhwannuary Raditya Priyadana (BRIN, Indonesia)	Mirza Zulfikar Rahmat
ECS-9	1571056732	Buck Converter Parameters Design Using Artificial Intelligence-Based Genetic Algorithm	Krishna Laksheta (University of Gadjah Mada, Indonesia); Yohan Fajar Sidik and Fransisco Danang Wijaya (Universitas Gadjah Mada, Indonesia)	Krishna Laksheta
IT-1	1571028355	PyraMaze VR: An Immersive Gameplay for Ancient Egypt Learning	Intanon Tangtung, Luksamee Lunsiay and Sirion Vittayakorn (King Mongkut's Institute of Technology Ladkrabang, Thailand)	Sirion Vittayakorn

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IT-2	1571031151	Effective Product Recommender System Using Hybrid FastTex, Attention and Probabilistic Matrix Factorization	Muh Hanafi (Universitas Amikom Yogyakarta, Indonesia & Time Excellindo, Malaysia)	Muh Hanafi; Muhammad Akbar Maulana
IT-3	1571031321	Measurement Module for Supporting Arrange Difficulty Coding Questions on KruCode Platform	Peerasak Pianprasit and Nuttaporn Phakdee (Burapha University, Thailand)	Peerasak Pianprasit
IT-4	1571031715	Verbalization Categories During Information Evaluation	Umi Proboyekti (Gadjah Mada University & Duta Wacana Christian University, Indonesia); Paulus Insap Santosa and Ridi Ferdiana (Universitas Gadjah Mada, Indonesia)	Umi Proboyekti
IT-5	1571032968	Gap Analysis for Smart Contract Standardisation	Soumya Kanti Datta (Digiotouch, Estonia)	Soumya Kanti Datta
IT-7	1571041136	A Comparison of Restaurant-Based and E-Commerce Food Delivery: Customer Evaluation Based on Expectations and Satisfaction	Rahmat Yasirandi (King Mongkuts Institute of Technology Ladkrabang, Thailand & Telkom University, Indonesia); Bundit Thanasopon (King Mongkut's Institute of Technology Ladkrabang, Thailand)	Rahmat Yasirandi
IT-8	1571041752	A Computer Assembly Training with VR Technology	Tanadon Parosin, Sittijet Vanichsan and Pornsuree Jamsri (KMITL, Thailand)	Pornsuree Jamsri
IT-9	1571043155	An Empirical Study on the Correlation Between BrainHex Gamer Type and Internet Gaming Disorder	Flourensia Rahayu (Atma Jaya Yogyakarta University, Indonesia); Yohanes Priadi Wibisono and Venansius Fortunatus Arjuna (Universitas Atma Jaya Yogyakarta, Indonesia)	Yohanes Priadi Wibisono; Flourensia Rahayu

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IT-11	1571045181	ThinkMeal: Ingredient Classification and Recipe Recommendation Application	Supannada Chotipant (King Mongkut's Institute of Technology Ladkrabang, Thailand & School of Information Technology, Thailand); Napat Aungtanagul and Thitiwut Hoontamai (King Mongkut's Institute of Technology Ladkrabang, Thailand); Theerada Chotiphan (Ubon Ratchathani Rajabhat University, Thailand)	Supannada Chotipant
IT-12	1571056619	Aspect-Based Sentiment Analysis of PLN Customer Complaints Data Using Bert to Improve Services	Raditya Arizal Pranata (Gadjah Mada University & PT PLN (Persero), Indonesia); Indriana Hidayah and Syukron Abu Ishaq Alfarozi (Universitas Gadjah Mada, Indonesia)	Raditya Arizal Pranata
IT-13	1571056809	Comparison of Hidden Markov Model and KD-Tree in GPS Data-Based Map Matching Process	Alfath Nuurlathif Sulistianto (University of Gadjah Mada, Indonesia); Azkario Rizky Pratama (UGM, Indonesia); Widy Widyawan (Gadjah Mada University, Indonesia)	Azkario Rizky Pratama
IT-14	1571057556	Comparison of TDoA Algorithm Dimension and Modified Kalman Filter for Ultra-Wide Band Indoor Positioning System	Dhonan N Hibatullah (Universitas Gadjah Mada, Indonesia); Azkario Rizky Pratama (UGM, Indonesia); Ahmad Ataka (Universitas Gadjah Mada, Indonesia)	Azkario Rizky Pratama; Dhonan N Hibatullah
IT-15	1571057614	Immersive Virtual Reality-Based Serious Game for Fire Drill Education	Reinhart Siregar and Ridi Ferdiana (Universitas Gadjah Mada, Indonesia); Ahmad Nasikun (UGM, Indonesia)	Reinhart Siregar
IT-16	1571057750	Analysis of Marker Factors Effect on the Detection Process of Image-Based Tracking in Web Augmented Reality	Vallentina Wahyu Febrihartanti (Gadjah Mada University, Indonesia); Bimo Sunarfri Hantono (Universitas Gadjah Mada, Indonesia); Ahmad Nasikun (UGM, Indonesia)	Vallentina Wahyu Febrihartanti

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IT-17	1571057765	Virtual Reality-Based Educational Game for Basic Korean Pronunciation Assessment	Muhammad Fadhil Mahendra, Indriana Hidayah and Achmad Rio Dessiar (Universitas Gadjah Mada, Indonesia); Ahmad Nasikun (UGM, Indonesia)	Muhammad Fadhil Mahendra
IT-19	1571057788	Design and Implementation of a Dashboard System for Monitoring Key Performance Indicators in Digitalized Higher Education Institutions: A Case Study	Iskan Mustamir and Sunu Wibirama (Universitas Gadjah Mada, Indonesia); Ahmad Nasikun (UGM, Indonesia)	Ahmad Nasikun
IT-20	1571057840	Performance Analysis of RouteSegmentation Algorithm in Identifying Perimeter Area Around Travel Route	Muhammad Avied Bachmid, Muhammad Yasir Anshari Haq, Muhammad Rafly Mumtaz and Aryo Pinandito (Universitas Brawijaya, Indonesia)	Muhammad Avied Bachmid
IT-21	1571058010	How Can Gov-CSIRT Indonesia Maintain National Cybersecurity in the Future?	Rakha Wilis and Jeckson Sidabutar (Politeknik Siber dan Sandi Negara, Indonesia)	Jeckson Sidabutar
IT-22	1571058103	AI-Enhanced Honeypots: Leveraging LLM for Adaptive Cybersecurity Responses	Jason Aljenova Christli (Swiss German University, Indonesia); Charles Lim (Swiss German University, Indonesia); Yevonnael Andrew (Swiss German University, Indonesia)	Charles Lim
IT-23	1571058966	Academic Sandbox: Enabling Access and Exploration Mobile Positioning Data for Supporting Mobility Analytics	Syafaatul Khayati (Universitas Gadjah Mada, Indonesia); Widy Widyawan (Gadjah Mada University, Indonesia); Azkario Rizky Pratama (UGM, Indonesia)	Widyawan; Azkario Rizky Pratama
PS-1	1571031299	A Review: Health Diagnostic of Photovoltaic and Correlation with Electrical Performance	Zainur Oktafian Prabandaru and Tumiran Tumiran (Universitas Gadjah Mada, Indonesia)	Zainur Oktafian Prabandaru

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PS-2	1571031455	Fault Detection in Transmission Lines Using CNN	Shazia Kanwal (King Moungkut's Institute of Technology Ladkrabang, Thailand); Somchat Jiriwibhakorn (King Mongkut 's Institute of Technology Ladkrabang (KMITL), Thailand)	Shazia Kanwal
PS-3	1571031505	Behavior Investigation of Conventional Synchronous Generators and Grid Photovoltaic in Microgrid	Fredi Prastiyo (Diponegoro University, Indonesia)	Fredi Prastiyo
PS-5	1571043549	Partial Feedback Linearization Approach to Nonlinear Control of Synchronous Generator with Transient Model	Sabira Geralda Harnanda (Gadjah Mada University, Indonesia); Husni Rois Ali (UGM, Indonesia); Lesnanto Multa Putranto (Universitas Gadjah Mada, Indonesia)	Husni Rois Ali
PS-6	1571043774	Verification of Voltage Stabilization Effects in a Hybrid Microgrid by Experimental and Simulation Studies	Hayato Igarashi and Guohong Wu (Graduate School of Tohoku Gakuin University, Japan); Jinghan He (Beijing Jiaotong University, China)	Hayato Igarashi
PS-7	1571044273	Adaptive Control of Synchronous Generator with Transient Model Using Deep Reinforcement Learning	Muhammad Nurhafiz Sidiq (Universitas Gadjah Mada, Indonesia); Husni Rois Ali (UGM, Indonesia); Ahmad Ataka Awwalur Rizqi (Universitas Gadjah Mada, Indonesia)	Husni Rois Ali
PS-8	1571044796	Reactive Power Support Devices on Weak Grids Connected to High Penetration of Wind Farms in Indonesia: A Review	Herlambang S Jatmiko, Roni Irnawan and Mokhammad Isnaeni Bambang Setyonegoro (Universitas Gadjah Mada, Indonesia)	Herlambang S Jatmiko
PS-9	1571045147	Determining the Droop Coefficient of PWM Rectifier in Hybrid Train Application	Darma Adi Guna Alfat, Fransisco Danang Wijaya and Eka Firmansyah (Universitas Gadjah Mada, Indonesia)	Darma Adi Guna Alfat

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PS-10	1571045188	Analyzing Harmonic Effects on Synchronous Generator Supplying Parallel PWM Rectifier in Hybrid Train Systems	Fransisco Danang Wijaya and Darma Adi Guna Alfat (Universitas Gadjah Mada, Indonesia)	Fransisco Danang Wijaya
PS-11	1571052003	Generation Expansion Planning for the Kalimantan Interconnected System Considering the Renewable Energy Mix and Carbon Dioxide Emissions Targets	Muhammad Alvin, Lesnanto Multa Putranto and Bambang Sugiyantoro (Universitas Gadjah Mada, Indonesia); Ahmad Edy Syukral Siregar (PT PLN (Persero) UIP3B Kalimantan, Indonesia)	Lesnanto Multa Putranto
PS-12	1571054891	Assessment of Government-Owned Electric Vehicle Penetration on Distribution Network: A Case Study in Denpasar, Bali	Pradika Sakti and Mokhammad Isnaeni Bambang Setyonegoro (Universitas Gadjah Mada, Indonesia); Husni Rois Ali (UGM, Indonesia)	Pradika Sakti; Mokhammad Isnaeni Bambang Setyonegoro; Husni Rois Ali
PS-13	1571056544	Impact Assessment and Mitigation of A Power System with Dynamic Electric Arc Furnace Load	I Nyoman Aditya (Gadjah Mada University, Indonesia & PT. PLN (Persero), Indonesia); Lesnanto Multa Putranto and Roni Irnawan (Universitas Gadjah Mada, Indonesia); Rian Fatah Mochamad (UGM, Indonesia)	I Nyoman Aditya
PS-14	1571056615	Oscillation Control in Aceh System Under Disturbances: A Case Study	Farid Choirul Akbar (Gadjah Mada University, Indonesia & PT PLN (Persero), Indonesia); Husni Rois Ali (UGM, Indonesia); Lesnanto Multa Putranto (Universitas Gadjah Mada, Indonesia)	Farid Choirul Akbar
PS-15	1571056729	Household Electricity Tariff Analysis in Smart City Development Using Tariff Design and Analysis (TDA) Tool	Sandra Aditya Kurniawan (Gadjah Mada & Gadjah Mada University, Indonesia); Sarjiya Sarjiya (Universitas Gadjah Mada, Indonesia); Yusuf Wijoyo (Gadjah Mada University, Indonesia)	Sandra Aditya Kurniawan

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PS-16	1571057208	Determination of PV Location to Reduce Losses with Mini Hydro Power Plant Connected to Grid	Ken Satrio Utomo, Sarjiya Sarjiya, Mokhammad Isnaeni Bambang Setyonegoro and Wijaya Yudha Atmaja (Universitas Gadjah Mada, Indonesia)	Ken Satrio Utomo
PS-17	1571057340	Optimal Capacity and Location of PV Farms Penetration in 150 kV Bali Power System	Alam Hardik Dewantara, Sarjiya Sarjiya, Lesnanto Multa Putranto, Wijaya Yudha Atmaja and Muhammad Yasirroni (Universitas Gadjah Mada, Indonesia)	Alam Hardik Dewantara
PS-18	1571057449	Defense Scheme of Interconnection System: A Design Review	Aufa Hammam Muhammad, Roni Irnawan and Mokhammad Isnaeni Bambang Setyonegoro (Universitas Gadjah Mada, Indonesia); Rian Fatah Mochamad (University of Manchester, Indonesia)	Aufa Hammam Muhammad
PS-19	1571057457	Multi-Terminal HVDC Implementation for Connecting Indonesian Islands: Technological Review	Said Muhammad Rakhen Dwiafrianta, Roni Irnawan and Sarjiya Sarjiya (Universitas Gadjah Mada, Indonesia); Rian Fatah Mochamad (University of Manchester, Indonesia)	Said Muhammad Rakhen Dwiafrianta
PS-20	1571057462	Advancing Multi-Island Interconnectors in Indonesia: A Comprehensive Technological Review of Multi-Infeed VSCHVDC Systems	Derana Syahda Trisnakusuma, Roni Irnawan and Fransisco Danang Wijaya (Universitas Gadjah Mada, Indonesia); Rian Fatah Mochamad (University of Manchester, Indonesia)	Rian Fatah Mochamad
PS-21	1571057500	A PV Hosting Capacity Technique on Distribution Network with Considering New Grid Requirement	Faris Sina Prinata (Gadjah Mada University, Indonesia & PT PLN (Persero), Indonesia); Lesnanto Multa Putranto (Universitas Gadjah Mada, Indonesia); Husni Rois Ali and Rian Fatah Mochamad (UGM, Indonesia)	Faris Sina Prinata

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PS-22	1571057607	Network Reconfiguration Strategies for Reducing Network Losses Under High PV Penetration	Fauziyah Amin, Sarjiya Sarjiya, Mokhammad Isnaeni Bambang Setyonegoro and Wijaya Yudha Atmaja (Universitas Gadjah Mada, Indonesia)	Fauziyah Amin
PS-23	1571057634	Characteristic Analysis of Partial Discharge Parameters in Air Insulation Using High Frequency Current Transformer	Fatimah Nurul Fadzilah (Universitas Gadjah Mada, Indonesia); Avrin Nur Widiastuti (UGM, Indonesia); Noor Akhmad Setiawan (Universitas Gadjah Mada, Indonesia); Naufal Hilmi Fauzan (NTUST, Taiwan); Naufal Hilmi Fauzan and Mochammad Wahyudi (Universitas Gadjah Mada, Indonesia)	Avrin Nur Widiastuti
PS-24	1571057830	State-Of-The-Art Optimization Approaches for Battery Energy Storage in UtilityScale Floating PV Systems	Muhammad Shahrizal Erlangga (Gadjah Mada University & PT. PLN, Indonesia); Fransisco Danang Wijaya (Universitas Gadjah Mada, Indonesia); Yusuf Wijoyo (Gadjah Mada University, Indonesia)	Muhammad Shahrizal Erlangga
PS-25	1571057860	Energy Management System of a Fuel-Cell Hybrid-Electric Aircraft Based on Dynamic Programming	Ugo Marco Ferrulli, Massimo Tipaldi, Paolo Roberto Massenio and David Naso (Polytechnic University of Bari, Italy)	Paolo Roberto Massenio
PS-26	1571057912	Analysis of Fuel and Energy Consumption Using the Torque Assist on Single Cylinder ICE	I Wayan Adiyasa (Universitas Negeri Yogyakarta, Indonesia); Fransisco Danang Wijaya and Eka Firmansyah (Universitas Gadjah Mada, Indonesia)	I Wayan Adiyasa

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PS-27	1571057946	Techno-Economic Feasibility Analysis of a Hybrid Renewable Energy System for Gili Labak Island as a Disadvantaged, Outermost and Frontier Region of Indonesia Using HOMER	M. Hafiz Putra Wijaya (Gadjah Mada University, Indonesia); Mokhammad Isnaeni Bambang Setyonegoro (Universitas Gadjah Mada, Indonesia); Husni Rois Ali (UGM, Indonesia)	M. Hafiz Putra Wijaya
PS-28	1571057996	Generation Expansion Planning in Indonesia: A Comparative Study of Interconnection vs. Local Renewable Integration in BaubauRaha System Considering Uncertainties	Asnovita Sari Duhri (Gadjah Mada University, Indonesia); Sasongko Hadi and Sarjiya Sarjiya (Universitas Gadjah Mada, Indonesia); Rian Fatah Mochamad (UGM, Indonesia)	Asnovita Duhri
PS-29	1571058031	Choosing the Optimization Method of Grid with DG from a Distribution Operator Perspective	Erfan Syahputra (Universitas Gadjah Mada & PT PLN (Persero), Indonesia); Eka Firmansyah (Universitas Gadjah Mada, Indonesia)	Erfan Syahputra
PS-30	1571062291	Advance Induction Motor Model with Fault Development for Undergraduate Electric Machinery Course	Nurafnida Afrizal, Tuan Sharifah Nor Fatieha Tuan Mohammad, Muhamad Zalani Daud and Md Rabiul Awal (Universiti Malaysia Terengganu, Malaysia)	Nurafnida Afrizal
SPMI-2	1571031465	Effective Lung Deseases Detection Using Contrast Enhancement and Efficientnet	Muh Hanafi (Universitas Amikom Yogyakarta, Indonesia & Time Excellindo, Malaysia)	Muh Hanafi; Muhammad Akbar Maulana
SPMI-3	1571031706	A Low Cost Multisensor System for Stress Changes Detector	Sisdarmanto Adinandra (Indonesian Islamic University, Indonesia); Suatmi Murnani, Muchammad Maftuch Nashichin and Azhar Nurhafiz Prawira (Universitas Islam Indonesia, Indonesia)	Sisdarmanto Adinandra

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SPMI-6	1571042624	Time Series Classification for Eye Tracking-Based Visual-Verbal Learning Style	Hafzatin Nurlatifa and Teguh Bharata Adji (Universitas Gadjah Mada, Indonesia); Igi Ardiyanto (Universitas Gadjah Mada & Faculty of Engineering, Indonesia); Aloysius Gonzaga Pradnya Sidhawara and Sunu Wibirama (Universitas Gadjah Mada, Indonesia)	Teguh Bharata Adji
SPMI-7	1571043009	Comparative Analysis of Online and Offline Learning Algorithms with Data Drift Detectors in MultiTarget Time Series	Napat Paniangvait (King's Mongkut Institute of Technology Ladkrabang, Thailand); Kitsuchart Pasupa (King Mongkut's Institute of Technology Ladkrabang, Thailand)	Napat Paniangvait
SPMI-8	1571043600	Comparative Analysis of Deep Learning Models for Validating Use Case Diagrams	Bella Dwi Mardiana and Tiara Rahmania Hadiningrum (Institut Teknologi Sepuluh Nopember, Indonesia); Daniel Siahaan (Institut teknologi Sepuluh Nopember, Indonesia)	Daniel Siahaan
SPMI-9	1571044111	Weed Detection Based on Fine-Tuned YOLOv5	Indra Agustian (University of Bengkulu, Indonesia); Sunu Wibirama (Universitas Gadjah Mada, Indonesia); Igi Ardiyanto (Universitas Gadjah Mada & Faculty of Engineering, Indonesia); Ika Anggraini (University of Bengkulu, Indonesia); Pariyanto Noviansyah (Universitas Bengkulu, Indonesia)	Indra Agustian

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SPMI-10	1571045021	Enhancing Nannofossil Image Quality for Improved Detection Using Modified Contrast Stretching Method and YOLO-v8	Andi Shafira Dyah Kurniasari (Gadjah Mada University, Indonesia); Silmi Fauziati (Universitas Gadjah Mada, Indonesia); Rudy Hartanto (Gadjah Mada University & Electrical Engineering and Information Technology Departmen, Faculty of Engineering Gadjah Mada University, Indonesia); Akmaluddin Akmaluddin (Universitas Gadjah Mada, Indonesia)	Andi Shafira Kurniasari
SPMI-11	1571045172	Clustering in a Sensor Array System Based on the Distribution of Volatile Compounds from Palm Oil Using Electronic Nose	Taufiq Choirul Amri, Riyanarto Sarno, Dwi Sunaryono and Rizqy Ahsana Putri (Institut Teknologi Sepuluh Nopember, Indonesia)	Taufiq Choirul Amri
SPMI-12	1571045195	Performance Investigation of Customized MFCC Feature Extraction in Recognizing Indonesian Conversational Emotion	Noor S Halimah (Gadjah Mada University & UGM, Indonesia); Risanuri Hidayat (Gadjah Mada University (UGM), Indonesia); I Wayan Mustika (Universitas Gadjah Mada, Indonesia)	Noor S. Halimah
SPMI-13	1571055666	Instance Segmentation-Based Shrimp Weight Predictor Using YOLOv8 and Bayesian Regression Model	Haru Nakajima (Toyohashi University of Technology, Japan); Rayhan Adi Wicaksono (Universitas Gadjah Mada, Indonesia); Farid Inawan (Jala Tech, Indonesia); Igi Ardiyanto (Universitas Gadjah Mada & Faculty of Engineering, Indonesia); Ahmad Ataka (Universitas Gadjah Mada, Indonesia); Jun Miura (Toyohashi University of Technology, Japan); Lukman Hakim and Yoga Prabowo (Jala Tech, Indonesia)	Ahmad Ataka; Farid Inawan; Igi Ardiyanto

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SPMI-14	1571056309	Image-Based Orientation for Printed Arabic Character Analysis	Imam Yuadi (Airlangga University, Indonesia); Ullin Nihaya and Friska Dwi Pratiwi (Tatung University, Taiwan); Khoirun Nisa' (Airlangga University, Indonesia); Nisak Nazikhah (Hasyim Asy'ari University, Indonesia); Nining Nur Alaini (Badan Riset dan Inovasi Nasional, Indonesia)	Imam Yuadi
SPMI-15	1571056691	Multi-Task Learning Aspect Based Sentiment Analysis with BERT	Muhammad Naufal Hakim, Syukron Abu Ishaq Alfarozi and Paulus Insap Santosa (Universitas Gadjah Mada, Indonesia)	Muhammad Naufal Hakim
SPMI-16	1571056862	Impact of Rhythm, Tempo, and Rest Variations on Pitch Detection in Deep Learning-Based Piano Transcription Models	Priyakorn Pangwapee and Juthakan Mekkoktanphira (King Mongkut's Institute of Technology Ladkrabang, Thailand); Nat Dilokthanakul (King Mongkuts Institute of Technology Ladkrabang, Thailand); Sirasit Lochanachit, Nont Kanungsukkasem and Praphan Pavarangkoon (King Mongkut's Institute of Technology Ladkrabang, Thailand)	Nont Kanungsukkasem
SPMI-17	1571057643	Comparison of Various Windowing Methods on Filter Bank for Speech Recognition	Ihsanul Hajid (Universitas Gadjah Mada, Indonesia); Risanuri Hidayat (Gadjah Mada University (UGM), Indonesia); Bimo Sunarfri Hantono (Universitas Gadjah Mada, Indonesia)	Ihsanul Hajid; Risanuri Hidayat

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SPMI-18	1571057869	Paddy Rows Detection in "Legowo" Paddy Field Based on YOLO and Hough Transform	Andi Rahmadiansah, Dzaky Adla Hikmatiyar and Syamsul Arifin (Institut Teknologi Sepuluh Nopember, Indonesia); Bambang W (Institut Teknologi 10 Nopember, Indonesia); Suyanto Suyanto (Institut Teknologi Sepuluh Nopember (ITS) - Surabaya, Indonesia); Katherin Indriawati (Institut Teknologi Sepuluh Nopember Surabaya & Faculty of Industrial Technology, Indonesia)	Andi Rahmadiansah
SPMI-19	1571058146	Improving Image Fidelity Using Skip Connections Autoencoder	Atyanta Nika Rumaksari (Universitas Gadjah Mada, Indonesia & Satya Wacana Christian University, Indonesia); Risanuri Hidayat (Gadjah Mada University (UGM), Indonesia); Rudy Hartanto (Gadjah Mada University & Electrical Engineering and Information Technology Departmen, Faculty of Engineering Gadjah Mada University, Indonesia)	Atyanta Nika Rumaksari
SPMI-20	1571065850	Robust Quality Clustering of Rice Varieties Using Object Detection	Farah Athaya Harukirana, Addin Suwastono and Wahyu Dewanto (Universitas Gadjah Mada, Indonesia); Igi Ardiyanto (Universitas Gadjah Mada & Faculty of Engineering, Indonesia); Risanuri Hidayat (Gadjah Mada University (UGM), Indonesia)	Addin Suwastono

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IB-1	1571021222	Advanced Clinical Diagnostic Models for ECG Pulse Classification in Arrhythmia Detection	Renann G Baldovino, Patricia Mikaela S Almonte, Claire Marquiz Caliwag, Izabelle Nisha Maxine Chan and Jaun Raquel A Lato (De La Salle University, Philippines)	Claire Marquiz C Caliwag
IB-2	1571028712	Development and Evaluation of Automatic Facemask Template Generator	Takehito Kikuchi (Oita University & Faculty of Engineering, Japan)	Takehito Kikuchi
IB-3	1571029096	Investigation of the Effect of Roller Pump Geometry and Speed on Pulsation in Dialysis Tube	Toshiki Komatsu (Graduate School, Japan)	Toshiki Komatsu
IB-4	1571031218	Deep Learning Algorithms for Breast Cancer Histopathology Classification in H&E-Stained Images	Nicky Nicky and Aulia A. Iskandar (Swiss German University, Indonesia); Rose Khasana Dewi (Brawijaya University, Indonesia)	Nicky
IB-7	1571031570	Emerging Technologies of Sensor-Based Assistive Devices for Spinal Position Monitoring: A Review	Renann G Baldovino, Adrian Nathan L Agravante, Kaethe Mackenzie S Guillermo, Kenji D Angelo C Lim, Raphael Antoine U Lim, Nester Neil C Lopez and Iram Rigs T Carpeso (De La Salle University, Philippines)	Iram Rigs T Carpeso
IB-8	1571031638	Pulmonary Tuberculosis Detection Using an Ensemble of ConvNeXts	Seng Hansun (University of New South Wales); Ahmadreza Argha and Hamid Alinejad-Rokny (University of New South Wales, Australia); Siaw-Teng Liaw (University of New South Wales); Branko Celler and Guy B Marks (University of New South Wales, Australia)	Seng Hansun

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IB-10	1571031669	Lung Sound Denoising with Adaptive Noise Cancellation of Heart Sounds on a Raspberry Pi-Powered Stethoscope	Dharren Sandhi Goutama, Aulia A. Iskandar and Rusman Rusyadi (Swiss German University, Indonesia)	Dharren Sandhi Goutama
IB-11	1571031719	An Ultrasound Image Quality Improvement Approach Based on Non-Subsampled Shearlet Transform and Maximum Local Variation-Based Unsharp Masking	Rika Favoria Gusa (Universitas Gadjah Mada, Indonesia); Risanuri Hidayat (Gadjah Mada University (UGM), Indonesia); Hanung Adi Nugroho (Universitas Gadjah Mada, Indonesia)	Rika Favoria Gusa
IB-13	1571041415	Enhancing Protein Recovery from Peanut Meal: High-Voltage Electrical Discharge as an Efficient and Green Pretreatment Method	Bhoomika Sridhar, Pronama Biswas and B M Ashwin Desai (Dayananda Sagar University, India)	Bhoomika Sridhar
IB-14	1571041700	Multi-Ligand Simultaneous Docking Analysis of Moringa Oleifera Phytochemicals Reveals Enhanced BCL-2 Inhibition via Synergistic Action	Asmita Saha, B M Ashwin Desai and Pronama Biswas (Dayananda Sagar University, India)	Asmita Saha
IB-15	1571042196	Few-Shot Weakly Supervised Segmentation for Retinal Fundus Images Using MetaLearning	Pandega A. Zumarsyah and Hanung Adi Nugroho (Universitas Gadjah Mada, Indonesia); Igi Ardiyanto (Universitas Gadjah Mada & Faculty of Engineering, Indonesia)	Pandega A. Zumarsyah
IB-16	1571042781	A Decision Support System (DSS) for Symptom-Based Differential Diagnosis in Diabetes	Renann G Baldovino, Iram Rigs T Carpeso, Juliana Joie G Gianan, Elaine Mae G Doctolero, Elyssa Kristine A Espinosa and Danielle Marie P Qunitos (De La Salle University, Philippines)	Iram Rigs T Carpeso

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IB-17	1571042877	Development of an Integrated Off-Grid Audio and Haptic Wearable Vest for Visually Impaired Navigation	Carlamae Nicole D Ventura (Saint Mary's University, Philippines); Renann G Baldovino (De La Salle University, Philippines); Angelino A Pimentel (Southern Taiwan University of Science and Technology & Saint Mary's University, Taiwan); Aaron Raymond A. See (Southern Taiwan University of Science and Technology, Taiwan)	Carlamae Nicole D Ventura
IB-19	1571043282	Physics Informed Neural Network for Fitting Ultra High Field Magnetic Resonance Spectrum	Landoline Bonnin and Pascal Bourdon (University of Poitiers, France); Carole Guillevin, Rémy Guillevin and Clement Giraud (CHRU Poitiers, France); Christine Fernandez-Maloigne (University of Poitiers & I3M Laboratory, France)	Landoline Bonnin
IB-20	1571043307	Optimized Obstacle Detection for the Visually Impaired Using a Machine Learning-Based Modified Map Function for Ultrasonic Sensors	Renann G Baldovino (De La Salle University, Philippines); Angelino A Pimentel (Southern Taiwan University of Science and Technology & Saint Mary's University, Taiwan); Aaron Raymond A. See (Southern Taiwan University of Science and Technology, Taiwan)	Angelino A Pimentel
IB-21	1571044300	Hyperparameter Selection for a Breast Cancer Classification Using Machine Learning	Shofwatul Uyun (UIN Sunan Kalijaga Yogyakarta, Indonesia); Annida Rizki Luthfi Astuti and Ade Umar Ramadhan (Universitas Islam Negeri Sunan Kalijaga Yogyakarta, Indonesia); Lina Choridah (Universitas Gadjah Mada, Indonesia)	Annida Rizki Luthfi Astuti

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IB-22	1571044489	Leveraging Bidirectional Long Short-Term Memory with Bayesian Optimization for Accurate Eye Movement Classification	Muhammad Oka Bagus Wibowo, Adhistya Erna Permanasari, Syukron Abu Ishaq Alfarozi and Sunu Wibirama (Universitas Gadjah Mada, Indonesia)	Sunu Wibirama
IB-23	1571044502	A Systematic Literature Review of Artificial Intelligence on Medical Imaging: COVID-19 and Lung Cancer Classification	Sunu Wibirama, Ignatius Gilbert Wicaksana, Irfan Maulana Marantika and Willybrodus Andhika Budikusuma (Universitas Gadjah Mada, Indonesia)	Ignatius Gilbert Wicaksana
IB-24	1571044524	A Fusion of Transfer Learning Features on Breast Cancer Classification	Shofwatul Uyun (UIN Sunan Kalijaga Yogyakarta, Indonesia); Muh Nur Aslam (Universitas Islam Negeri Sunan Kalijaga, Indonesia); Lina Choridah (Universitas Gadjah Mada, Indonesia)	Muh Nur Aslam
IB-25	1571044580	3D Reconstruction Techniques for Visualization of the Internal Carotid Artery in the Brain Vascular System	Muhammad Ibadurrahman Arrasyid Supriyanto (Institut Teknologi Sepuluh November & Universitas Mulawarman, Indonesia); Riyanarto Sarno (Institut Teknologi Sepuluh Nopember, Indonesia); Nur Setiawan Suroto (Universitas Airlangga, Indonesia)	Muhammad Ibadurrahman Arrasyid Supriyanto
IB-26	1571044795	Deep Learning on Automatic ICD Coding for Clinical Decision Support Systems: Review	Azzamuddien Hanifa (Universitas Gadjah Mada, Afghanistan); Adhistya Erna Permanasari and Indriana Hidayah (Universitas Gadjah Mada, Indonesia)	Azzamuddien Hanifa

Paper Code	Paper ID	Title	Author(s)	Presenter
IB-27	1571044861	SurgiColab: Collaborative Mixed Reality for Enhanced Pre-Surgical Planning with 3D Anatomical Models	Saurav Prabhakaran (Center for Wireless Networks & Applications (WNA) Amrita Vishwa Vidyapeetham Amritapuri India); Uma G (Amrita Vishwa Vidyapeetam, India); Mahesh Kappanayil (Amrita Institute of Medical Sciences and Research Centre, India)	Uma G
IB-29	1571045007	Skin Cancer Segmentation and Feature Extraction of Dermatoscopy Images Based on Deep Learning U-Net	Amanda Sharon Purwanti Junior (Sepuluh Nopember Institute of Technology, Indonesia); Mohammad Nuh (Institut Tegnologi Sepuluh November, Indonesia); Nada Fitrieyatul Hikmah (Institut Teknologi Sepuluh Nopember, Indonesia)	Amanda Sharon Purwanti Junior
IB-30	1571045008	Improving Conjunctiva Segmentation for Robust Anemia Detection Using Raspberry Pi's Camera and Macro Lens	Meitha Auliana Dwi Winarsih (Sepuluh Nopember Institute of Technology, Indonesia); Mohammad Nuh (Institut Tegnologi Sepuluh November, Indonesia); Nada Fitrieyatul Hikmah (Institut Teknologi Sepuluh Nopember, Indonesia)	Meitha Auliana Dwi Winarsih
IB-31	1571047242	Design of A Biopotential Amplifier for ECG	Prapto Nugroho and Azami Muhammad Farraz (Universitas Gadjah Mada, Indonesia); Sigit Basuki Wibowo (Gadjah Mada University, Indonesia)	Prapto Nugroho
IB-33	1571055814	Analysis of Deep Learning Models for Disease Diagnosis in Laryngoscopic NBI Images	Pratham Tejas Shah, Kanika Prasad Chitnis, Arjun Brajesh Pareek, Alfin Ashpak Patel and Narendra Shekokar (Mumbai University, India)	Kanika Prasad Chitnis

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IB-34	1571057016	Optimizing Image Quality and Diagnostic Accuracy in Impedance Tomography with Gastric Phantom Model	Ridwan Wicaksono (Universitas Gadjah Mada, Thailand); Prima Nafisman, Muhammad Fathur R., Habib Fabian Fahlesi, Dheandy Keriswasiat and Chenaniah Chenaniah (Universitas Gadjah Mada, Indonesia)	Prima Nafisman, Muhammad Fathur R., Habib Fabian Fahlesi, Dheandy Keriswasiat, and Chenaniah
IB-35	1571057074	Application of Asymmetric Windowing Recurrence Plots in ECG Signal Encoding for Emotion Classification	Noan Yaseka Pradanya and Noor Akhmad Setiawan (Universitas Gadjah Mada, Indonesia); Sri Kusrohmaniah (Gadjah Mada University, Indonesia)	Noan Yaseka Pradanya
IB-36	1571057163	A Novel Feature Representation Method for Automating Genetic Variant Classification	Chandra Prasetyo Utomo and Nashuha Insani (Universitas YARSI, Indonesia); Puspa Pratiwi (Indonesian International Institute of Life Science, Indonesia); Muhamad Fathurahman and Ahmad Rusdan Utomo (Universitas YARSI, Indonesia); Achmad Dimas Cahyaning Furqon, Aldo Al Deanov and Sarah Adinda Puteri (PT Biogenome Total Solusi, Indonesia); Tyas Ikhsan Hikmawan (Universitas Gadjah Mada, Indonesia)	Chandra Prasetyo Utomo
IB-37	1571057207	Relating Muscle Activity and Mouse Sensitivity in FPS Game Players Using Surface EMG Signals	Vaibhav Prajapati (Indian Institute of Information Technology, Sri City, India); Anish Turlapaty (Indian Institute of Information Technology, India); Himangshu Sarma and Mrinmoy Ghorai (Indian Institute of Information Technology Sri City, India)	Vaibhav Prajapati
IB-38	1571058165	Enhanced Computer Vision Techniques for Differentiating Tremor Types	Chandra Reddy Gadhe (SRM University-AP, India)	Chandra Reddy Gadhe

Paper Code	Paper ID	Title	Author(s)	Presenter
IB-39	1571058987	Impact of Gender and Information Layout on User Experience and Gaze Patterns in a Fitness and Diet App Interface	Attar Husna Fathiya (Universitas Gadjah Mada, Indonesia); Ahmad Nasikun (UGM, Indonesia); Sunu Wibirama (Universitas Gadjah Mada, Indonesia)	Attar Husna Fathiya
IB-40	1571060944	Precision Boundary Detection for EIT Foot Swelling Imaging Using Rotational ToF Sensors	Ridwan Wicaksono (Universitas Gadjah Mada, Indonesia); Alfian Daffa Baihaqi and Adha Imam Cahyadi (Universitas Gadjah Mada, Indonesia)	Ridwan Wicaksono; Alfian Daffa Baihaqi
IB-41	1571064592	Ensemble-Stacking Machine Learning Model for Multi-Class Skin Diseases Identification	Dennis Tandelon, David Lawrence Christiono and Nur Afny Catur Andryani (Bina Nusantara University, Indonesia); Srie Prihianti Gondokaryono (Indonesian Society of Dermatology & Venereology, Indonesia)	David Lawrence Christiono; Dennis Tandelon

EI.A

E-A1 A Cost-Effective Edge Computing Gateway for Smart Buildings

E-A2 Leveraging Internet of Things Network Metadata for Cost-Effective Automatic Smart Building Visualization

E-A3 Scheduling Electric Currents in Converter-Dominated Power Grids with Time-Slotted Energy Packets

E-A4 Symbiosis: A Web-Based Decision Support Tool for Achieving Symbiosis in Industrial Parks

E-A5 Process-to-Market: A Web-based Evaluation Tool for Electricity Market Participation

E-A6 IoT Based Smart Air Ventilation and Energy Management System

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E-B1 Dynamic Phenotype Mapping in Evolutionary Algorithms for Energy Hub Scheduling

E-B2 Analytical solution for the cost optimal Electric Energy Storage size based on the Effective Energy Shift (EfES) algorithm

E-B3 Impact and Integration of Mini Photovoltaic Systems on Electric Power Distribution Grids

E-B4 Semi-supervised state classification in distribution systems with graph neural networks

E-B5 Comparison of optimal reactive power dispatch methods in IEEE 30 bus system

E-B6 Comparison of Metaheuristic Techniques for Optimal Power Flow in Nordic Pricing Areas (video presentation)

E-B7 Battery Life Prediction Using Physics-Based Modeling and Coati Optimization

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E-C2 Multi-Agent Based Simulation for Investigating Centralized Charging Strategies and their Impact on Electric Vehicle Home Charging Ecosystem

E-C3 Geospatial Semantic Enriched Digital Twin with Logical Reasoning Rules for Managing Control Loops

E-C4 Challenges in Transitioning from Co-Simulation to Practical Application: A Case Study on Economic Emission Dispatch in a Greenhouse Compartment

E-C5 Hardware-in-the-Loop-Based Validation of Distribution System Control Applications with Grid Operators, Customer & Market Participants

E-C6 Data-Driven Digital Twin for Foundry Production Process: Facilitating Best Practice Operations Investigation and Impact Analysis

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E-F5 Detection of Municipal Heat Plan Documents Using Semantic Recognition Methods

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PAPER ABSTRACTS

I. ICITEE

I.1. Communication and Network Technologies

[CNT-1]
Improving Machine Learning-Based Wi-Fi Fingerprint Technique with Feature Selection and Grid Search Methods

Olarn Wongwirat and Tanapol Nimnaul (King Mongkut's Institute of Technology Ladkrabang, Thailand)

Abstract – This paper presents the enhancement of the Wi-Fi-based fingerprint technique for an indoor positioning system applied to a real experimental area. In typical Wi-Fi-based fingerprint techniques, classification algorithms such as k-nearest neighbor (k-NN), decision tree (DT), and random forest (RF) are used for position estimation. However, these algorithms do not perform well with high-dimensional and large datasets. They also face limitations related to overfitting and uninformative features in datasets. This paper overcomes these challenges by deploying feature selection based on filter methods. This process removes uninformative features from the datasets before feeding them to construct a training model. The grid search method is also employed to perform hyperparameter tuning, which is used to construct the outperforming models. The experimental setup involved collecting received signal strength indicators (RSSIs) from access points (APs) in the real indoor environment to create the radio map. The accuracy performance of the proposed methods was tested by employing the feature selection method on the radio map dataset and using the grid search method to find optimized hyperparameters for constructing the training models based on the k-NN, DT, and RF algorithms. The accuracy results were compared with those of non-feature selection and default hyperparameters used for the three algorithms. The computational results demonstrate that the RF algorithm outperforms the other two algorithms. Furthermore, performance is improved when using grid search and feature selection as proposed.

Keywords – *Indoor positioning system; Wi-Fi-based fingerprint; Random forest algorithm; k-NN algorithm; Decision tree algortithm; Feature selection method; Grid search method*

[CNT-2]
Fairness-Driven Channel Allocation on Cognitive Radio with Moth Flame Optimization

Yusriyadi Yusriyadi and Nisa Intan Kumalasari (Universitas Gadjah Mada, Indonesia); Azkario Rizky Pratama (UGM, Indonesia); I Wayan Mustika (Universitas Gadjah Mada, Indonesia)

Abstract – The Cognitive Radio Networks (CRNs) are capable of sensing their operational environment and encountering a situation known as spectrum scarcity. An adaptive scheme is therefore required for CRNs to minimize user interference and improve the throughput performance. In this research, we proposed a modified Moth Flame Optimization for optimal channel allocation to improve the network throughput while maintaining fairness in channel allocation. Simulation results demonstrated that the proposed algorithm could improve network throughput and provide fair channel allocation. The performance improvement showed a 44.41% increase in mean throughput to a value of 200.65 bps/Hz compared to 138.94 bps/Hz that was achieved with a random allocation scheme..

Keywords – *Cognitive Radio; Optimization; MFO; Resource Allocation; Fairness; Jain Fairness Index*

[CNT-3]
Designing an XGS-PON Network to Support Large-Scale Radio Astronomy at the Timau National Observatory

Riyani Jana Yanti and Nurul Fadilah (Universitas Indonesia, Indonesia); Yus Natali (Universitas Telkom, Indonesia); Catur Apriono (Universitas Indonesia, Indonesia)

Abstract – The Timau National Observatory has been established as an alternative solution to the now less-than-ideal conditions at the Boscha Observatory. In addition to optical telescopes, the National Observatory will also feature a radio telescope that requires infrastructure that enables fast and secure data transmission free from radio signal interference. This research proposes a fiber optic network design using XGS-PON technology with speeds up to 10 Gbps to facilitate data transfer to BPON as the operational control office. From the design and simulation results, the performance analysis parameters for the link power budget met the threshold of -28 dB, the value of the rise time budget was below 0.07 ns, the factor Q was above 6, and the BER threshold of 10^{-9} was achieved with a transmitter power of 11 dBm (class E2), due to the long distance and uneven terrain that require a high transmitter power. The system design analysis revealed that the link power budget, the rise time budget, the Q factor, and the BER parameters all meet the standards set by ITU-T G-9807.1.

Keywords – *XGS-PON; Fiber Optics; Observatory; Radio Telescope*

[CNT-5]
A Secure Vehicular Communication Protocol Using Synchronization of Chen Chaotic System

Nur Afiqah Suzelan Amir (University of Malaya, Malaysia); Fatin Nabila Abd Latiff (University of Taylor, Malaysia); Wong Kok Bin (University of Malaya, Malaysia)

Abstract – In vehicular communication, the announcement protocol is crucial for disseminating safety messages to enhance traffic safety and efficiency. Balancing message reliability with vehicle privacy is challenging. Our protocol, using the Chen chaotic dynamical system, addresses this by achieving reliability, privacy, and accountability. It enables vehicles to broadcast messages without revealing identities, ensuring privacy. Misbehaving vehicles can be identified and isolated, maintaining public safety and accountability. Our research provides comprehensive analysis and simulations, demonstrating the improved performance and feasibility of this approach. The Chen chaotic system offers a promising solution to the challenges of reliability, privacy, and accountability in vehicular communication.

Keywords – *Vehicular Communication; Announcement; Chen Chaotic System; Reliability; Privacy; Accountability*

[CNT-6]
The Future of Submarine Cable: Research Topics and Emerging Technologies

Lesti Setianingrum (Universitas Indonesia & National Research and Innovation Agency, Indonesia); Muhammad Suryanegara (Universitas Indonesia, Indonesia); Nur Hayati (Universitas Muhammadiyah Yogyakarta, Indonesia)

Abstract – Submarine cables are crucial for global communication and energy infrastructure, underpinning international connectivity and the shift towards sustainable energy systems. They facilitate high-speed internet access, communication, and energy transmission-key drivers of economic growth, innovation, and infrastructure development. This study aims to identify key research topics and emerging technologies in the field of submarine cables by employing bibliometric methods, including co-occurrence network and trend analysis of keywords from 576 scientific articles published between 2018 and 2023. The analysis reveals five primary research topics: 1) optical communication; 2) cable structure and characteristics; 3) power cables, offshore systems, and wind farms; 4) marine environment; and 5) marine technology. The study also highlights several emerging technologies with potential for further development in submarine cable networks, including: 1) Space Division Multiplexing (SDM); 2) Multi-Core Fiber (MCF); 3) Multi-Mode Fiber; 4) High Voltage Direct Current (HVDC); 5) Cable monitoring and protection; and 6) Science Monitoring and Reliable Telecommunication (SMART) Cables. These findings offer insights into future research directions and technological advancements in submarine cable systems.

Keywords – *Submarine Cable; Space Division Multiplexing; Multi Core Fiber; SMART Cable; Emerging Technology*

[CNT-7]
Delay-Aware Task Offloading and Bandwidth Allocation Using Particle Swarm Optimization in Mobile Edge Computing

Dedi Triyanto and I Wayan Mustika (Universitas Gadjah Mada, Indonesia); Widy Widyawan (Gadjah Mada University, Indonesia)

Abstract – Mobile Edge Computing (MEC) is a viable solution for applications that require minimal delay and have high computational demands on mobile devices (MD). This study used the Particle Swarm Optimization (PSO) method to find the best offloading ratio, bandwidth allocation, and transmission power to cut down on the overall execution delay in MEC system. We here chose the PSO considering its rapid and effective ability to identify solutions that are close to the optimal solution. In different situations, the simulation results showed that fitness values and overall execution delay decreased significantly. This showed that PSO could keep performing consistently and efficiently in different settings. The findings indicated that PSO is an effective optimization strategy for computational offloading in MEC systems, enhancing performance by minimizing delay.

Keywords – *Mobile Edge Computing; task offloading; bandwidth allocation; particle swarm optimization; task backlog*

[CNT-8]
Comparison of Ship Tracking Algorithms on Dual Overlapping High Frequency Surface Wave Radars

Iswandi Iswandi and Sigit Basuki Wibowo (Gadjah Mada University, Indonesia); Risanuri Hidayat (Gadjah Mada University (UGM), Indonesia)

Abstract – High-frequency surface wave radar (HFSWR) is a reliable ship surveillance device that can cover a vast area. The weakness of this radar is its low spatial and time resolution, which causes low tracking performance for ships with high maneuverability. This study tested the ship tracking algorithm on various types of ship maneuvers. The effort to improve tracking performance is carried out by detecting the ship using two radars working together. The tracking accuracy is increased compared to tracking with a single radar. The results show that the tracking errors with dual radars decreased by 65.3% on linear ship motion and 45.9% on maneuvering ships compared to monitoring with a single radar. The results conclude that integrating dual radar can significantly improve the tracking process.

Keywords – *HF radar; HFSWR; ship tracking; tracking algorithm; high maneuver ship; dual radar*

I.2. Control Systems

[CS-1]
Rollover Prevention for Quadruped Tracked Mobile Robot by Legs Dynamics Control

Toyomi Fujita (Tohoku Institute of Technology, Japan)

Abstract – A tracked mobile robot with legs has an ability for prevention rollover in the move on uneven terrain by controlling its legs. A quadruped tracked mobile robot developed in this study can quickly control the legs mounted on the four corners of the body so that they posture properly according to its tipping situation. This paper presents a method for the prevention of rollover by the quadruped tracked robot. An angular acceleration with the angle of the robot is measured using an inertial measurement device which is mounted on the robot. Corresponding to the information, the robot can give necessary torques for the legs to prevent rollover. A model for the computation of the leg torques is presented based on dynamics. The computational results of the torques showed that the robot is able to prevent rollover in a situation in which the robot moving forward and running over a protruding object. Some experiments were conducted by the leg control for rollover prevention based on the result when the robot normally run without the leg control. The result showed the robot was able to prevent rollover effectively.

Keywords – *quadruped tracked mobile robot; rollover prevention; leg control; dynamics*

[CS-2]
Equation Discovery of KUKA 6-DoF Industrial Robotic Manipulator Dynamics with Backlash Using Lasso Model Selection Criteria

Swadexi Istiqphara (Institut Teknologi Sumatera, Indonesia); Oyas Wahyunggoro (UGM, Indonesia); Adha Imam Cahyadi (Universitas Gadjah Mada, Indonesia)

Abstract – The dynamics equations of robot manipulators are crucial for control system design and system analysis. Manipulator robots driven by electric motors with gearboxes often experience backlash and friction during movement, leading to inaccuracies in dynamic modeling. This study proposes functions to model backlash and friction forces to enhance the accuracy of 6-DoF robot manipulator dynamics modeling. Additionally, the nonlinear dynamic equations of the manipulator robot were derived using the LASSO model selection criteria using the Variable Segregation Algorithm (LMSCVS) method. The results demonstrate that the LMSCVS method can produce dynamic equations of robot manipulators with an improved accuracy of up to 95\% when using the proposed library functions to model backlash and friction.

Keywords – *backlash modeling; dynamic equations; equation discovery; friction modeling; LASSO model selection; robot manipulator dynamics*

[CS-3]
Multiple Model Approach of A Soft Robotic Arm

Agustinus Algusta Indrayanto, Ahmad Ataka and Adha Imam Cahyadi (Universitas Gadjah Mada, Indonesia); Vani Virdyawan (Institut Teknologi Bandung, Indonesia); Varell Ferrandy (Imperial College London, United Kingdom (Great Britain)); Yusuf Kurnia Badriawan (Gadjah Mada University, Indonesia)

Abstract – Soft robotics is the next generation of robotics systems that complements rigid robots using concepts inspired by natural organisms. Despite possessing extraordinary flexibility, agility, and endurance, making them safe to interact with humans, modelling and controlling soft robots still prove to be a major challenge. On the one hand, data-driven model requires a huge amount of training data while accurate physics-based model suffers from computational complexity. In this paper, we present a multiple model approach to soft robotics. Here, the model is two-fold: a pressure-to-bending equation which models steady-state characteristics and several linear models to capture transient characteristics. This can be used as an alternatives to non-linear model of planar arm-shaped soft robots. We found that 2nd order exponential function achieve a good performance in modelling the staedy-state bending angle while a 2nd order linear model achieve a good accuracy in predicting the transient response.

Keywords – *soft robotics; soft robot modelling; robot modelling*

[CS-4]
Soft-Growing Robot Navigation in Unknown Environment via Deep Reinforcement Learning

Muhammad Faqih, Ahmad Ataka and Adha Imam Cahyadi (Universitas Gadjah Mada, Indonesia); Yusuf Kurnia Badriawan (Gadjah Mada University, Indonesia)

Abstract – Soft-growing robots are an emerging field in robotics, offering significant potential for various applications. One critical aspect of their functionality is effective obstacle avoidance, especially in applications where the robots must navigate through narrow and intricate spaces. However, controlling these robots presents substantial challenges, primarily due to the increasing degrees of freedom (DOF) associated with the growing number of segments, which complicates control strategies. Traditional control methods often fall short, as they struggle to manage numerous segments and require internal sensor integration, adding further complexity. This research proposed a navigation strategy for a soft-growing robot using deep reinforcement learning in unknown 2D environment consisting of simple obstacles. By employing two navigation strategies-reward shaping and distance sensors-the robot successfully avoided obstacles in 100 trials. The results demonstrate that the robot reached its target with an average error of 0.36 ± 0.22 meters using distance sensors and 0.37 ± 0.27 meters with reward shaping.

Keywords – *Soft-growing Robot; Navigation; Reinforcement Learning; Obstacle Avoidance; Reward Shaping*

[CS-5]
Speed Control of Coconut Grater Machine Using PID Based ANFIS Controller

Satria Muhammad Azis (Gadjah Mada University, Indonesia); Oyas Wahyunggoro (UGM, Indonesia); Adha Imam Cahyadi (Universitas Gadjah Mada, Indonesia)

Abstract – This research presents a single-phase induction motor model with a capacitor run and a combination method for the PID controller-based ANFIS under load conditions. This research aims to minimize transient response parameters such as settling time, overshoot and rise time and also to determine the control system's performance under load conditions. This research presents a performance from a PID Ziegler-Nichols and PID based ANFIS controller under two conditions: when there is no load and loaded. The scenarios performed were compared and analyzed with each other to validate the performance advantage of the best controller. The results obtained from the controller combination simulation show the best performance of the PID based ANFIS controller in no-load and load conditions. The proposed controller has a very small overshoot value of 0.0636 %. Overall, the simulation results show that the proposed method has a good response, minimizes transient response, and resistant to external disturbances. The presented method can outperform traditional control and single-control methods.

Keywords – *Single-phase induction motor; Speed control; PID; Adaptive Neuro Fuzzy*

I.3. Electronics, Circuits, and Systems

[ECS-1]
Development of Network Analyzer Sharing System with Multi-User Access

Sungtae Hwang, JangHoon Jeong and Jongsik Lim (Soonchunhyang University, Korea (South)); Jaebok Lee (ERANGTEK Co., Ltd, Korea (South)); Dal Ahn and Seong-Ho Son (Soonchunhyang University, Korea (South))

Abstract – We presented a network analyzer sharing system that allows multiple user to access a single vector network analyzer. The system consists of hardware that is switching module to extend two-port VNA into multiple ports and software that distributes measurement signals eight port. The hardware uses SP4T switches to simplify the system. The software uses an automatic channel switching time setting algorithm to prevent signal distortion or abnormal signals. To validate this system, we conducted an experiment measuring a device under test. Experimental results validate the measurement performance of the sharing system.

Keywords – *vector network analyzer; multiple user access; switching module*

[ECS-2]
RF Waveguide Filter Turning Method Using Simulated Annealing Optimization Technique

Dongwon Kwon, Hee-Jong Gil and Seong-Ho Son (Soonchunhyang University, Korea (South))

Abstract – This study investigates the simulated annealing optimization algorithm for tuning a 5th order elliptic RF waveguide filter in wireless communication systems. The filter operates in the fre-quency range of 0.4 to 1.6 GHz with a center frequency of 1 GHz and a bandwidth of 200 MHz. It is designed as a band-pass filter with transmission zeros, intended to selectively pass desired frequencies while attenuating unwanted signals. The optimization process effectively transitions the filter from an untuned to a tuned condition, meeting stringent performance requirements. Through adjustments to the filter's S-parameter, signal integrity is enhanced, with effective passage of desired frequencies and attenuation of unwanted signals. The findings validate the efficacy of simulated annealing optimization in addressing complex and nonlinear systems, underscoring its potential for enhancing RF filter performance and reliability in practical applications. This research emphasizes the value of advanced optimization techniques in meeting specific tuning requirements and supporting the evolving demands of wireless communication technologies.

Keywords – *RF waveguide filter; simulated annealing optimization; transmission zeros with bandpass filter*

[ECS-3]
Microwave Imaging Method for Object Localization Without Background Measurements

JangHoon Jeong, Jang-Moon Jo and Seong-Ho Son (Soonchunhyang University, Korea (South))

Abstract – Background measurement dataset is essential for multistatic microwave imaging. Here the background data is the incident field measured in an environment without a target object. However, measuring the incident field in the real-world is challenging. To address this problem, we present a simple statistical method to estimate averaged scattered field from measured total fields. The method assumes that the bias in the total field averages out, making the averaged scattered field a close approximation of the incident scattered field. Experimental validation using a uniform circular array of antennas and a small object in water demonstrated that the proposed method can accurately estimate the incident field. Imaging results using bifocusing method with the estimated scattered field showed high similarity to those using actual incident field, confirming the effectiveness of the proposed method. The results indicate that accurate microwave imaging for small object localization is achievable even without precise background information, by using averaged total scattered fields.

Keywords – *Microwave imaging; volume integral equation; object locaization; bifocusing method*

[ECS-4]
Null-Power Point Analysis of Wireless Power Transfer Coupler and Improvement Method

Nahyun Hyeong (Soonchunhyang University, Korea (South)); Sang-Min Han (Soonchunhyang, Korea (South)); SangWook Park (Soonchunhyang University, Korea (South))

Abstract – This study analyzes the causes of null-power point phenomena in wireless power transmission systems and discusses methods for designing and overcoming them. The occurrence of null-power points is influenced by the coupling level between couplers and can be designed based on the shape of the couplers. To overcome null-power points, a stacked CPT coupler with a 90% front plate area ratio is proposed, which can be effectively utilized in the implementation of multiple input single output (MISO) CPT systems.

Keywords – *Wireless Power Transfer; Null-Power Point; Stacked CPT Coupler; Multiple Input Single Output; Misalignment*

[ECS-5]
Design of High Speed Multipliers Using Counter Based 4:2 Compressor with Pre Processing

Pavitra YJ and Mahanta Talakal (PES University, India)

Abstract – Adders and multipliers form the basic building blocks in most of the system designs. Multipliers are widely used in arithmetic and logic units, digital signal processing, audio processing and image processing applications. Multipliers have complex structures and optimization of multiplier designs plays a vital role in improving the performance parameters like area, power and delay. The proposed work aims to design compressor-based multipliers with counter logic for power and delay efficient models. A novel 4:2 counter-based compressor with pre-processing is proposed for the design of multipliers to improve the performance parameters. The proposed designs are synthesized on Cadence Genus with 90nm technology. Experiments carried out reveal that the proposed multipliers save a maximum of 21.71% of area, 75.63% of power and improve speed by 24.28% over multipliers reported in literature.

Keywords – *Compressors; Multipliers; Optimization; Performance*

[ECS-6]
Complementary Reflectance and Carbon Dots Fluorescence Imaging Using Endoscopic Scanner

Yang Sing Leong (Universiti Kebangsaan Malaysia, Malaysia); Mohd Hafiz Abu Bakar (Universiti Tenaga Nasional, Malaysia); Mohd Hadri Hafiz Mokhtar and Norhana Arsad (Universiti Kebangsaan Malaysia, Malaysia); Mohd Saiful Dzulkefly Zan (UKM, Malaysia); Ahmad Ashrif A. Bakar (Universiti Kebangsaan Malaysia, Malaysia)

Abstract – Endoscopic imaging plays a crucial role in biomedical research, offering insights into biological structures and chemical processes. In this study, we present a fibre pair cantilever-based endoscopic scanner capable of employing confocal reflectance and carbon dots-based fluorescence imaging. Fluorescent microspheres were used to verify the fluorescence detection capability of the proposed scanner. Subsequently, a carbon dots-labelled sample was imaged and analysed. The results show that the confocal reflectance images capture the surface profile of the sample while the fluorescence images detect the emitted fluorescence signals. The findings show the complementary strength between confocal reflectance and carbon-dots based fluorescence modalities for precise localisation of fluorescence signals within the sample. The proposed endoscopic scanner shows the potential of multimodal endoscopic imaging for advancing biomedical research.

Keywords – *Endoscopic scanner; Multimodal imaging; Lissajous scan; Optoelectronic*

[ECS-7]
Phase-Transition Investigation of Whipped Cream Agitation by Electrical Capacitance Measurement Assessed by Physical-Rheological Characteristics

Ryuichi Fukumoto (Chiba University, Japan); Prima Asmara Sejati (Chiba University & Universitas Gadjah Mada, Japan); Masahiro Takei (Chiba University, Japan)

Abstract – Phase-transition of whipped cream agitation has been investigated by electrical capacitance measurement assessed by physical-rheological characteristics. To assess the capacitance trend by physical-rheological characteristics, an overrun ($\boldsymbol{OR}$) and rheology measurement was conducted. In rheology measurement, storage modules $\boldsymbol{G'}$, loss modules $\boldsymbol{G''}$ and rheological phase-delay $\boldsymbol{\delta}$ was measured. In the experiment, commercial whipping cream with 40% vegetable fat content was agitated under the constant rotation of 1000 rpm. In this case, the whipping cream is measured by capacitance meter which applies 2 frequencies of 1 kHz and 1 MHz with a constant voltage of 1 V. As a result, the measured capacitance $\boldsymbol{C\mathrm{Avg}}$ decreased in liquidous phase and was stable in solidus phase. This capacitance changes $\boldsymbol{C\mathrm{Avg}}$ have strong correlation relationship with $\boldsymbol{\tan\delta}$ and correlation coefficient $\boldsymbol{rc}$ was higher than 0.9 in 1 kHz and 1 MHz. On the other hand, the relationship between capacitance changes $\boldsymbol{C\mathrm{Avg}}$ and overrun $\boldsymbol{OR}$ was inverse correlation in liquidous phase.

Keywords – *Electrical capacitance; Rheology; Whipping cream; Phase-transition*

[ECS-8]
Simulation of PCM/FM Telemetry Data Encoder Based on IRIG-106 Standard in Matlab Simulink

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Abstract – The telemetry data encoder, a component of the PCM/FM transmitter system in the rocket telemetry (TM), adheres to the IRIG-106 standard. It's used to gather data from sensors that monitor various rocket flight parameters, such as inertia, combustion pressure, temperature, etc. These encoders are typically developed and manufactured by defense-oriented industries, and due to their specialized applications, information about their development is rarely published. This paper elucidates the operational principles of the rocket TM system, with a specific focus on the TM data encoder module. The TM data encoder is designed and simulated using Matlab Simulink, and it's capable of acquiring two types of input: analog sources and digital sources. The simulation uses a dataset of analog sensor acquisition results from previous tests to accurately represent the measured parameters, while actual hardware such as INS modules and cameras are used for digital sources. The performance of the simulation is evaluated by comparing the output signal of the TM data encoder simulation with the output of the Zodiac CMA, a device that complies with the IRIG-106 standard. The simulation results reveal that the output signal closely mirrors that of the actual TM data encoder Zodiac CMA. The sampling time for one TM data encoder parameter is designed to be 7.8125 μs, resulting in a bit rate of 1.024 Mbps. The latency that occurs during the process is 8.4355 μs.

Keywords – *Telemetry; IRIG-106; PCM/FM Transmitter; TM data encoder; Matlab simulink*

[ECS-9]
Buck Converter Parameters Design Using Artificial Intelligence-Based Genetic Algorithm

Krishna Laksheta (University of Gadjah Mada, Indonesia); Yohan Fajar Sidik and Fransisco Danang Wijaya (Universitas Gadjah Mada, Indonesia)

Abstract – The design of circuit parameters is critical to optimize the performance and efficiency of power converters. This research focuses on designing synchronous buck converters using an AI-based approach that combines machine learning models and genetic algorithms. The genetic algorithm run on the machine learning model operates within error bounds for voltage ripple (≤ 1%), current ripple (≤ 10%), and total component volume (≤ 7cm^3). It uses these criteria to evaluate fitness values. The results show that the AI-based design achieves higher efficiency (99.383%), lower voltage ripple (0.168%), and lower current ripple (9.757%) compared to the conventional design (99.354%, 1.1543%, and 11.661%). In addition, the AI-based method is more compact (5.732 cm^3 vs. 7.716 cm3). Thus, AI is proven to be more effective in improving power converters' efficiency and performance than conventional methods.

Keywords – *buck converter; efficiency; machine learning; parameter optimization; power loss*

I.4. Information Technology

[IT-1]
PyraMaze VR: An Immersive Gameplay for Ancient Egypt Learning

Intanon Tangtung, Luksamee Lunsiay and Sirion Vittayakorn (King Mongkut's Institute of Technology Ladkrabang, Thailand)

Abstract – PyrMaze VR is an virtual reality game which immerses players into the depths of an ancient pyramid, offering an innovative tool for educating about the future of ancient Egyptian civilization. Within the pyramid's confines, players must decipher numerous puzzles related to ancient Egypt, ultimately navigating their way back to the modern world. Throughout gameplay, players are tasked with gathering information about ancient Egyptian civilization by solving puzzles scattered across the map. Experimental results showcase that PyraMaze VR serves as not only an effective learning tool, enhancing players' understanding by approximately 30%, but also attains satisfaction scores of 3.72 ± 0.31 out of 5. This achievement surpasses traditional learning methods by around 9.59% and alternative games by 6%.

Keywords – *Game-based learning; Educational game; Interactive learning; Virtual reality*

[IT-2]
Effective Product Recommender System Using Hybrid FastTex, Attention and Probabilistic Matrix Factorization

Muh Hanafi (Universitas Amikom Yogyakarta, Indonesia & Time Excellindo, Malaysia)

Abstract – Recommender system (RS) is a machine learning model to support consumer in online shopping. RS responsible to show essential product/item to customer. A variant of RS that adopted in many e-commerce businesses called Collaborative Filtering (CF). CS calculated connection between user and item using previous activity of user. RS framework that leverages past customer action, such as ratings, to provide recommendations. Unfortunately, we have collected a relatively small number of customer ratings that are below 4%. An implicit factor model is a type of matrix factorization-based CF that generates rating predictions. However, depending exclusively on matrix factorization would result in a recommendation that lacks accuracy. Product review records are utilized in various models to enhance the accuracy of rating predictions. Most individuals utilized the TF-IDF method, which is an LDA methodology, to analyze texts pertaining to product reviews. However, the standard models such as TF-IDF and LDA had limitations in terms of their ability to accurately understand the content of the document. This work employed probabilistic matrix factorization (PMF) to generate rating predictions by incorporating word sequential contextual representation through the use of LSTM (Long Short-Term Memory) and Attention. The contextual portrayal utilized Fasttext to convert word vector representation, each in their own way. The average values for Hybridization PMF, Attention, and Fasttext were 0.880691. Furthermore, our Hybridization PMF, Attention, and Fasttext achieved an average score of 0.7246844. Our model demonstrated a superior performance by achieving a gain of over 2% compared to the earlier studies.

Keywords – *recommender system; e-commerce; fasttext; attention; pmf*

[IT-3]
Measurement Module for Supporting Arrange Difficulty Coding Questions on KruCode Platform

Peerasak Pianprasit and Nuttaporn Phakdee (Burapha University, Thailand)

Abstract – This paper aims to present a measurement module that is an ongoing development for the KruCode platform, which is a platform for teaching and learning programming-related subjects. Currently, the platform includes functions such as defining problems, assigning students assignments, and assessing source code and reports. The objective of this platform was to make teaching and learning more accessible for teachers and students. The measurement module will measure the complexity of the student source code for each problem. We use cyclomatic metrics and object oriented design metrics (C-K metrics) to measure student source codes. The question complexity reports support the instructor in deciding the coding questions, considering the difficulty level of coding questions well suited to students, and building the learning outcome of that course. This information may be utilized to establish assignments, adjust activities to be relevant skills for the class's learners, and assess the level of skills of students.

Keywords – *measurement; cyclomatic metrics; object oriented design metrics; difficulty coding question*

[IT-4]
Verbalization Categories During Information Evaluation

Umi Proboyekti (Gadjah Mada University & Duta Wacana Christian University, Indonesia); Paulus Insap Santosa and Ridi Ferdiana (Universitas Gadjah Mada, Indonesia)

Abstract – Observing the verbalization of the think-aloud protocol results as part of the investigation stage into the factors that play a role in the information evaluation process produced several findings. The observation activities consist of transcribing the recorded process, coding the transcript, validating the code, and identifying the verbalizations without examining the factors. Three categories of usability testing verbalizations can be applied to the resulting verbalizations. The relationship between the verbalization categories and comfort with English material and the number of categories ensure that the two English-language websites from the four experimental materials are not the cause of the low number of verbalizations. 55 academic librarians supported the study as participants, so researchers discovered a new category of verbalization, namely cursory. Despite its association with minimal verbalization, this category possesses the capacity to generate verbalization that warrants consideration.

Keywords – *verbalization categories; think-aloud protocol; information evaluation*

[IT-5]
Gap Analysis for Smart Contract Standardisation

Soumya Kanti Datta (Digiotouch, Estonia)

Abstract – Although smart contracts have emerged as a key innovation for industries, siloed development and deployment of smart contracts pose numerous challenges to mass adoption and interoperability. This paper presents a comprehensive gap analysis of current standardisation efforts in smart contracts, focusing on common requirements, data formats, schema, and software templates. Through an examination of existing standards, best practices, and identified gaps, this paper proposes contributions to address these challenges. By advocating for cross-platform compatibility, scalability, and maintainability, it aims to advance the standardisation of smart contracts and foster their broader adoption in the industry.

Keywords – *Blockchain; Smart Contract; Standardisation*

[IT-7]
A Comparison of Restaurant-Based and E-Commerce Food Delivery: Customer Evaluation Based on Expectations and Satisfaction

Rahmat Yasirandi (King Mongkuts Institute of Technology Ladkrabang, Thailand & Telkom University, Indonesia); Bundit Thanasopon (King Mongkut's Institute of Technology Ladkrabang, Thailand)

Abstract – This study examines the impact of the COVID-19 pandemic on consumer preferences between restaurant-based and e-commerce food delivery services. Utilizing the E-Service Quality (E-ServQual) model, which includes dimensions such as Efficiency, Fulfillment, Reliability, Privacy, Responsiveness, Compensation, and Contact, the research assesses which delivery method satisfactions align more closely with user expectations through customer evaluations. Methods include a comparative analysis using data collected from surveys. To obtain a robust dataset, the study surveyed 200 consumers who have used both restaurant-based and e-commerce services during the pandemic. This sample size provides sufficient statistical power to discern significant differences between the two service types. Findings indicate that e-commerce platforms generally excel in efficiency, responsiveness, and compensation, whereas restaurant-based services perform better in terms of fulfillment, reliability, privacy, and contact. The results also identify key dimensions from both types of online food delivery services. This analysis provides valuable insights into specific areas where service providers can focus their improvement efforts to meet and exceed consumer expectations. The study contributes to the understanding of shifting consumer behaviors in response to global disruptions like the pandemic.

Keywords – *E-ServQual; Restaurant-based; E-Commerce; Customer Expectation; Customer Satisfaction*

[IT-8]
A Computer Assembly Training with VR Technology

Tanadon Parosin, Sittijet Vanichsan and Pornsuree Jamsri (KMITL, Thailand)

Abstract – This article discusses the creation and development of a learning platform called "RookiePC". This learning platform serves as a guide for users on how to assemble a computer, aiming to reduce errors and resource usage in the assembly process. It will present the development process of the learning platform and user evaluation after usage. The simulation learning platform of computer assembly in a virtual world, providing knowledge before they are dealing with real components. This learning platform is developed with VR technology via Oculus Quest 1 and the Unreal Engine software. RookiePC is designed as an educational simulation game to inspire learners about computer components and its assembly knowledge. This platform offers 2 modes: 1) Learning Mode, which provides basic knowledge of 11 essential components and the steps involved in assembling a computer including embedded tips and insights; and 2) Practice Mode, which allows users to experiment with assembling a computer on their own. The target audience includes individuals with or without prior experience in computer assembly. The evaluation is conducted through pre-test and post-test in 2 areas: computer components and computer assembly. The results gathered from 10 participants showed that the significant result increasing from 10 to 14.2 out of 20 and also giving useful feedback for further development.

Keywords – *Virtual Reality; 3D Model; Computer Assembly; Learning Platform; Game Development*

[IT-9]
An Empirical Study on the Correlation Between BrainHex Gamer Type and Internet Gaming Disorder

Flourensia Rahayu (Atma Jaya Yogyakarta University, Indonesia); Yohanes Priadi Wibisono and Venansius Fortunatus Arjuna (Universitas Atma Jaya Yogyakarta, Indonesia)

Abstract – Internet Gaming Disorder (IGD) has been a growing concern since it affects many people around the world and causes detrimental effects. One of the factors that may contribute to the development of IGD is personality traits. In the gaming industry, one of the prominent models to classify the personality of the gamers is BrainHex model. The BrainHex model categorizes gamers into seven types: Seeker, Survivor, Daredevil, Masterminds, Conquerors, Socializers, and Achievers. This study aims to investigate the correlation between BrainHex gamer types and the severity of game addiction. As many as 153 Indonesian gamers participated in this study. We used BrainHex questionnaire to classify the participants' gamer type and Internet Gaming Disorder Scale - Short Form (IGDS9-SF) to measure IGD. The result shows that 53.59% of participants indicated with IGD. Spearman Rank correlation analysis reveals that gender and all gamer types exhibit a significant correlation with Internet Gaming Disorder (IGD). However, only gender, Socalizer, and Achiever types demonstrate a moderate correlation with IGD, while other gamer types show a weak correlation. Identifying high-risk player types may enables the development of suitable interventions and prevention strategies.

Keywords – *Internet Gaming Disorder (IGD); BrainHex; gamer types*

[IT-11]
ThinkMeal: Ingredient Classification and Recipe Recommendation Application

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Abstract – Food is one of the four essential factors, and nowadays, Thai cuisine is highly famous domestically and internationally. The majority of Thai culinary culture involves preparing and enjoying meals within households. Therefore, it's essential to have recipes that are easily accessible and adjustable to one's taste preferences. Currently, there are applications available to assist in finding recipes. However, these applications typically limit searches to recipe or ingredient names. To address this limitation, a new application called "ThinkMeal" has been developed to recommend dishes based on available ingredients. ThinkMeal utilizes a model based on the MobileNetV2 image classification, achieving an impressive accuracy of up to 95.14% in experiments conducted with 13 types of ingredients. This enables users to conveniently find recipes that meet their preferences, either by searching recipe names and ingredient names or even by uploading images of available ingredients. This application serves as a helpful tool for individuals interested in cooking, offering convenient assistance in meal preparation.

Keywords – *Ingredient Image Classification; Thai Recipe Recommendation; Mobile Application*

[IT-12]
Aspect-Based Sentiment Analysis of PLN Customer Complaints Data Using Bert to Improve Services

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Indriana Hidayah and Syukron Abu Ishaq Alfarozi (Universitas Gadjah Mada, Indonesia)

Abstract – Customer service quality determines customer satisfaction with a product or service. PLN, as a state-owned company in the electricity sector with the largest number of customers, can rely on customer feedback to evaluate and follow up on problems that arise, thus preventing similar problems from arising in the future. This research analyzes customer complaint feedback using aspect-based sentiment analysis (ABSA). The BERT Transformer algorithm was compared with two other methods, SVM and LSTM for comparison. Experimental results on 12511 rows of data show that the results obtained by the BERT model outperform the other two methods. The results concluded that the BERT model showed a promising average F1-Score value of 0,756. The implementation of BERT in sentiment analysis based on aspects of service complaints in PLN has shown substantial capabilities. And solutions to improve PLN customer service, which is also a challenge for the development of in-depth NLP systems.

Keywords – *ABSA; Sentiment Analysis; PLN; BERT; Transformer; Customer Satisfaction*

[IT-13]
Comparison of Hidden Markov Model and KD-Tree in GPS Data-Based Map Matching Process

Alfath Nuurlathif Sulistianto (University of Gadjah Mada, Indonesia); Azkario Rizky Pratama (UGM, Indonesia); Widy Widyawan (Gadjah Mada University, Indonesia)

Abstract – Data as a source of information in decision-making can be applied across various fields, such as government policy. Naturally, government policies have a significant impact because the entire society can feel their effects. Therefore, careful planning and structured implementation are required. Data can serve as one of the parameters for accurate planning. Policies can cover a wide range of scopes, including public mobility. An example of such a policy is the emergency health facilities built in the Java and Bali regions during the COVID-19 pandemic. Various types of data can be used in designing these policies, one of which is mobile positioning data (MPD). This data is advantageous because it can be collected quickly. However, MPD requires a complex process due to noise that can affect the information produced. One method to address this noise is map matching. The author is interested in comparing the accuracy levels of map matching using the Hidden Markov Model (HMM) algorithm and the KD-Tree algorithm. In this study, both algorithms process different categories of GPS data. Additionally, there is manipulation of the GPS data used, specifically random reduction. The parameter used to compare these algorithms is the similarity score obtained from the distance values in the Dynamic Time Warping (DTW) method. The test results show that the HMM algorithm has an accuracy level of about 80% for all tested data categories, while the KD-Tree algorithm has an accuracy level of about 55% for all tested data categories. It can be concluded that the HMM algorithm is superior in performing map matching for all data categories compared to the KD-Tree algorithm. Furthermore, it was found that a random reductionof GPS data can affect the resulting accuracy levels.

Keywords – *GPS Data; Map Matching; Hidden Markov Model; KD-Tree; Dynamic Time Warping*

[IT-14]
Comparison of TDoA Algorithm Dimension and Modified Kalman Filter for Ultra-Wide Band Indoor Positioning System

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Abstract – The Ultra-wideband indoor positioning system (UWB IPS) is a position tracking system that utilizes UWB transceivers. This research explores one of the commonly used techniques in UWB IPS, known as time difference of arrival (TDoA), and addresses two key issues related to TDoA-based UWB IPS: the selection of the TDoA algorithm dimension and filter design, specifically the Kalman filter (KF). This paper presents two distinct experiments to investigate these aspects.

The first experiment compares two TDoA algorithms-the Chan algorithm and the Newton-Raphson algorithm-across both two-dimensional and three-dimensional settings. The second experiment evaluates the performance of a modified Kalman filter (KF) for TDoA-based UWB IPS, comparing it with the conventional, unmodified KF. The results from the first experiment indicate that the three-dimensional TDoA algorithm is better suited for indoor applications where tags and anchors are not always at the same level. Conversely, the two-dimensional algorithm performs better when the tag is level with the anchors. In the second experiment, the result shows that the modified KF outperforms the conventional KF, exhibiting adaptive behavior, reduced overshoot during sudden changes in movement, and improved convergence to the reference.

Keywords – *ultra-wide band; indoor positioning system; localization; time difference of arrival; kalman filter*

[IT-15]
Immersive Virtual Reality-Based Serious Game for Fire Drill Education

Reinhart Siregar and Ridi Ferdiana (Universitas Gadjah Mada, Indonesia); Ahmad Nasikun (UGM, Indonesia)

Abstract – It is imperative to have discourses and research around the topic of fire since the cost of the occupant's inability to handle and evacuate during the fire has resulted in multiple losses of both property and human lives. This is highly relevant to the Faculty of Engineering Universitas Gadjah Mada, where around 7000 people utilize Smart and Green Learning Center (SGCL) on daily basis. The occupants need to taught how to act upon the case of fire. This research aims to develop a Virtual Reality (VR) fire drill on SGLC building of the Faculty of Engineering Universitas Gadjah Mada and compare it to the traditional method, the Faculty's official safety induction video. VR is chosen because it offers a comparatively more immersive and realistic fire environment and can better simulate the real world. The game is designed with the MDA (Mechanics, Dynamics, Aesthetics) framework to construct the overall model of the game with the gamification elements inside. The key gamification element in this game is the reward system which consists of stars given to the players based on the evacuation completion time and the level unlock system which unlocks a level when a player finishes the previous level while blocking the access for players who haven't. To ensure the efficacy and usability of our approach, we undergo three different tests: Black Box Testing, System Usability Scale (SUS), and User Experience Questionnaire (UEQ). In the Black Box Testing, all the features and functionalities of the game work well as per the pre-defined criteria. The game obtains an SUS score of 71.47 which indicates the game is easily playable by the users. This is also supported by the UEQ scores, where the game is considered attractive, efficient, and provides great positive stimulation. Compared to the traditional method, our VR-based game is therefore more preferrable by the user. The result of the learning outcome indicates that our VR-based approach is on par with the video.

Keywords – *Virtual Reality; Fire Drill; Game Development; Gamification; Serious Game*

[IT-16]
Analysis of Marker Factors Effect on the Detection Process of Image-Based Tracking in Web Augmented Reality

Vallentina Wahyu Febrihartanti (Gadjah Mada University, Indonesia); Bimo Sunarfri Hantono (Universitas Gadjah Mada, Indonesia); Ahmad Nasikun (UGM, Indonesia)

Abstract – Image-based tracking is one of the augmented reality methods used in the marker detection and tracking process. This method uses an image marker to determine the exact location and orientation of the camera when displaying virtual objects. Image marker has an important role in the image-based tracking augmented reality working process. Thus, to generate and utilize image markers, factors that functionally affect the performance of image-based tracking augmented reality are required. With the interest to uncover what these factors are and how they affect the performance of the image-based tracking system, this research will examine the factors applied to the image marker and their effect on the performance of image-based tracking web AR in bringing virtual objects to the real environment. In this research, six factors were tested, consisting of the image marker quality, surface area of the covered image marker, camera distance to the image marker, the camera angle towards the image marker, the Light-Marker-Camera (LMC) angle, and the type of device used. The effects of these factors are measured using the latency of image-based tracking augmented reality in displaying virtual objects. Therefore, it is concluded that the LMC angle factor significantly affects the latency of image-based tracking AR. Also, the factors of the surface area of the covered image marker, the distance between the camera and the image marker, and the camera angle towards the image marker show a positive influence on the latency of the system. On the other hand, the factors of image marker quality, and the type of device used prove a negative influence with the latency of image-based tracking augmented reality in displaying virtual objects.

Keywords – *image-based tracking; augmented reality; web AR; image marker*

[IT-17]
Virtual Reality-Based Educational Game for Basic Korean Pronunciation Assessment

Muhammad Fadhil Mahendra, Indriana Hidayah and Achmad Rio Dessiar (Universitas Gadjah Mada, Indonesia); Ahmad Nasikun (UGM, Indonesia)

Abstract – In today's globalized world, proficiency in foreign languages, such as Korean, is of paramount importance. While pronunciation is a fundamental aspect of language acquisition, conventional assessment techniques are constrained by limitations such as the subjectivity of human judgment, learners' discomfort during live examination, and teachers' limited time to assess. This research presents the development of an educational game based on virtual reality (VR) designed to assess basic Korean pronunciation, with the aim of overcoming the aforementioned problems. This study also evaluates the effectiveness of the developed application, assessing several key measures: usability, user experience and comfort, and the alignment of the developed system assessment results with human judgment. The methodology used in this research is agile method for development, black box testing, evaluation of usability and user experience, and correlation test between the system assessment and the manual human assessment. The app showed good usability with an SUS score of 72.625 and positive UEQ scores for attractiveness (2.225), perspicuity (1.838), stimulation (2.313), and novelty (1.863). A Spearman correlation coefficient of 0.631 indicated significant agreement between system and human assessments. The study demonstrates that the VR-based educational game effectively facilitates impartial Korean pronunciation assessment, enhances user experience, and reduces manual assessment time for teachers by automating the process.

Keywords – *Korean language; Language education; Virtual Reality; Serious game; Pronouncation assessment*

[IT-19]
Design and Implementation of a Dashboard System for Monitoring Key Performance Indicators in Digitalized Higher Education Institutions: A Case Study

Iskan Mustamir and Sunu Wibirama (Universitas Gadjah Mada, Indonesia); Ahmad Nasikun (UGM, Indonesia)

Abstract – The digital transformation of higher education institutions (HEIs) that is driven by the Industrial Revolution 4.0 and further accelerated by the COVID-19 pandemic has emphasized the importance of the information system in critical decision making. This study explores the design and implementation of a dashboard system for monitoring Key Performance Indicators (KPIs) in digitalized HEIs, focusing on an Indonesian university faculty case study. Using the Dashboard Design Process methodology, this study details the stages of defining user requirements, prototyping, building, and deploying a user-focused dashboard. This study also explore the testing of the dashboard developed using Black Box Test, Usability Test, and User Experience Questionnaire (UEQ). The implemented dashboard offers comprehensive visualization of the KPIs data as well as insights into performance at 3 levels, which are faculty, field, and department. The result of the testing shows this dashboard have 100\% functionality and a good usability score with 0.103 goals/s in time-based efficiency, 77.1\% overall relative efficiency; 90,1\% completion rate; and 9,9\% error rate; also 1,35; 1,31; 1,48; 1,21; 1,40; and 1,23 in the scale of attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty.

Keywords – *Digital transformation; Higher education institution; Key performance indicator; Dashboard; Quality Education*

[IT-20]
Performance Analysis of RouteSegmentation Algorithm in Identifying Perimeter Area Around Travel Route

Muhammad Avied Bachmid, Muhammad Yasir Anshari Haq, Muhammad Rafly Mumtaz and Aryo Pinandito (Universitas Brawijaya, Indonesia)

Abstract – Prior study has developed the RouteSegmentation algorithm to identify the perimeter area surrounding a route. In this study, a comparative experiment was carried out to investigate the performance of the RouteSegmentation algorithm implementation in contrast to the RouteBoxer algorithm. Both algorithms play a crucial role in geographical information systems (GIS), particularly in enhancing navigational tools by identifying points of interest along specified routes. Through systematic experimentation using various perimeter distance values and types of route, the trade-offs between processing efficiency and the granularity of the area identified by these algorithms were evaluated. The results demonstrate that RouteSegmentation maintained relatively consistent performance across different perimeter distance values and statistically significantly faster processing time than RouteBoxer. Furthermore, while the RouteBoxer algorithm benefits from larger perimeter distance values by reducing processing time, it compromises the coverage results of the algorithm and potentially undermines its usefulness in practical scenarios. This study not only provides insights into the optimal use of perimeter distance values for each algorithm but also guides users in selecting the appropriate algorithm based on their specific application needs, balancing detailed geographical analysis and runtime efficiency.

Keywords – *path; route; geofencing; RouteSegmentation; RouteBoxer; performance analysis*

[IT-21]
How Can Gov-CSIRT Indonesia Maintain National Cybersecurity in the Future?

Rakha Wilis and Jeckson Sidabutar (Politeknik Siber dan Sandi Negara, Indonesia)

Abstract – The National Cyber and Crypto Agency (Badan Siber dan Sandi Negara, BSSN) has established guidelines for the security of Electronic-Based Government Systems (Sistem Pemerintahan Berbasis Elektronik, SPBE) and encourages the implementation of Computer Security Incident Response Team (CSIRT) infrastructure across all government sectors. However, the RFC2350 document for Gov-CSIRT Indonesia lacks a detailed framework, leading to many government agencies encountering challenges in optimally implementing CSIRT. Through this research, the author will conduct a study on various CSIRT standards and implementations from other countries, which will subsequently be used to develop strategies for Gov-CSIRT Indonesia in addressing national cybersecurity issues. This research aims to conduct a thorough assessment to derive the best strategies for the future development of Gov-CSIRT Indonesia. Additionally, it seeks to facilitate the effective implementation of CSIRT, enhancing Indonesia's resilience against cyber threats and contributing to the overall strengthening of national cybersecurity.

Keywords – *CSIRT; SPBE; PDP; RFC2350*

[IT-22]
AI-Enhanced Honeypots: Leveraging LLM for Adaptive Cybersecurity Responses

Jason Aljenova Christli (Swiss German University, Indonesia); Charles Lim (Swiss German University, Indonesia); Yevonnael Andrew (Swiss German University, Indonesia)

Abstract – Honeypots have long been used as decoy systems to lure and study attackers, providing valuable intelligence on emerging cybersecurity threats. However, with the increasing sophistication of cyberattacks, static honeypots have become less effective against advanced adversaries. This paper presents an innovative solution: AI-driven honeypots powered by Large Language Models (LLMs), specifically the LLaMA-3 model. Unlike traditional honeypots, these AI-enhanced systems can dynamically generate contextually appropriate, human-like responses in real-time, greatly improving their ability to deceive and engage attackers. By leveraging the LLaMA-3 model, the proposed system enhances the realism of interactions, making it significantly more difficult for attackers to identify the decoy.

Keywords – *Cybersecurity; Honeypots; LLM; LLaMA-3; Adaptive Systems; SSH*

[IT-23]
Academic Sandbox: Enabling Access and Exploration Mobile Positioning Data for Supporting Mobility Analytics

Syafaatul Khayati (Universitas Gadjah Mada, Indonesia); Widy Widyawan (Gadjah Mada University, Indonesia); Azkario Rizky Pratama (UGM, Indonesia)

Abstract – With the advancement of technology and the widespread use of mobile devices, a vast amount of data is generated as a byproduct. One such dataset is Mobile Positioning Data (MPD), which is an estimation of individual and collective human mobility based on Call Detail Records (CDR) collected by mobile network providers. MPD holds valuable insights into human movement patterns and can be leveraged to solve various interdisciplinary problems if further explored. However, access to MPD is limited for academia and researchers due to its sensitive nature and proprietary constraints imposed by the companies.

To address the accessibility challenge, we propose the devel- opment of an academic sandbox system, utilizing Kibana as an interactive visualization platform and Elasticsearch as a storage and data analysis platform. This system enables researchers to observe, explore, and draw meaningful conclusions from the information contained within MPD. The sandbox incorporates three levels of authorization in its security system, ensuring the confidentiality of proprietary data.

The resulting academic sandbox provides a high-performance solution that meets the standard specifications, and initial testing has shown positive responses from the participants. Therefore, this sandbox is expected to overcome accessibility issues and create new opportunities for research related to MPD-based mobility studies, such as investigating the impact of human movement patterns on the spread of COVID-19.

Keywords – *people mobility; big data; mobility visualization; data analytics; academic sandbox; data accessibility; data exploration*

I.5. Power Systems

[PS-1]
A Review: Health Diagnostic of Photovoltaic and Correlation with Electrical Performance

Zainur Oktafian Prabandaru and Tumiran Tumiran (Universitas Gadjah Mada, Indonesia)

Abstract – The health diagnostic assessment of photovoltaic systems is vital for ensuring their long-term performance and reliability. This review explores the comprehensive analysis of health diagnostics in PV systems and their correlation with electrical performance. PV systems are exposed to various stress factors and degradation mechanisms, impacting their efficiency and reliability. Monitoring and diagnosing PV system health are crucial for early issue detection and performance optimization. This review provides an overview of diagnostic techniques, including electrical performance monitoring, thermal behavior analysis, and structural integrity assessment. It examines the correlation between health diagnostics and electrical parameters such as voltage, current, and power output. Insights gained contribute to understanding factors influencing PV system performance and degradation mitigation. Furthermore, the review discusses the significance of health diagnostics in enhancing PV system reliability, longevity, and efficiency. It emphasizes integrating health monitoring systems for real-time monitoring and proactive maintenance. Insights contribute to advancing effective health diagnostic strategies in PV systems, fostering their widespread adoption and sustainability in renewable energy.

Keywords – *health diagnostics; electrical performance; degradation mechanisms; stress factors*

[PS-2]
Fault Detection in Transmission Lines Using CNN

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Somchat Jiriwibhakorn (King Mongkut 's Institute of Technology Ladkrabang (KMITL), Thailand)

Abstract – Transmission line faults pose a significant risk to power systems, potentially leading to widespread outages. Detecting these faults using advanced algorithms is crucial for preventing major disruptions in power supply. In this paper, we work on a fault detection technique for the IEEE 9-bus system based on deep learning. By training a Convolutional Neural Network (CNN) on features extracted from both normal and faulty conditions, we achieve an accuracy of 86%. This high accuracy underscores the potential of CNNs for real-world implementation in fault detection systems. The robustness of the CNN approach suggests its viability for deployment in complex, real-time systems, offering improved reliability and resilience against transmission line faults. Additionally, utilizing deep learning techniques opens avenues for further refinement and optimization of fault detection strategies in the power grid.

Keywords – *convolutional neural network; fault detection; IEEE 9-bus; transmission lines*

[PS-3]
Behavior Investigation of Conventional Synchronous Generators and Grid Photovoltaic in Microgrid

Fredi Prastiyo (Diponegoro University, Indonesia)

Abstract – The quality of electrical power is an important aspect in the supply of electrical energy that can affect the performance and stability of the network, this phenomenon is even more crucial when referring to low-voltage systems that are directly connected to the load. This study aims to analyze the behavior of the synchronous generator micro generation system, especially the rotor angle aspect with the comparison of inverter grid photovoltaic feeding. Micro synchronous generators and photovoltaic grid inverters are renewable energy sources that are increasingly popular in integration into the power grid. The author conducted an in-depth analysis of the rotor angle by comparing the proportion of power generated by synchronous microgenerators and photovoltaic grid inverters under linear load conditions. Experimental methods are used to measure and analyze electrical power proportion parameters such as active power, apparent power, and reactive power in synchronous microgenerators and photovoltaic grid inverters. Tests are performed in a variety of linear load scenarios to evaluate how these two systems behave under different conditions. The results of this study provide a deeper understanding of the effect of synchronous mini generator feeding and photovoltaic grid inverter on the rotor angle that occurs. Analysis of the interaction between these two systems also provides insight into how the combination can affect the overall quality of electrical power. The findings of this research are expected to contribute to the development of renewable generation systems that are more reliable and efficient in maintaining the quality of electrical power.

Keywords – *Micro Generator; Photovoltaic; Electricity System; Generator Rotor Angle; Hybrid Electrical Power Proportion*

[PS-5]
Partial Feedback Linearization Approach to Nonlinear Control of Synchronous Generator with Transient Model

Sabira Geralda Harnanda (Gadjah Mada University, Indonesia); Husni Rois Ali (UGM, Indonesia); Lesnanto Multa Putranto (Universitas Gadjah Mada, Indonesia)

Abstract – Modern power systems are complex and nonlinear, requiring high-performance controllers to maintain system stability. This research presents the uses of nonlinear control called partial feedback linearization (PFBL) in power systems to restore equilibrium when dealing with disturbances. The PFBL controller is used to guarantee small-signal and transient stability. The linear quadratic regulator (LQR) method calculates the control law. The control law's application models are the detailed transient model of synchronous machines and an IEEE Exciter Type-I. Using the PFBL controller to simulate a significant disruption in the power system model proved that PFBL is an effective controller for averting instability in the power system. This nonlinear controller is less sensitive to changing operations because it does not rely on a linear system.

Keywords – *Synchronous Generator; Power System Stability; Linear System; Nonlinear Control Systems; Partial Feedback Linearization*

[PS-6]
Verification of Voltage Stabilization Effects in a Hybrid Microgrid by Experimental and Simulation Studies

Hayato Igarashi and Guohong Wu (Graduate School of Tohoku Gakuin University, Japan); Jinghan He (Beijing Jiaotong University, China)

Abstract – This paper presents the experimental study results related to microgrid voltage stability by use of a hybrid microgrid prototype system that has been developed and installed at the Itsutsubashi Campus of Tohoku Gakuin University, Japan. In addition, microgrid system simulation model has also been completed based on the system configuration of this experimental system, and simulation studies have been conducted for making comparison of the results from both experimental and simulation studies. The developed microgrid system is designed for facilitating the utilization of renewable power generations. Therefore, in the proposed microgrid, PV and wind power generation are used as the major power sources and supply power simultaneously to DC loads (such as EV chargers, LED or other DC-driven electrical equipment) and AC loads (such as those driven by conventional AC motors). In addition, for purpose of mitigating DC voltage fluctuations caused by renewable power generations and DC load change, two types of power storage devices with different electrical characteristics are introduced, which are rechargeable battery and EDLC (Electric Double Layer Capacitor), respectively. The purpose of this study is to verify whether the DC voltage can be effectively stabilized by the coordinated control of battery and EDLC and be able to supply power to AC and DC loads stably in case with considerable power fluctuations due to renewable power generations and load change in a microgrid, as well as to compare and discuss the results obtained from both experimental and simulation studies.

Keywords – *Microgrid; renewable power generation; voltage stabilization; power control; battery; EDLC*

[PS-7]
Adaptive Control of Synchronous Generator with Transient Model Using Deep Reinforcement Learning

Muhammad Nurhafiz Sidiq (Universitas Gadjah Mada, Indonesia); Husni Rois Ali (UGM, Indonesia); Ahmad Ataka Awwalur Rizqi (Universitas Gadjah Mada, Indonesia)

Abstract – This study proposes a novel approach to improve the stability of a Single Machine Infinite Bus (SMIB) system by developing a learning-based Power System Stabilizer (PSS) utilizing the Twin Delayed Deep Deterministic Policy Gradient (TD3) algorithm. The SMIB system, where a single generator is connected to a large distribution network, allows to more focus on the dynamic charactersitics of the generator without considering the complexity of interactions among various generators and loads within the system. The proposed controller adjusts the gain of the PSS in response to disturbances, ensuring robust control against various disturbances. In this research, TD3 is used because of its capacity to reduce sensitivity to actions and enhance overall stability. The performance of the learning-based PSS is evaluated under both small and transient disturbances, and its effectiveness is compared to a conventional Power System Stabilizer (CPSS). The results demonstrate that the DRL-based PSS can significantly enhance system stability against various disturbances, making it a promising solution for improving the robustness of power systems.

Keywords – *Single Machine Infinite Bus (SMIB); Power System Stability; Deep Reinforcement Learning (DRL); Power System Stabilizer (PSS); Twin Delayed Deep Deterministic Policy Gradient (TD3)*

[PS-8]
Reactive Power Support Devices on Weak Grids Connected to High Penetration of Wind Farms in Indonesia: A Review

Herlambang S Jatmiko, Roni Irnawan and Mokhammad Isnaeni Bambang Setyonegoro
(Universitas Gadjah Mada, Indonesia)

Abstract – In an attempt to reduce carbon emissions, wind farms (WF) have started to replace traditional electricity generation in the past ten years. However, in their integration into the grid, WFs have several issues that affect the stability and reliability of the power system. This paper discusses a review of the comparison of reactive power compensation technologies due to WF integration. The technologies include SVC, STATCOM, and synchronous condenser (SynCon). Each will be explained about the working principle of how the three devices are able to control reactive power so that the voltage on the system remains within the allowed grid code limits. Some reviews of current research on these three technologies are also discussed in terms of methodology and the contribution of each researcher. In addition, the development of renewable energy in Indonesia was also discussed.

Keywords – *SVC; STATCOM; synchronous condenser; wind farm; reactive power*

[PS-9]
Determining the Droop Coefficient of PWM Rectifier in Hybrid Train Application

Darma Adi Guna Alfat, Fransisco Danang Wijaya and Eka Firmansyah (Universitas Gadjah Mada, Indonesia)

Abstract – This paper introduces the development of a hybrid configuration for a train propulsion system, integrating diesel-electric generator and battery. The hybrid mode operation involves power sharing between generators and battery. The essential components in this system are the pulse with modulation (PWM) rectifier device, serving as an interface between the generator, battery, and inverter motor drive to balance energy in the propulsion system. The rectifier operates in various modes, including powering mode for achieving full speed, breaking mode to charge the battery, and full charging when the state of charge (SOC) of the battery is low. To address challenges in power sharing, the research proposes a droop control strategy for the three-phase PWM rectifier, enabling effective active power distribution between the generator and the battery. The control strategy, with an adjustable parameter (k_droop), demonstrates its capability to dynamically regulate power sharing. Simulation results validate the effectiveness of the proposed control strategy.

Keywords – *diesel-electric generator; three-phase PWM rectifier; battery; power sharing; droop control*

[PS-10]
Analyzing Harmonic Effects on Synchronous Generator Supplying Parallel PWM Rectifier in Hybrid Train Systems

Fransisco Danang Wijaya and Darma Adi Guna Alfat (Universitas Gadjah Mada, Indonesia)

Abstract – This paper presents an analysis of the harmonic impact of Pulse Width Modulation (PWM) rectifiers on synchronous generators used in hybrid trains. With the growing emphasis on sustainable and efficient transportation, hybrid trains employing synchronous generators and PWM rectifiers have become increasingly popular. While PWM rectifiers offer enhanced control and improved power quality, their high-frequency switching can introduce harmonics that may affect the performance and longevity of synchronous generators. This study aims to identify and quantify these harmonics and propose mitigation strategies. The analysis begins with a detailed theoretical background on PWM rectifiers and their interaction with synchronous generators. Simulation models are developed to replicate the hybrid train`s electrical system, incorporating various operating conditions and load scenarios. Harmonic spectra are generated to evaluate the distortion levels introduced by the PWM rectifiers. The study focuses on key performance metrics such as total harmonic distortion (THD) related to paralel operation of PWM rectifier. Results indicate that while PWM rectifiers can significantly improve overall system efficiency, they also introduce harmonics that could potentially degrade the generator's performance and reduce its lifespan. The paper discusses various harmonic mitigation techniques, including filtering and optimized control strategyy using droop control.

Keywords – *hybrid train; PWM rectifier; harmonic; synchronous generator; droop control*

[PS-11]
Generation Expansion Planning for the Kalimantan Interconnected System Considering the Renewable Energy Mix and Carbon Dioxide Emissions Targets

Muhammad Alvin, Lesnanto Multa Putranto and Bambang Sugiyantoro (Universitas Gadjah Mada, Indonesia); Ahmad Edy Syukral Siregar (PT PLN (Persero) UIP3B Kalimantan, Indonesia)

Abstract – The increasing annual demand for electricity requires an optimal generation expansion plan (GEP) while maintaining reliability levels, including renewable energy (RE) targets and carbon dioxide emission reductions to support global and national efforts against climate change. The optimization of GEP for the Kalimantan Interconnected system for the period 2026-2050 is carried out using OSeMOSYS software and the Linear Programming method. This optimization considers three scenarios: Business as Usual (BAU), RE Optimization, and Emission Optimization, which are analyzed in terms of installed capacity, renewable energy mix, carbon dioxide emissions, and levelized cost of electricity (LCOE). The Kalimantan Interconnected system in each scenario is dominated by coal and hydro power plants due to their economic advantages and abundant resources. The BAU scenario has the lowest LCOE of Rp1,333.12/kWh, but it does not support RE targets and results in high carbon dioxide emissions. The RE Optimization scenario meets the RE target with a LCOE of Rp1,379.34/kWh. Meanwhile, the Emission Optimization scenario meets both the RE target and emission reduction with the highest LCOE of Rp1,407.74/kWh, indicating that this scenario is the only one that can meet both targets, albeit with a high LCOE.

Keywords – *generation expansion planning; Kalimantan; renewable energy; carbon dioxide emission*

[PS-12]
Assessment of Government-Owned Electric Vehicle Penetration on Distribution Network: A Case Study in Denpasar, Bali

Pradika Sakti and Mokhammad Isnaeni Bambang Setyonegoro (Universitas Gadjah Mada, Indonesia); Husni Rois Ali (UGM, Indonesia)

Abstract – The Indonesian government is currently focusing on preparing infrastructure for electric vehicles (EVs), driven by clean energy issues and the Net Zero Emission plan for 2060. To support this transition, the Indonesian government has issued directives mandating the adoption of battery-based EVs in government agencies, both at the central and regional levels. One Indonesian province, Bali, has seen a significant increase in EV numbers, and the local government is actively promoting the transition to EVs. However, the increasing population of EVs poses challenges for national electricity providers (PT PLN). This study aims to analyze the impact of government-owned EV penetration on the distribution network in Denpasar, Bali, and determine appropriate locations for EV charging stations. Using real conditions from two feeders in Denpasar, simulations are conducted to analyze the impact of EV penetration on the distribution network. Simulation results show that EV penetration affects voltage drop and power losses, therefore these assessments provide a valuable contribution to determine the appropriate location for EV charging stations.

Keywords – *Electric Vehicle; Charging Station; Distribution Network; Network Parameter*

[PS-13]
Impact Assessment and Mitigation of A Power System with Dynamic Electric Arc Furnace Load

I Nyoman Aditya (Gadjah Mada University, Indonesia & PT. PLN (Persero), Indonesia); Lesnanto Multa Putranto and Roni Irnawan (Universitas Gadjah Mada, Indonesia); Rian Fatah Mochamad (UGM, Indonesia)

Abstract – The Indonesian government is currently actively involved in down streaming efforts, particularly in nickel, due to its abundant resources. This initiative is accompanied by an increasing number of operational arc furnaces. The Electric Arc Furnace (EAF) represents a high-power, non-linear industrial load that can have adverse effects to power system such as power quality degradation and voltage fluctuations. In this research, a 390 MVA EAF load is considered to be placed in modified IEEE 39 Bus England System network and simulated by DigSILENT PowerFactory. It has been found that the EAF contributes to system voltage fluctuations exceeding their minimum limits. Those detrimental impact can be mitigated by installing a VAR compensator. This research will examine the effects of EAF on system voltage fluctuations and compare the performance of different compensators, including Fixed Capacitor, Static VAR Compensator (SVC), and Static Synchronous Compensator (STATCOM), along with their respective impacts.

Keywords – *Electric Arc Furnace (EAF); Voltage Fluctuation; Fixed Capacitor; Static VAR Compensator (SVC); Static Synchronous Compensator (STATCOM)*

[PS-14]
Oscillation Control in Aceh System Under Disturbances: A Case Study

Farid Choirul Akbar (Gadjah Mada University, Indonesia & PT PLN (Persero), Indonesia); Husni Rois Ali (UGM, Indonesia); Lesnanto Multa Putranto (Universitas Gadjah Mada, Indonesia)

Abstract – This study examines the dynamic response of the Aceh power system under disturbances, focusing on oscillation control. The primary concern is the critical damping of generator rotor angle modes, which can either be oscillatory or fully damped. Damping reduction is problematic as it prolongs oscillations, adversely affecting system stability. The eigenvalues and participating modes during disturbances are analyzed to determine the optimal strategy for enhancing system stability. Various operational scenarios and Power System Stabilizer (PSS) tuning methods are evaluated through dynamic simulations. The results demonstrate that tuning PSSs on all units at the Nagan Raya power plant yields the most effective improvement in system response, reducing oscillation duration and enhancing overall stability.

Keywords – *Oscillation Control; Power System Stabilizer; Eigenvalues; Dynamic Analysis*

[PS-15]
Household Electricity Tariff Analysis in Smart City Development Using Tariff Design and Analysis (TDA) Tool

Sandra Aditya Kurniawan (Gadjah Mada & Gadjah Mada University, Indonesia); Sarjiya Sarjiya (Universitas Gadjah Mada, Indonesia); Yusuf Wijoyo (Gadjah Mada University, Indonesia)

Abstract – This study investigates household electricity tariff analysis in the context of smart city development using the Tariff Design and Analysis (TDA) tool. Reducing electricity usage is crucial since households contribute over 50% of carbon dioxide emissions. Smart cities, which leverage interconnected systems and advanced information and communication technologies, offer a significant opportunity to enhance energy efficiency through the implementation of smart meters. However, deploying smart meters is complex and costly, particularly for dispersed household customers. This study highlights the need to assess the urgency of smart meter installation based on applicable tariffs, which can drive improved outcomes for the power system. The TDA tool is utilized to evaluate the cost reflectivity of electricity tariffs for households, focusing on different tariff schemes and their impact on network peak demand. The findings emphasize the importance of strategic smart meter deployment by identifying the most suitably designed electricity tariff. Based on the analysis, the pa50/e50 tariff structure, which incorporates both peak and energy costs, is the most cost-reflective electricity tariff for unplanned smart cities.

Keywords – *Electricity Tariff; Smart City Development; Tariff Design; Cost Reflectivity*

[PS-16]
Determination of PV Location to Reduce Losses with Mini Hydro Power Plant Connected to Grid

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Abstract – Initiatives to achieve net zero emissions globally began in 2018, including significant efforts in Indonesia. The Indonesian government has set a goal to reach net zero emissions by 2060, with photovoltaic systems comprising 89% of its renewable energy potential. This significant potential poses challenges for national electricity providers, particularly regarding the impact of photovoltaic systems on the distribution network. This study aims to analyze the effects of photovoltaic penetration on a distribution system network with two sources: the Main Substation and a Mini Hydro Power Plant. Additionally, it seeks to determine the optimal location for photovoltaic installations based on real field data. The study concludes with simulation results and discussions on the impact of photovoltaic installations, comparing the system's performance before and after the connection of photovoltaic systems. The simulation results demonstrate that installing photovoltaic systems can increase voltage by up to 5.66%. Furthermore, it shows a reduction in power losses by up to 190%. These findings highlight the importance of strategic planning in photovoltaic placement. This research provides valuable insights into the integration of renewable energy sources into the national grid.

Keywords – *On-Grid PV; Distribution Network; Power Losses; Voltage Profile*

[PS-17]
Optimal Capacity and Location of PV Farms Penetration in 150 kV Bali Power System

Alam Hardik Dewantara, Sarjiya Sarjiya, Lesnanto Multa Putranto, Wijaya Yudha Atmaja and Muhammad Yasirroni (Universitas Gadjah Mada, Indonesia)

Abstract – Currently, the Indonesian government is highly concerned with the issue of transitioning from fossil energy to renewable energy. They are encouraging Indonesian State Electricity Corporation to build power plants with renewable energy and urging local governments to implement supporting programs related to this issue. Bali Island has the Kerthi Bali Economic Roadmap Towards a New Era in Bali: Green, Resilient, and Prosperous program, which aligns with the Indonesian government's target, one of which is the construction of utility-scale photovoltaic farms (PVF) in Bali. The output of PVF is intermittent and tends to contribute active power; therefore, the issue of voltage fluctuations at the bus becomes a concern. The determination of the optimal location and capacity using the Particle Swarm Optimization method is carried out with network quality constraints and the objective of obtaining the best voltage profile. The results of this study show that the location where PVF tends to be installed is at the bus with the worst voltage profile and with varying capacities of PVF. This paper can serve as a recommendation for the installation of utility-scale PV in high voltage networks.

Keywords –

[PS-18]
Defense Scheme of Interconnection System: A Design Review

Aufa Hammam Muhammad, Roni Irnawan and Mokhammad Isnaeni Bambang Setyonegoro (Universitas Gadjah Mada, Indonesia); Rian Fatah Mochamad (University of Manchester, Indonesia)

Abstract – This paper aims to review the literature related to defense schemes to conduct a defense scheme design process in order to maintain the stability of the Kalimantan Interconnection System frequency for the 2024 operating year in an effort to support the development of the Archipelago's National Capital City (IKN) in East Kalimantan. The paper examines power system reliability and stability from published articles in the context of accomplishing Indonesia's Sustainable Development Goals. This study explores Under Frequency Load Shedding (UFLS) and Under Voltage Load Shedding (UVLS) as important defense mechanisms to maintain system stability during abnormal conditions. The main focus of this study is the development of defense scheme design based on frequency stability with load shedding by under frequency relay (UFR). This highlights the importance of frequency stability, as measured by the nadir frequency and steady state frequency, in order to prevent system failure. This study reviews conventional and adaptive defense schemes, and concludes that the adaptive method optimizes load shedding and generation by utilizing real-time data, thereby improving power system stability resilience and minimizing outages.

Keywords – *defense scheme; power system stability; frequency stability; under frequency relay; load shedding*

[PS-19]
Multi-Terminal HVDC Implementation for Connecting Indonesian Islands: Technological Review

Said Muhammad Rakhen Dwiafrianta, Roni Irnawan and Sarjiya Sarjiya (Universitas Gadjah Mada, Indonesia); Rian Fatah Mochamad (University of Manchester, Indonesia)

Abstract – Multi-terminal high voltage direct current (MTDC) systems have emerged as a modern technology for the integration of renewable energy sources and the enhancement of power system stability and reliability. The development of the MTDC system continues to produce a more efficient and reliable system. This development of MTDC systems includes the system configuration, converter topology, control strategy. Each of those development offers its own benefits in optimizing the MTDC system. This system is suitable for countries that have renewable energy potential in meeting the needs of well-distributed electrical energy and making the energy transition, such as Indonesia. Indonesia has a huge amount of renewable energy potential that needs to be utilized optimally. This paper provides a comprehensive overview of converters and control strategies in MTDC systems. The advantages and disadvantages of each converter and control strategy are presented as a reference in designing the MTDC system.

Keywords – *multi-terminal; implementation; control strategies; converter*

[PS-20]
Advancing Multi-Island Interconnectors in Indonesia: A Comprehensive Technological Review of Multi-Infeed VSC-HVDC Systems

Derana Syahda Trisnakusuma, Roni Irnawan and Fransisco Danang Wijaya (Universitas Gadjah Mada, Indonesia); Rian Fatah Mochamad (University of Manchester, Indonesia)

Abstract – This paper discusses multi-infeed HVDC. The application of High Voltage Direct Current (HVDC) technology offers a promising solution for efficiently transmitting electrical energy over long distances, especially from renewable energy sources located far from existing load centers. Multi-feed HVDC systems further enhance this potential by integrating diverse renewable resources into the grid. However, ensuring the stability of these systems is a major challenge. Extensive research has been conducted to improve the stability of multi-feed HVDC systems, with a focus on Voltage Source Converter (VSC) technology. Despite progress, further research into the response of multi-infeed VSC-HVDC systems under various operating conditions is still needed. Future research efforts should aim to comprehensively understand system behavior under normal and abnormal conditions, contributing to the advancement of HVDC technology and the integration of renewable energy sources into the power grid.

Keywords – *VSC-HVDC; multi-infeed; renewable energy sources integration*

[PS-21]
A PV Hosting Capacity Technique on Distribution Network with Considering New Grid Requirement

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Abstract – Grid-connected distributed photovoltaic systems are becoming more and more commonplace worldwide, and their spread could pose technical hurdles to the grid in the form of voltage spikes, equipment overloads, power quality issues, and protection breaches. The system's dependability may be enhanced by the growing use of rooftop solar PV. Due to the growing use of VRE in distribution systems, rooftop PV will probably be needed to support the restoration of remote distribution feeder power during an emergency. This condition can occur due to the non-dispatchable nature of PV generation which tends to be difficult to control and fluctuates, depending on the irradiation and environmental conditions received by the PV. These stochastic characteristics of PV also affect overvoltage and load conditions, especially for residential consumers (households) [1]. However, having rooftop PV in the distribution network also interferes with voltage regulation, which causes the voltage to fluctuate throughout the day based on the PV rooftop's power output and to decrease at night. The results demonstrate that, depending on the technical circumstances that arise, namely the value of reverse power, the value of voltage, short-circuit current capacity, and power factor (pf) against the limit defined grid code boundaries, can determine the maximum capacity (hosting) that the network can receive from the PV penetration of each scenario.

Keywords – *Hosting Capacity; Distributed Generation (DG); Photovoltaic; Voltage; Short circuit current contribution; Power factor*

[PS-22]
Network Reconfiguration Strategies for Reducing Network Losses Under High PV Penetration

Fauziyah Amin, Sarjiya Sarjiya, Mokhammad Isnaeni Bambang Setyonegoro and Wijaya Yudha Atmaja (Universitas Gadjah Mada, Indonesia)

Abstract – The modern distribution system faces stability issues with high solar PV penetration, leading to increased variability and uncertainty. To address these challenges, network reconfiguration is proposed to reduce losses by optimizing switch operations and increasing PV capacity. Simulations on the Majalaya network show significant loss reduction and improved reliability, providing valuable insights for sustainable energy integration and infrastructure investment. This approach enhances grid efficiency and supports the integration of renewable energy sources. By identifying optimal configurations and gradually increasing PV capacity, the research underscores the importance of strategic planning in modernizing electrical distribution systems to accommodate renewable energy growth.

Keywords – *PV Penetration; Losses Analysis; Voltage Analysis; Network Reconfiguration; Scenario Analysis*

[PS-23]
Characteristic Analysis of Partial Discharge Parameters in Air Insulation Using High Frequency Current Transformer

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Abstract – This paper aims to detect PD in air solutions using HFCT and Fluke ii910 acoustic cameras to analyze PD signals in air insulation under varying voltages, comparing setups with and without room conditioning. PD signals, processed into PD pattern plots, exhibit asymmetry, with positive peaks centered at phases 45◦-135◦ and negative peaks at 225◦-315◦. The analysis reveals an increased PD count, an expanded phase angle range, and an amplified signal amplitude with voltage rise. Acoustic camera data mirrors HFCT results, confirming corona PD traits. This study sheds light on corona discharge PD in air insulation, laying the groundwork for further research.

Keywords – *partial dicharge; air insulation; corona discharge; HFCT; acoustic camera*

[PS-24]
State-Of-The-Art Optimization Approaches for Battery Energy Storage in Utility-Scale Floating PV Systems

Muhammad Shahrizal Erlangga (Gadjah Mada University & PT. PLN, Indonesia); Fransisco Danang Wijaya (Universitas Gadjah Mada, Indonesia); Yusuf Wijoyo (Gadjah Mada University, Indonesia)

Abstract – This paper reviews the advancements and challenges in Floating Photovoltaic (PV) systems and Battery Energy Storage Systems (BESS). Floating PV systems, or floatovoltaics, install solar panels on water bodies, addressing land scarcity and improving energy efficiency. Technological improvements like dual-glass PV modules and specialized anchoring systems have enhanced their performance and durability. Economically, these systems are cost-effective, eliminating land costs and integrating well with hydropower infrastructure. BESS technology has seen significant growth, with large-capacity installations worldwide, such as the 648 MWh sodium-sulfur batteries in Abu Dhabi and the 565 MWh lithium iron phosphate battery in Hawaii. These systems are vital for grid stability, providing services like frequency regulation and energy arbitrage. The review examines various types of Battery Energy Storage Systems (BESS), including lithium-ion, sodium-sulfur, lead-acid and flow batteries, evaluating their advantages and disadvantages. Optimizing BESS size is crucial for cost-efficient power systems, balancing operational and investment costs. The paper emphasizes the need for advanced optimization techniques and thorough environmental and economic assessments to enhance the deployment of these technologies. The integration of these systems represents a significant step towards achieving sustainable and reliable energy solutions globally.

Keywords – *Floating PV; Battery Energy Storage System; BESS; Optimization*

[PS-25]
Energy Management System of a Fuel-Cell Hybrid-Electric Aircraft Based on Dynamic Programming

Ugo Marco Ferrulli, Massimo Tipaldi, Paolo Roberto Massenio and David Naso
(Polytechnic University of Bari, Italy)

Abstract – Aviation significantly contributes to CO2 and NOX emissions, which, particularly at cruise altitudes, also lead to ozone production. This has driven the push for greener aviation policies. Hybrid-electric propulsion systems, which combine traditional combustion engines with electric powertrains, offer reduced fuel consumption, lower emissions, and increased range. Hydrogen fuel cells, with their high energy density, are a promising alternative to conventional batteries. However, these systems add complexity in design and management, necessitating advanced Energy Management Systems (EMSs) for optimal performance. While EMS strategies for battery-powered hybrid aircraft are well-studied, research on fuel cell-based hybrid architectures with combustion engines are still limited. This paper proposes an EMS strategy using Dynamic Programming (DP) for a hybrid aircraft with a gasoline engine and a fuel cell-powered electric motor. The DP approach aims to optimize the power split between these propulsion sources to minimize fuel consumption. Simulation results across various flight scenarios demonstrate the effectiveness of this approach.

Keywords – *Hybrid-Electric Aircraft; Energy-Management-System; Fuel-Cell; Dynamic Programming*

[PS-26]
Analysis of Fuel and Energy Consumption Using the Torque Assist on Single Cylinder ICE

I Wayan Adiyasa (Universitas Negeri Yogyakarta, Indonesia); Fransisco Danang Wijaya and Eka Firmansyah (Universitas Gadjah Mada, Indonesia)

Abstract – Hybridization on a motorcycle is a condition of utilizing an electric motor as an additional powertrain. Motorcycle hybridization needs to consider the topology used, specifications of the internal combustion engine (ICE), electric motor (EM), and battery capacity. This paper focuses on the hybridization mechanism using the P1 topology and considering 3 basic components. The P1 topology design is commonly used on conventional motorcycles. The use of the P1 topology makes the EM a torque assist when the engine accelerates. The ICE used is a single cylinder with a capacity of 125cc, the EM uses a BLDC type motor with a power of 250W, and the battery is described with a voltage of 51.8V with 5 capacity variations such as 6.8, 9.6, 12.8, 16.0, and 19.2 Ah. Motorcycle dynamics tests use 3 Driving Cycle models, such as ECE-R15, ECE-R40, and WMTC. The achievement of this analysis is the determination of battery capacity with a deep of discharge (DoD) of less than 70%. The results show that when testing on the ECE-R15 Driving Cycle, using a 6.8 Ah battery is effective with a DoD of 11.911%. The reduction in fuel consumption reaches 6.891%. Testing on the ECE-R40 Driving Cycle, a 9.6 Ah battery is more effective with a DoD of 50.181%. The reduction in fuel consumption reaches 1.853%. Testing on the ECE-R40 Driving Cycle, a 9.6 Ah battery is more effective with a DoD of 69.795%. The reduction in fuel consumption reaches 0.863%. In 3 Driving Cycle tests, the use of a 3P battery is more efficient because during testing, the DoD value is not more than 70%.

Keywords – *battery; energy consumption; fuel consumption; internal combustion engine; torque assist*

[PS-27]
Techno-Economic Feasibility Analysis of a Hybrid Renewable Energy System for Gili Labak Island as a Disadvantaged, Outermost and Frontier Region of Indonesia Using HOMER

M. Hafiz Putra Wijaya (Gadjah Mada University, Indonesia); Mokhammad Isnaeni Bambang Setyonegoro (Universitas Gadjah Mada, Indonesia); Husni Rois Ali (UGM, Indonesia)

Abstract – Indonesia, as the largest archipelagic country with 17,491 islands according to the Coordinating Ministry for Maritime Affairs and Investment, has significant energy challenges, such as on Gili Labak Island, Sumenep Regency, East Java, which the PLN electricity network has not touched. Currently, people on this island rely on diesel power plants (PLTD) as the main source of electricity, which has environmental impacts in the form of carbon gas (CO) emissions. To reduce environmental impacts and achieve the target of a sustainable energy mix in Indonesia, a new approach is needed by utilizing renewable energy sources (EBT), which are abundant on Gili Labak Island, such as solar radiation reaching 5 kWh/m2/day and wind speed reaching 4.84 m/s. Therefore, this paper designs a hybrid renewable energy installation by integrating PLTD, PLTS, and PLTB as a strategic step towards a more sustainable and efficient energy system on Gili Labak Island. Based on the simulations and calculations using HOMER software, information was obtained that the cost of energy (COE) of the hybrid power plant on Gili Labak Island is $ 0,15 / kWh for a capacity of 32.64 kW at peak load with daily variations and 0% timestep, and average usage of 18.2 kW. This comparison of COE costs shows that the figure is 1.74 times higher than the electricity price from PLN of $ 0,088 / kWh. These results indicate that investment in a hybrid power plant or EBT on Gili Labak Island, Sumenep, is a potential option because it not only considers the availability of sufficient alternative energy through potential wind speed and adequate solar radiation but also has relatively competitive production costs. Compared to PLN electricity prices.

Keywords – *hybrid; cost of energy; generation; electricity; HOMER*

[PS-28]
Generation Expansion Planning in Indonesia: A Comparative Study of Interconnection vs. Local Renewable Integration in Baubau-Raha System Considering Uncertainties

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Abstract – This study examines the strategic generation expansion planning within the Baubau-Raha electrical system in Southeast Sulawesi, Indonesia, to meet sustainability and energy security goals given the insufficiency of current fossil fuel-based generation to meet growing demand and RE mix goals. The five scenarios analyzed are the RUPTL Compliance Scenario (RUC), Time-Shifted RUPTL Scenario (TSRU), Local Renewable Energy Scenario (LRE), Local Renewable Energy - Storage Scenario (LRES), and Local Renewable Energy - Storage With Interconnection Scenario (LRESI). The study uses linear programming optimization to assess each scenario's economic and operational impacts. The RUC and TSRU scenarios follow existing plans; however, TSRU offers cost savings due to its adjusted schedule. The LRE scenario reduces dependence on imported fuels but results in a higher Levelized Cost of Energy (LCOE) due to the need for more RE investments. The LRES scenario involves high initial costs due to BESS. However, it improves system reliability by stabilizing RE variability and reducing fossil fuel use, leading to a lower LCOE than LRE. The LRESI scenario combines local renewable integration and grid interconnections. While its LCOE is similar to RUC and higher than TSRU, it offers the highest system resilience and is more cost-effective in the long run compared to LRES and LRE.

Keywords – *generation expansion planning; linear programming optimization; evelized cost of electricity; renewable energy integration; battery energy storage systems; interconnection*

[PS-29]
Choosing the Optimization Method of Grid with DG from a Distribution Operator Perspective

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Abstract – The growing concern over global warming has significantly influenced distribution systems. The most notable one is the integration of renewable energy sources. However, incorporating these sources poses unique characteristics that necessitate suitable optimization methods to improve the distribution system's efficiency. Researchers and engineers have proposed various strategies, including energy storage implementation, distribution system reconfiguration, effective control of reactive power from existing distributed generation, and determining the location and capacity of new distributed generation. This paper aims to explore these methods, evaluating their feasibility and ease of implementation from the perspective of distribution system operators. After exploring the presented methods, energy storage and installing new distributed generation have remarkably high costs. Moreover, distribution system reconfiguration and reactive power control have no capital cost. However, for distribution system operators reactive power control might be out of their jurisdiction, so distribution system reconfiguration is chosen from the presented methods.

Keywords – *distribution system; distributed generation; optimization method; energy storage system; reactive power control; distribution system reconfiguration*

[PS-30]
Advance Induction Motor Model with Fault Development for Undergraduate Electric Machinery Course

Nurafnida Afrizal, Tuan Sharifah Nor Fatieha Tuan Mohammad, Muhamad Zalani Daud and Md Rabiul Awal (Universiti Malaysia Terengganu, Malaysia)

Abstract – Induction motors are essential components in numerous industrial applications, making it crucial for undergraduate electrical engineering students to develop a strong understanding of their operation, potential faults, and diagnostic techniques. This research introduces an advanced induction motor model specifically designed for educational purposes, focusing on the simulation and analysis of parallel misalignment faults. Developed using MATLAB and Simulink, the model provides a visual and interactive platform for students to explore the impact of misalignment on motor performance. Through interactive simulations, students can manipulate the degree of parallel misalignment and observe its effects on key parameters such as current, speed, and vibration, enhancing their understanding of fault characteristics and diagnostic methods. This model aims to provide a valuable tool for educators to enhance student engagement and comprehension of complex fault phenomena in electric machinery courses.

Keywords – *Induction motor; Motor Current Signature Analysis (MCSA); Fault Diagnosis; Misalignment; MATLAB/Simulink; Education*

I.6. Signal Processing and Machine Intelligence

[SPMI-2]
Effective Lung Deseases Detection Using Contrast Enhancement and Efficientnet

Muh Hanafi (Universitas Amikom Yogyakarta, Indonesia & Time Excellindo, Malaysia)

Abstract – lung diseases including Covid-19 become major factor due to deadly human in the earth. Late early detection was influencing the fatal impact for patient. Majority of medical employed adopted image material to detect lung diseases. However, medical imaging experts are very limited. Image diagnosis operated diagnosis with traditional human vision. This is very hard to classify the classification of lung diseases. According to the problem above, artificial intelligent (AI) has been implemented to detect lung diseases effective. However, the result of lung disease detection faces the mis detection in high number. This problem emerges the serious problem for patients. Aim to handle of high error detection lung diseases classification, we employed several image pre-processing and adoption of deep learning model in the term of Efficienet. The pre-processing model including augmentation, white balance enhancement and contrast enhancement. According to previous research, majority of medical imaging process face with low quality of image. According to experiment report, our proposed model achieved significantly in reducing mistake detection on lung diseases classification. Where accuracy result was 0,97, precision was 0,96, recall was 0,98, F1-score was 0,97. We consider adopting our proposed model in multi-class classification. We evaluated our proposed model using evaluation metric and AUC Curve.

Keywords – *lung disease; CLAHE; efficientnet; covid-19; white balance*

[SPMI-3]
A Low Cost Multisensor System for Stress Changes Detector

Sisdarmanto Adinandra (Indonesian Islamic University, Indonesia); Suatmi Murnani, Muchammad Maftuch Nashichin and Azhar Nurhafiz Prawira (Universitas Islam Indonesia, Indonesia)

Abstract – Nowadays, more and more people experience uncertain emotional conditions and these conditions are usually defined as stress. This stressful condition can be seen through the body's physical response, including high heart rate and changes in body temperature. High stress can have a negative impact on a person's health, so a tool is needed that can detect changes in stress and classify stress levels that can be immediately known by the user.

LAZARUS, a Low Cost System for Detecting Changes in Stress with Multisensor Gen-2 is a tool used to detect how high a person stress level is by taking into account heart rate and body temperature. The tool realized uses Wemos D1 Mini ESP8266 as a microcontroller, Tsukamoto method Fuzzy logic as a data processing logarithm, PAH8001EI-2G Sensor as a body heart rate detector, and DS18B20 Sensor as a body temperature detector. Each sensor will take the measured parameter data and then compare it with the stress level parameter table. From the results of the comparison with this table, a decision will be obtained that displays the condition of human stress levels

The system test results show that the LAZARUS tool can display stress level classification results automatically well on the Blynk platform with an average error value of 2.19% and an accuracy rate of 97.81% in heart rate measurements and an average error value of 4.13% and an accuracy rate of 95.87% in measuring body temperature. Apart from that, the system also shows that the results of the justification of stress values compared using a questionnaire filled out by the subject have an error of 64% and an accuracy rate of 36%. These results show that the realized LAZARUS Gen.2 tool can answer the expected system specifications, namely having a sensor reading error rate below 5%, but has shortcomings in terms of justifying stress levels due to the lack of stress level comparison methods.

Keywords – *stress; lazarus; multisensor; heart rate; fuzzy logic*

[SPMI-6]
Time Series Classification for Eye Tracking-Based Visual-Verbal Learning Style

Hafzatin Nurlatifa and Teguh Bharata Adji (Universitas Gadjah Mada, Indonesia); Igi Ardiyanto (Universitas Gadjah Mada & Faculty of Engineering, Indonesia); Aloysius Gonzaga Pradnya Sidhawara and Sunu Wibirama (Universitas Gadjah Mada, Indonesia)

Abstract – Classifying learning styles is crucial for personalized education. Eye tracking has been used successfully to classify visual-verbal learning style. However, previous studies on classification of visual-verbal learning style still relied on proprietary eye movement analysis software. Thus, limiting feature extraction from eye movement data. To address this research gap, we investigated the use of raw time series eye tracking data and machine learning to classify visual-verbal learning style using the Felder-Silverman Learning Style Model (FSLSM). This study evaluated several machine learning methods to classify visual-verbal learning styles based on eye tracking data. We also systematically evaluated the effect of various window sizes on the classification accuracy of machine learning models. Experimental results indicated that the Supervised Time Series Forest (STSF) as the best performing classifier with an accuracy of 97.70% ($Z = -2.812$, $p = 0.005$). We also found a window size of 10 demonstrated superior performance compared to other window sizes. Our findings demonstrate that features extracted from raw eye tracking data significantly enhance classification accuracy, highlighting the potential of time series eye tracking data for classifying visual-verbal learning styles. This study serves as an initial step toward enhancing data-driven personalized education and adaptive learning technologies.

Keywords – *Eye tracking; Cognitive learning style; Machine learning; Time series classification*

[SPMI-7]
Comparative Analysis of Online and Offline Learning Algorithms with Data Drift Detectors in Multi-Target Time Series

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Kitsuchart Pasupa (King Mongkut's Institute of Technology Ladkrabang, Thailand)

Abstract – In machine learning, addressing data drift is crucial due to its profound impact on model accuracy over time. This study investigates the performance of online and offline learning algorithms, alongside black-box and white-box models, integrated with data drift detectors, focusing on multi-target time series problems using real-world datasets in an online setting. We systematically compare the efficacy of these algorithms within a unified experimental framework, evaluating their ability to manage data drift while sustaining predictive accuracy. Our findings reveal that offline algorithms generally outperform their online counterparts, albeit at the expense of higher computational costs when implemented in an online environment. Notably, among the algorithms examined, a single-stack Random Forest model demonstrates superior performance even without explicitly considering correlations between targets. Additionally, black-box models consistently outperform white-box models. For data drift detection, the Kolmogorov-Smirnov Windowing detector emerges as the most effective method. Furthermore, we enhance model interpretability by leveraging rules derived from the RuleFit white-box model and SHapley Additive exPlanations values, illustrating their efficacy in enhancing transparency and understanding of model decisions in the context of drift events. This comprehensive analysis offers insights into optimizing model selection and deployment strategies for dynamic data environments.

Keywords – *Drift detectors; Online learning; Offline learning; Interpretability*

[SPMI-8]
Comparative Analysis of Deep Learning Models for Validating Use Case Diagrams

Bella Dwi Mardiana and Tiara Rahmania Hadiningrum (Institut Teknologi Sepuluh Nopember, Indonesia); Daniel Siahaan (Institut teknologi Sepuluh Nopember, Indonesia)

Abstract – In the ever-evolving world of technology, the validation of use case diagrams is essential to ensure the reliability and consistency of software applications. An effective validation approach plays an important role in optimizing system quality. This study adopts a comparative approach to analyze the performance of three major models in object detection, namely Detectron2, YOLOv5, and YOLOv9, to validate use case diagrams. These three models were trained using an open repository dataset, Roboflow "Use Case Diagram Checker Computer Vision Project". Through a series of careful experiments, we evaluated and compared the three models based on relevant performance metrics, such as precision, recall, and AP50. Our analysis results show that YOLOv9 outperforms the other models with significant improvements in detecting objects in user case diagrams. Although YOLOv9 shows superior performance, we also consider other aspects such as model speed and complexity. This research not only provides deep insight into the relative performance of each model in the context of user case diagram validation but also provides valuable insights for practitioners and researchers in choosing the approach that best suits their needs. Thus, the contribution of this research is highly relevant in the development of reliable and efficient software systems, as well as being a practical guide for the selection and implementation of object detection technologies in the context of user case diagram validation.

Keywords – *Use Case Diagram; Use Case Validation; Object Detection; Deep Learning; YOLO Algorithm*

[SPMI-9]
Weed Detection Based on Fine-Tuned YOLOv5

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Abstract – Conventional weed control often ignores weed locations, potentially causing land damage. AI-based weed detection offers a modern solution. Unfortunately, little attention has been paid to how an augmentation technique improves performance of AI-based weed detection. To address this research gap, we proposed a weed detection model based on fine-tuned YOLOv5 to detect weeds in corn fields aged 1 to 3 weeks. YOLOv5 offers computational benefits, includes auto-augmentation capabilities, and presents a more organized visualization of the outcomes from the training data. The primary dataset used in this study comprised 3,437 images with a total of 18,267 annotated objects, including corn plants and weeds. We observed the effect of mosaic augmentation on the dataset images based on auto-augmentation in YOLOv5. We found that mosaic augmentation with a 0.75 probability outperformed 0.5 and 1.0. The best mAP performance was at the level @0.5 with score of 0.776 for all classes. Meanwhile, the mAP@0.5:0.95 was 0.573 for all classes, indicating that the model's performance requires further improvement. Our study is promising as a guidance for future development of AI-based weed detection.

Keywords – *Weed detection; Weed-yolo; YoloV5; Weed deep learning*

[SPMI-10]
Enhancing Nannofossil Image Quality for Improved Detection Using Modified Contrast Stretching Method and YOLO-v8

Andi Shafira Dyah Kurniasari (Gadjah Mada University, Indonesia); Silmi Fauziati (Universitas Gadjah Mada, Indonesia); Rudy Hartanto (Gadjah Mada University & Electrical Engineering and Information Technology Departmen, Faculty of Engineering Gadjah Mada University, Indonesia); Akmaluddin Akmaluddin (Universitas Gadjah Mada, Indonesia)

Abstract – This research focuses on enhancing the quality of nannofossil images, specifically the discoaster and coccolith genus, to improve the performance of detection and prediction models using advanced deep learning techniques. The study employs Enhanced Super-Resolution Generative Adversarial Networks (ESRGAN) for image resolution enhancement and a modified mean-standard deviation contrast stretching method for contrast enhancement. The You Only Look Once version 8 (YOLOv8) algorithm is then used to detect enhanced images. Evaluation metrics, including precision and recall, were used to assess the impact of image enhancement on detection performance. Results indicate that the modified mean-standard deviation contrast stretching method significantly improves image clarity and object detectability, achieving a precision of 0.592 and a recall of 0.211. However, these results are still lacking to be considered as good result for object detection. Thus, further improvement is required to analyze the data. This research is expected to make significant contributions to the study of paleoclimatology and the development of deep learning-based object detection methods in the future.

Keywords – *Nannofossil; Image Enhance; Image Processing; Object Detection; YOLO v8; ESRGAN; Contrast Stratching*

[SPMI-11]
Clustering in a Sensor Array System Based on the Distribution of Volatile Compounds from Palm Oil Using Electronic Nose

Taufiq Choirul Amri, Riyanarto Sarno, Dwi Sunaryono and Rizqy Ahsana Putri (Institut Teknologi Sepuluh Nopember, Indonesia)

Abstract – Unsaturated fat in palm cooking oil becomes dangerous if repeated heating to become trans-fat which is carcinogenic. Many circulating used cooking oils that are not fit for consumption are clarified in various ways, but this process does not change the composition of the harmful substances it contains so that it remains dangerous if consumed. In previous studies, the method often used was Gas Chromatography - Mass Spectrometry (GC-MS), by providing complete compound results. However, the use of this method has a long process and high costs. The previous method e-nose (electronic nose) was used to differentiate cooking oil from a mixture of olive oil and lard. However, there has been no research that focuses on e-nose to detect the quality of cooking oil. In this research, the e-nose was used to differentiate between used cooking oil and fresh cooking oil. Based on the clustering results, there is a distribution that separates fresh and used oil. The results of this study are expected to be an alternative to measure the quality of cooking oil quickly and easily. In addition, the results of this study can also assist in efforts to improve public health through food quality control.

Keywords – *Electronic Nose; Cooking Oil Quality; Clustering; Fresh Cooking Oil; Signal processing*

[SPMI-12]
Performance Investigation of Customized MFCC Feature Extraction in Recognizing Indonesian Conversational Emotion

Noor S Halimah (Gadjah Mada University & UGM, Indonesia); Risanuri Hidayat (Gadjah Mada University (UGM), Indonesia); I Wayan Mustika (Universitas Gadjah Mada, Indonesia)

Abstract – Modifying the MFCC extraction process is an opportunity to improve Indonesian SER performance. This work confirmed the performance of MFCC features obtained by customized MFCC extraction that was built to vary parameter values in the MFCC extraction steps. Utilizing customized MFCC features with single-layer LSTM as a classifier model shows better performance compared with SVM using PCA, which results in a training accuracy of 0.789 and a testing accuracy of 0.787. K-fold cross-validation was confirmed with an average accuracy of 0.816 using k value 5 and 0.879 with k value 10.

Keywords – *Indonesian Conversational Emotion; Speech Emotion Recognition; MFCC; LSTM; SVM with PCA; Accuracy*

[SPMI-13]
Instance Segmentation-Based Shrimp Weight Predictor Using YOLOv8 and Bayesian Regression Model

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Abstract – Shrimp Farmers traditionally measure shrimp's size by picking them from the pond using a net, putting them into scales, drying them, and counting the average body weight. This method is time-consuming.

Additionally, continuous and high-frequency sampling, which is essential for accurate shrimp growth prediction and efficient shrimp farming, is challenging with traditional methods.

In this paper, We developed a method of shrimp weight sampling using computer vision and machine learning model. The proposed system achieves an 11.74% MAPE score for individual weight prediction and a 6.59% MAPE score for ABW prediction with a 96% detection rate..

Keywords –

[SPMI-14]
Image-Based Orientation for Printed Arabic Character Analysis

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Abstract – Printed documents exhibit distinct features that are influenced by the specific printers employed. The objective is to ascertain the distinct attributes of the printouts produced by each printer and evaluate whether any disparities exist between them. Therefore, the use of source identification is anticipated to yield optimal decision outcomes. Therefore, the present study employs the Arabic character (ب) along with four different printer models, including the HP DesignJet 111, HP LaserJet 4350, HP Colour LaserJet CP3525, and HP LaserJet 4100, to collect sample data. Subsequently, the data will be subjected to analysis with the OrientationJ plugin. Consequently, this study provides valuable insights into the differentiation of sources through the analysis of written Arabic characters. It is worth mentioning that the LJ-3525 printer produces a more concentrated range of colors in comparison to other printers, whilst the DS-111 printer demonstrates a more extensively distributed color profile.

Keywords – *Image-based orientation; Arabic Character; Printed document; printer*

[SPMI-15]
Multi-Task Learning Aspect Based Sentiment Analysis with BERT

Muhammad Naufal Hakim, Syukron Abu Ishaq Alfarozi and Paulus Insap Santosa
(Universitas Gadjah Mada, Indonesia)

Abstract – Recent advances in sentiment analysis have enabled the categorization of text into positive, negative, and neutral classes. Despite these advances, sentiment analysis often fails to capture specific aspects or topics with sufficient detail. To remedy this, previous research has introduced Aspect-Based Sentiment Analysis, which discerns sentiment based on particular aspects within a text. The latest developments in ABSA have employed multi-label learning principles, deploying a classifier for each aspect label present in the dataset to simultaneously classify aspects and sentiment.

This study seeks to investigate the application of multi-task learning (MTL) in ABSA models, employing two classifiers for each label: one dedicated to aspect classification and another to sentiment classification. As a result, each classifier within the model gains enhanced specialization, focusing on a more specific task. Additionally, the model will learn from the combined loss values of both aspect and sentiment tasks, utilizing a weighted sum loss approach. This method allows for performance enhancement by adjusting the weight values between aspect and sentiment classification tasks, where the aspect weight is denoted as α and the sentiment weight as 1 - α.

The results of this study demonstrate that the multi-task learning model achieved an F1 score of 96.16% in the unified classification of aspects and sentiments, generally outperforming non-multi-task learning models. In addition, the MTL model exhibits superior performance in both aspect classification, with an F1 score of 96.93%, and sentiment classification, with an F1 score of 94.13%. The optimal performance in these tasks is attained with a slightly higher emphasis on aspect classification, where α is set to 0.55, highlighting the importance of this weighting for accurate sentiment prediction.

Keywords – *aspect based sentiment analysis; multi-task learning; multi-label learning; BERT; weighted-sum loss*

[SPMI-16]
Impact of Rhythm, Tempo, and Rest Variations on Pitch Detection in Deep Learning-Based Piano Transcription Models

Priyakorn Pangwapee and Juthakan Mekkoktanphira (King Mongkut's Institute of Technology Ladkrabang, Thailand); Nat Dilokthanakul (King Mongkuts Institute of Technology Ladkrabang, Thailand); Sirasit Lochanachit, Nont Kanungsukkasem and Praphan Pavarangkoon (King Mongkut's Institute of Technology Ladkrabang, Thailand)

Abstract – This paper investigates the impact of rhythm, tempo, and rest variations on pitch detection in deep learning-based models for piano transcription. We conducted a series of experiments using GRU and Transformer architectures, manipulating note lengths, rhythmic patterns, and rest intervals to assess their effect on pitch transcription accuracy. Our findings indicate that model performance is significantly influenced by these musical factors. The experiment with GRU shows notable sensitivity to rhythmic and rest changes. However, the Transformer model handles varied conditions more robustly.

These findings help refine our approach to music transcription software, particularly in improving pitch recognition across varied rhythmic patterns, tempos and rests.

Keywords – *Pitch Detection; Piano Transcription; Deep Learning; Music Education*

[SPMI-17]
Comparison of Various Windowing Methods on Filter Bank for Speech Recognition

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Abstract – Mel-Frequency Cepstral Coefficients (MFCC) are one of the techniques used for extracting audio features. In the MFCC feature extraction process, there is a step called Mel Frequency Wrapping, which is based on a band-pass filter. Typically, this band-pass filter uses a triangular filter. This paper proposes to compare the triangular filter with several windowing methods in the Mel filter bank. The windowing methods chosen for comparison are the Hamming Window, Hanning Window, and Blackman Window. The data used in this study consists of audio recordings of the pronunciation of the numbers 0 to 9 in Bahasa Indonesia. The results show that the Blackman window achieves the highest accuracy at 96.43%, with a reduction in standard deviation.

Keywords – *MFCC; Mel Frequency Wrapping; Filter bank; Windowing*

[SPMI-18]
Paddy Rows Detection in "Legowo" Paddy Field Based on YOLO and Hough Transform

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Abstract – Paddy is one of the most important commodities in Indonesia where the result of it which is rice is one of the primary foods of Indonesian residents. Amid the dynamics of rice farming, the "Jajar Legowo" planting system emerged as an innovation that attracted attention. However, currently, activities such as controlling weeds and planting paddy in Indonesia are still carried out using human power. This is less efficient because this activity should be carried out automatically using a smart tractor. When designing an autonomous vehicle, one of the things that needs to be considered is how the vehicle can move steadily along its path. To meet these conditions, a paddy rows detector can be designed. Paddy row detection will be carried out using YOLOv4 and Hough transform. YOLOv4 is used to detect paddy position coordinates. The paddy detection results are then processed using the Hough transform to produce virtual lines depicting rows of paddy. The paddy rows detection model has been successfully designed and achieved performance, namely a detection speed of 21 fps with paddy rows angle detection accuracy of 97.5%.

Keywords – *Hough transform; legowo paddy field; paddy rows detection; YOLO*

[SPMI-19]
Improving Image Fidelity Using Skip Connections Autoencoder

Atyanta Nika Rumaksari (Universitas Gadjah Mada, Indonesia & Satya Wacana Christian University, Indonesia); Risanuri Hidayat (Gadjah Mada University (UGM), Indonesia); Rudy Hartanto (Gadjah Mada University & Electrical Engineering and Information Technology Departmen, Faculty of Engineering Gadjah Mada University, Indonesia)

Abstract – This study presents an advanced autoencoder model with skip connections designed to enhance the image fidelity quality. Traditional methods often face challenges in preserving high-resolution details and textures, particularly in tasks involving noise reduction, super-resolution, and low-light enhancement. Our model leverages skip connections to maintain essential spatial information across different layers, effectively addressing the vanishing gradient problem and improving gradient propagation during training. We compare our model against several state-of-the-art methods, including the Overall Improved Autoencoder (OIAE), Cascade Decoders-Based Autoencoders, and Edge-Aware Autoencoder Design, evaluating performance based on Mean Squared Error (MSE), Peak Signal-to-Noise Ratio (PSNR), and Structural Similarity Index (SSIM). Our autoencoder consistently achieves superior results, with MSE of 5.889e-05, PSNR consistently above 40 dB, and SSIM close to 1. These findings demonstrate the significant advantages of incorporating skip connections, which allow for better retention of high-resolution features and more accurate image reconstructions.

Keywords – *Image Fidelity; Autoencoder; Image Reconstruction; Skip Connection*

[SPMI-20]
Robust Quality Clustering of Rice Varieties Using Object Detection

Farah Athaya Harukirana, Addin Suwastono and Wahyu Dewanto (Universitas Gadjah Mada, Indonesia); Igi Ardiyanto (Universitas Gadjah Mada & Faculty of Engineering, Indonesia); Risanuri Hidayat (Gadjah Mada University (UGM), Indonesia)

Abstract – The classification of rice according to SNI 6128:2020 is essential for ensuring eligibility and standardizing rice quality. An automated classification system is necessary to achieve accurate, objective, fast, cost-effective, and efficient results. This study develops an automated classification system to address the diverse rice varieties in Indonesia, generally categorized as short, medium, and long. The research findings are crucial for aiding farmers in enhancing their rice production standards. The study utilized actual rice samples available to farmers, represented by specific variety of rice from Indonesia. The research utilized datasets comprising short and long-grain rice as per SNI standards, while medium-grain data were sourced from available online datasets. The datasets were trained using one-stage object detection algorithms: YOLOv5-x, YOLOv7-x, and YOLOv8-x. The findings indicate that YOLOv7-x exhibited the best performance, with the short grain model achieving a mAP0.5 of 99.39% and a mAP0.5:0.95 of 88.61%. Furthermore, the short-grain dataset demonstrated the highest accuracy, followed by medium and long-grain datasets, meanwhile YOLOv8-x had faster training time, 1.004 to 2.35 or 0.437% to 57.5% faster. Notably, the accuracy for the medium grain dataset also showed improvement compared to Karlwillem's rice quality detection using YOLOv4. where mAP50 was 98.2%.

Keywords – *SNI Rice Quality; YOLOv5; YOLOv7; YOLOv8; Rice Varieties; Object Detection; Machine Learning; Single-Stage Object Detectio*

II. iBioMed

[IB-1]
Advanced Clinical Diagnostic Models for ECG Pulse Classification in Arrhythmia Detection

Renann G Baldovino, Patricia Mikaela S Almonte, Claire Marquiz C Caliwag, Izabelle Nisha Maxine D Chan and Jaun Raquel A Lato (De La Salle University, Philippines)

Abstract – The significance of observing the abnormalities in the human heartbeat is to detect the presence of arrhythmia for any given population. Arrhythmia is the condition wherein the heart beats at a pace different from usual, may it be faster or slower. This occurrence is associated with various cardiovascular risks, posing threats to vital organs if not diagnosed immediately. This paper implemented three predictive algorithms with aims of providing reliable insights towards the diagnosis of regular and irregular pulse readings. Through an ensemble approach, featuring a voting classification between the predictions of three learning models, namely logistic regression, decision tree classifier, and support vector classification, a diagnostic model was implemented to improve clinical decisions. This approach was made to ensure a reliable decision support system through the consideration of several machine learning model predictions, eliminating risks of misclassification due to errors, biases, and irregularities.

Keywords – *arrhythmia; diagnostics; electrocardiogram (ECG); machine learning*

[IB-2]
Development and Evaluation of Automatic Facemask Template Generator

Takehito Kikuchi (Oita University & Faculty of Engineering, Japan)

Abstract – The COVID-19 pandemic has resulted in the normalization of wearing masks in public spaces. Face masks can be classified as disposable and non-disposable. Disposable masks are clean, but their burden on the ecosystem is non-negligible. Microplastic expansion from illegal waste significantly destroys the ecological sustainability of oceans and land. The use of cloth masks effectively prevents the spread of microplastics. However, cloth masks are generally inferior to disposable non-woven masks in terms of droplet protection. In addition, commercially available masks assume symmetrical faces and are unsuitable for faces deformed by diseases or accidents. Therefore, it is important to make cloth masks that fit the faces of individuals. To address this problem, we developed a prototype of an automatic facemask template generator for individuals using the three-dimensional surface data of their faces. In a previous study, we proposed the generation of a face mask template from a set of portrait and profile images of a user's face. This method was evaluated using airflow tests to check for air leakage around the masks. The results show that the proposed mask has a better protection ability; however, its fitness also affects the three-dimensional shapes of faces. To improve the fitting and droplet protection performance, we developed a new method for an automatic template generator using three-dimensional facial data. This study describes the basic architecture of the generator and the results of airflow and fitness tests as evaluations. Flow analysis was conducted using particle image velocimetry and a mannequin with three types of facemasks. The airflow around the proposed mask successfully reduced the flow leakage compared to the other masks. In the fitness experiments, two masks were fabricated using this software and the positional error for each feature point was measured. Subsequently, although the maximum error was approximately 20 mm for the mental protuberance, the subjects subjectively felt a better fit with the proposed mask.

Keywords – *face mask, image processing, face recognition, airflow measurement, particle image velocimetry*

[IB-3]
Investigation of the Effect of Roller Pump Geometry and Speed on Pulsation in Dialysis Tube

Toshiki Komatsu (Graduate School, Japan)

Abstract – Standard hemodialysis (HD) units are employed for dialyzing uremic patients and utilize roller pumps to generate blood and dialysate flow. The Wearable Artificial Kidneys (WAK) are designed for continuous renal replacement therapy 24/7, requiring prolonged or continuous operation. Consequently, the fouling of the dialysis filter is a significant consideration for the WAK due to its restricted flow speed. The ultimate objective of this study is to develop a novel roller pump with the capability to prevent filter fouling in the dialyzer. In order to elucidate the optimal pump geometry conditions, we constructed a prototype roller pump and conducted experimental investigations on the variation coefficient of the outer pressure of the pump. The experimental results revealed that when using shells without bosses, pressure fluctuations remained minimal at practical flow velocities, making it challenging to achieve a pulsating function. Conversely, the addition of bosses to the surface demonstrated the potential to increase pressure fluctuation even under identical motor operating conditions.

Keywords – *dialysis; roller pump; fouling; pulsating flow*

[IB-4]
Deep Learning Algorithms for Breast Cancer Histopathology Classification in H&E-Stained Images

Nicky Nicky and Aulia A. Iskandar (Swiss German University, Indonesia); Rose Khasana Dewi (Brawijaya University, Indonesia)

Abstract – Breast cancer is a leading cause of cancer deaths worldwide. Diagnosing breast histological images is challenging due to their complexity, compounded by the limited and unevenly distributed availability of pathology experts. This results in a burdensome and time-consuming diagnostic process, with inconsistencies due to subjectivity and varying expertise levels. Therefore, research on computer-aided diagnosis (CAD) is essential. This study aims to assist in distinguishing H&E-stained smear images from various categories of breast cancer tissues by exploring feature extraction, pre-processing, classifier, and input image strategies. The goal is to alleviate the burden on pathologists and standardize interobserver diagnoses. The method developed aims to classify breast cancer into four states and eight morphological subtypes, using feature extractors such as DenseNet201, InceptionV3, and VGG16. Pre-processing methods include data expansion, on-the-fly augmentation, stain normalization, and CLAHE. Input images and classifiers include single input images with different magnifications and multiple patches with majority voting. Analytical methods used were accuracy and loss curves, and evaluation measures included accuracy, precision, and F1-score. The optimal model for 4-class classification used single input images with multiple magnifications, achieving an accuracy, precision, recall, and F1 score of 93.26%, 95.33%, 95.41%, and 95.35%. For 8-class classification, the best model used multiple patches with majority voting, achieving an accuracy, precision, and F1-score of 91.25%, 91.96%, and 91.21%. Despite limitations, this method shows potential for improving tissue analysis and aiding classification. In the future, it may be adapted to help diagnose breast cancer in Indonesia, enhancing diagnostic accuracy and efficiency.

Keywords – *breast cancer; histopathology; classification; subtypes; machine learning*

[IB-7]
Emerging Technologies of Sensor-Based Assistive Devices for Spinal Position Monitoring: A Review

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(De La Salle University, Philippines)

Abstract – Spinal deformities encompass a variety of postural disorders resulting from abnormalities in the thoracolumbar spine. Conventional diagnostic methods for spinal deformities are expensive and carry health risks, driving the search for alternative, non-invasive techniques for monitoring and visualizing spine posture. Inertial measurement unit (IMU) sensors, which combine accelerometers and gyroscopes, can detect both rotational and acceleration movements of the body, thereby determining its position and orientation across three spatial axes. This review paper aims to summarize the latest technological developments in the area of spinal position monitoring and mapping through the use of various sensors. Eighteen papers were analyzed in this review identifying the specific area of application and sensor type utilized. Most papers used IMUs as the main positional monitoring system however some supplemented the sensor system with motion capture technology. A lack of information regarding signal processing has been observed in the majority of the papers in this review indicating no standardization on how positional mapping is applied. Most papers also require the presence of medical experts to operate the technology presenting the need to develop more accessible technologies for patients in this field.

Keywords – *spinal deformities; lower back pain; scoliosis; IMU; positional analysis*

[IB-8]
Pulmonary Tuberculosis Detection Using an Ensemble of ConvNeXts

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Abstract – This study discusses the efficacy of a new ensemble transfer learning (TL) method for tuberculosis (TB) detection. We used a newly introduced convolutional-based deep learning architecture, dubbed ConvNeXt, as the backbone model. We further applied two TL approaches at some middle layers of a pre-trained model (PTM) considered in this study, including ConvNeXt-Tiny, Small, and Base variants. Two different cutting approaches are used, namely the Hard Cut where features extracted from a middle layer are passed directly to the classifier, and Soft Cut where features extracted from a middle layer are fine-tuned to the classifier model. The experimental results on two popularly used TB datasets, namely the Montgomery County (MC) and the Shenzhen (SZ), the proposed ensemble TL method could enhance the detection results. The proposed ensemble with Soft Cut approach could increase the accuracy results of around 11.46% (Tiny), 8.71% (Small), 3.58% (Base) for MC and 11.18% (Tiny), 10.27% (Small), 6.65% (Base) for SZ compared to the direct method.

Keywords – *ConvNeXt; convolutional neural networks; deep learning; ensemble; transfer learning; tuberculosis detection*

[IB-10]
Lung Sound Denoising with Adaptive Noise Cancellation of Heart Sounds on a Raspberry Pi-Powered Stethoscope

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Abstract – Lung auscultation offers a quick and non-invasive diagnosis of respiratory conditions. However, background and heart noises may influence lung sound clarity and may reduce diagnosis accuracy. Heart noises are particularly challenging to separate from lung sounds due to overlapping frequencies. Therefore, this research proposes a method of reducing heart sounds through an LMS adaptive noise cancellation filter with Hilbert Transform and peak thresholding to estimate a reference heart sound signal, within a Raspberry Pi 4B-based digital stethoscope. The lung sound denoising algorithm starts with a Type 1 Chebyshev Bandpass Filter for background noise reduction, followed by wavelet threshold denoising using SureShrink adaptive thresholding, for finer noise reduction. The LMS adaptive noise cancellation filter was then applied to reduce heart sounds and ending with applying the same bandpass filter to smoothen the signal. Performance evaluation of the lung sound denoising algorithm demonstrated significant lung sound clarity improvement, with most of the background noises greatly reduced, achieving an average heart peak reduction of 87.5%, a good LMS filtering performance with a Pearson correlation coefficient of 98.9% between estimated and replicated reference signals and a large reduction in magnitude within the heart sound frequency range was observed in an FFT. The system's robust signal processing capabilities make it a promising tool for a more accurate respiratory diagnosis and has great future potential to include machine learning to diagnose respiratory diseases.

Keywords – *adaptive noise cancellation; heart sound reduction; Hilbert Transform; Raspberry Pi; digital stethoscope*

[IB-11]
An Ultrasound Image Quality Improvement Approach Based on Non-Subsampled Shearlet Transform and Maximum Local Variation-Based Unsharp Masking

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Abstract – Speckle noise is the most prominent source of poor ultrasound image quality. Likewise, the contrast in an ultrasound image is often low. Therefore, this paper presents an approach for improving ultrasound image quality. Non-subsampled Shearlet Transform (NSST) was employed to reduce speckle noise, while Maximum Local Variation-Based Unsharp Masking (MLVUM) was used to increase image contrast and sharpness. The number of decomposition levels and shearing directions in each decomposition level of the NSST was varied. The number of decomposition levels varies by 2, 3, and 4, while the number of shearing directions varies by 4, 8, and 16. The effectiveness of NSST in reducing speckle noise was evaluated using PSNR, EPI, ENL, and SSI. Meanwhile, ALC and AG were used to measure the difference in contrast and sharpness before and after using MLVUM. The results indicate that speckle noise gradually decreases as the number of image decomposition levels increases. NSST with 4-level decomposition provides the best speckle suppression. The increased speckle suppression blurs the image and makes the edges of objects less obvious. However, the use of MLVUM enhances sharpness and contrast. Meanwhile, varying the number of shearing directions at each decomposition level does not have a significant effect on denoising results.

Keywords – *ultrasound image; speckle noise; image contrast and sharpness; shearlet transform; unsharp masking*

[IB-13]
Enhancing Protein Recovery from Peanut Meal: High-Voltage Electrical Discharge as an Efficient and Green Pretreatment Method

Bhoomika Sridhar, Pronama Biswas and B M Ashwin Desai (Dayananda Sagar University, India)

Abstract – Efficient and sustainable protein extraction from agro-industrial by-products like peanut meal is crucial for maximizing their potential. This study focuses on a novel and environmentally friendly technique known as High-Voltage Electrical Discharge (HVED) for protein extraction from peanut meal. Given the increasing demand for sustainable plant-based proteins, and with peanut meal being a significant global resource, green extraction methods are essential to minimize environmental impact. This study marks the first application of HVED for peanut meal protein extraction, offering a better alternative to other conventional methods. This method utilizes high-voltage electrical discharges to disrupt cell structures and liberate proteins without the need for harsh chemicals or high temperatures. The study also focuses on optimizing Alkaline Extraction (AE) parameters, such as pH levels and solid-to-solvent ratios, to enhance protein extraction efficiency and, compares the fluorescence properties of proteins extracted via AE and HVED pretreatment. These findings underscore the potential of HVED as an efficient and sustainable pretreatment method for protein extraction, contributing to the development of environmentally friendly industrial processes.

Keywords – *HVED; Peanut meal; Protein extraction; Fluorescence spectroscopy; Bathochromic shift; Conformational changes*

[IB-14]
Multi-Ligand Simultaneous Docking Analysis of Moringa Oleifera Phytochemicals Reveals Enhanced BCL-2 Inhibition via Synergistic Action

Asmita Saha, B M Ashwin Desai and Pronama Biswas (Dayananda Sagar University, India)

Abstract – Moringa oleifera, known for its medicinal properties, contains bioactive compounds such as polyphenols and flavonoids with diverse therapeutic potentials, including anti-cancer effects. This study investigates the efficacy of M. oleifera leaf phytochemicals in inhibiting BCL-2, a critical protein involved in cancer cell survival. For the first time, multi-ligand simultaneous docking (MLSD) has been employed to understand the anti-cancer properties of M. oleifera leaf extract. Molecular docking techniques, including single-ligand and MLSD, were used to assess binding interactions with BCL-2. Single-ligand docking revealed strong binding affinities for compounds such as niazinin, alpha carotene, hesperetin, apigenin, niaziminin B, and niazimicin A, with some compounds even surpassing Venetoclax, a commercial BCL-2 inhibitor. MLSD highlighted inter-ligand interactions among apigenin, hesperetin, and niazimicin A, exhibiting a binding affinity of -14.96 kcal/mol, indicating a synergistic effect. These results shed light on the potential synergistic effects of phytochemicals when using multi-ligand simultaneous docking, underscoring the importance of considering compound interactions in the development of therapeutic strategies.

Keywords – *Moringa oleifera; Multi-ligand simultaneous docking; BCL-2; Synergistic effect*

[IB-15]
Few-Shot Weakly Supervised Segmentation for Retinal Fundus Images Using Meta-Learning

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Abstract – Automated segmentation of the optic disc (OD) and optic cup (OC) in retinal fundus images can help in early glaucoma diagnosis. Many studies used deep learning models, but they usually required a large number of densely labeled images, which is hard to obtain. Few-shot weakly supervised segmentation (FWS) can address this issue since it requires only a small number of sparsely labeled images. Some studies developed meta-learning methods for FWS, but none of them have been applied to fundus images. Thus, we implement and adjust those methods, namely WeaSeL and ProtoSeg, for multiclass segmentation on multichannel fundus images. We use a different meta-training strategy for better data uniformity and develop sparsification techniques for multiclass labels: points, grid, contours, skeleton, and regions. Multiple scenarios, variations in sparse labels, and the number of shots are evaluated. Our evaluation using WeaSeL achieves an Intersection over Union (IoU) of 0.94 for OD and 0.90 for OC using five shots with grid sparse labels. ProtoSeg even achieves an IoU of 0.95 for OD and 0.92 for OC using only one shot with contours sparse labels. These results are superior to unsupervised domain adaptation approaches and comparable to fully supervised ones.

Keywords – *few-shot; domain adaptation; meta-learning; optic cup; optic disc; weakly supervised*

[IB-16]
A Decision Support System (DSS) for Symptom-Based Differential Diagnosis in Diabetes

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Abstract – Diabetes, characterized by elevated blood sugar levels due to insulin deficiency or resistance, affects individuals across all age groups and necessitates lifelong management. Type 1 and type 2 diabetes present distinct symptoms, with type 1 often appearing suddenly and type 2 potentially remaining undetected. While traditional diagnostic methods are commonly utilized, limited access to healthcare can impede their efficacy, highlighting the need for innovative solutions. To solve this challenge, a predictive and user-friendly application providing preliminary diabetes information was developed using various machine learning algorithms. Among these, logistic regression emerged as the primary classification model, achieving the highest accuracy score of 0.94. These findings underscore the reliability and potential practical significance of the application in healthcare settings.

Keywords – *decision support system; diabetes; machine learning; user-interface*

[IB-17]
Development of an Integrated Off-Grid Audio and Haptic Wearable Vest for Visually Impaired Navigation

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Abstract – Visual impairments afflict millions globally, significantly impacting mobility and quality of life (QoL) for approximately 253 million individuals, including 36 million who are blind. Their most used tools for navigation were guide dogs and white canes; however, their effectiveness is limited by their speed, coverage, and capabilities. Additionally, related systems where internet connectivity-dependent (on-grid). With that, this study proposed an integrated system development of an off-grid audio-haptic wearable vest for visually impaired navigation. Specifically, the study will develop a personalized audio and haptic wearable navigation system tailored for the blind and visually impaired individuals, develop a prototype with IoT capabilities, and assess the system's accuracy by determining the distance and direction for wearable navigation through audio-haptic feedback. Processing GY-273 magnetometer data for bearing and NRF51822 BLE scanning for distance, were completed considering both unobstructed and obstructed real-world scenarios within the school campus. Results showed that system was capable of auditory directional notification such as "turn left", "turn right" and "destination address" simultaneously with haptic feedback thru vibrations. Also, using the nonparametric Mann-Whitney U test, for obstructed (real-life) distances, the accuracy ranged is up to 91.43%. While unobstructed distances accuracy was up to 100%. Obstructed (real-life) bearing accuracy from up to 100%, while unobstructed bearing accuracy was also up to 100%. Indicating that there is slight difference between the expected and actual values for distance while bearing measurements prove no difference enabling the seamless integration of haptic and aural commands to improve navigation support for individuals with visual impairments.

Keywords – *assistive devices; IoT; visually impaired; wearable technology*

[IB-19]
Physics Informed Neural Network for Fitting Ultra High Field Magnetic Resonance Spectrum

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Abstract – Traditional neural networks have shown promising performance in fitting proton Magnetic Resonance Spectroscopy (1H-MRS). However, they have difficulty adapting to low abundance metabolites and have limitations that make them difficult to use in clinical applications: the training database needs to be large and they do not take into account the physical reality of 1H-MRS. Recently, a new neural network method has emerged, the Physics Informed Neural Network (PINN), which links neural networks to physical laws. It provides a promising solution for fitting 1H-MRS data. In this paper, we propose a PINN framework for fitting 1H-MRS 7T data. The proposed method consists of an end-to-end one-dimensional CNN encoder-decoder model integrating a new method of discriminative spectral parameter extraction and weight adjustment guided by the physical reality of 1H-MRS. The data used in this article are collected in our center, which contain 90 1H-MRS samples, healthy and pathological, from multilobe white and grey matter. The proposed framework gives similar and better results than the current scientific literature with a speed of 0.030 ms for the 1H-MRS 7T fitting task. Thus, our model provide accurate and fast fitting of brain metabolites in clinical contexts that can discriminate pathologies.

Keywords – *Physic Informed Neural Network; PINN; Proton Magnetic Resonance Spectroscopy; 1H-MRS fitting*

[IB-20]
Optimized Obstacle Detection for the Visually Impaired Using a Machine Learning-Based Modified Map Function for Ultrasonic Sensors

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Abstract – The Lancet Global Health Commission on Global Eye Health reported in 2020 that the number of people with visual impairment is rising, with a total estimate of 43 million being blind worldwide. With this, numerous studies were conducted, aiming to develop an assistive technology using ultrasonic waves to detect obstacles. There is, however, a limited study that develops an assistive technology with the integration of ultrasonic sensors for obstacle detection and optimizes its system through machine learning (ML). In response, this study proposed an adaptive system that can accurately detect and navigate around obstacles by integrating ML-based modified map function methods. Specifically, design a wearable obstacle detection technology using integrated microcontrollers, ultrasonic, audio, and vibration; develop the system using a ML algorithm; and optimize the accuracy using the improved system of wearable obstacle detection technology. Among the 10 ML regression algorithms, the ridge regression (L2) was the best ML suited for proposed modified map function (MSE = 9.36, R2 = 1), whereas its generated regression equation (y = 92.23 + 1.04x) is used to optimize its obstacle detection performance. The proposed ML-based modified map function system improved the device's obstacle detection performance by 99% compared to the traditional map function's 97.77% accuracy. As a result, the performance of ultrasonic sensors in detecting obstacles was maximizes utilizing a ML-based modified map function method - thus making safer utilization for visually impaired obstacle detection.

Keywords – *assistive devices; machine learning; ultrasonic sensors; visually impaired; wearable technology*

[IB-21]
Hyperparameter Selection for a Breast Cancer Classification Using Machine Learning

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Abstract – Breast cancer is a disease that attacks breast cells in women. One way to assist in diagnosis is to use ultrasound and mammography intelligently using machine learning. There are several algorithms of machine learning that need to determine the selection of hyper-parameters in order to produce a model with the best accuracy. Therefore, this research conducts experiments to determine the best performance of hyperparameters for each machine learning algorithm. The research stages include: data preprocessing, feature extraction, classification, and evaluation. The feature extraction process uses depthwise convolution feature fusion, while the classification process uses five machine learning algorithms, namely SVM, Random Forest, KNN, Decision Tree and Logistic Regression with k-fold cross-validation. The results of testing several hyperparameters of each machine learning algorithm show the best average accuracy. On ultrasound images, the best average accuracy is obtained by the svm algorithm with a 'linear' hyperparameter of 84.35%, while on mammography images, there is a random forest algorithm with a min_samples_split-2 hyperparameter of 92.80%. After testing, the best performance was obtained using the logistic regression algorithm with an accuracy validation value of 86.50% on ultrasound images and 95.90% on mammography images. In the ROC and precision recall curve, the best performance is produced by the LR algorithm on ultrasound images with a value of 0.95 and on mammography images, the RF algorithm provides the best value of 0.98. The use of appropriate algorithms and hyperparameters can improve accuracy and precision in disease detection and diagnosis.

Keywords – *Machine Learning; Hyperparameter; Breast Cancer*

[IB-22]
Leveraging Bidirectional Long Short-Term Memory with Bayesian Optimization for Accurate Eye Movement Classification

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Abstract – The Covid-19 outbreak has accelerated scientific growth, especially in touchless technology to reduce disease transmission. Despite its 30-year history, the gaze-based user interface remains underused in touchless technology. This is due to the intricate challenges associated with eye movement classification, particularly for complex time series data. Despite prior efforts, hyperparameter optimization (HPO) for enhancing deep learning in eye movement classification has been largely overlooked. To address this scientific gap, we leveraged the Bayesian Optimization for Bidirectional Long Short-Term Memory (Bi-LSTM) to enhance the accuracy of eye movement classification. We compared the proposed method with several state-of-the-art deep learning models for time series classification. We also implemented other pervasive HPO techniques, such as Grid Search and Randomized Search. We focused on several key hyperparameters, including initialization mode, activation function, learning rate, and optimizer. Experimental results show that the Bi-LSTM with Bayesian Optimization achieved F-1 scores of 0.86 and 0.81 for fixation and smooth pursuit eye movement, respectively. The overall accuracy of the proposed method is 0.79. The experimental results indicate that the proposed method is promising for future development of eye movement-based touchless technology.

Keywords – *Optimization; Hyperparameter tuning; Deep learning; Eye movement classification; Eye tracking*

[IB-23]
A Systematic Literature Review of Artificial Intelligence on Medical Imaging: COVID-19 and Tuberculosis Classification

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Abstract – Medical imaging techniques play a pivotal role in disease management and monitoring. Image scans offer a magnified lens into the intricate workings of human body parts with clear, precise information, and fast image acquisition. In particular, chest imaging reveals lung conditions, including COVID-19 and tuberculosis. However, even skilled radiologists may find it challenging to evaluate minor variations in the amount and nature of lung abnormalities. Artificial intelligence (AI) emerges as a promising solution. AI can support conventional medical imaging equipment by providing computational power to process images more quickly and accurately. Despite this potential, comprehensive studies on AI's benefits in medical imaging remain scarce, especially for COVID-19 and tuberculosis. These conditions share structural similarities in their radiological patterns, emphasizing the need for targeted research. To address this research gap, this review paper provides an AI-powered method of tracking, diagnosis, and prognosis of COVID-19 and tuberculosis using different types of medical imaging scans. Several models, including deep learning architectures and convolutional neural network (CNN), are examined in this comprehensive review. The analysis demonstrates how well they classify lung ailments; certain models have accuracy rates as high as 98.80% accuracy for TB and 98.31% for COVID-19. However, there are still issues, namely the improvement of AI transparency and its incorporation into clinical practice. Reducing diagnostic errors and enabling faster treatment are two ways in which addressing these concerns could improve patient care.

Keywords – *Medical imaging techniques; Lung conditions; COVID-19; Tubercolosis; Artificial intelligence*

[IB-24]
A Fusion of Transfer Learning Features on Breast Cancer Classification

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Abstract – This paper presents a feature extraction fusion method that can help improve the performance of breast cancer classification. Specifically, we conducted three experiments to determine the performance of feature extraction performance, namely: feature extraction with one model and fusion of feature extraction on 2 and 3 transfer learning models. We combine features that are considered rich information that can capture the deep features of the image. The dataset used in this study is a private dataset collected from hospital patients. The data set is in the form of images divided into 2 modalities, namely ultrasound and MAMO. This research introduces a new approach to the incorporation of feature extraction to distinguish between benign and malignant classes. The results obtained from the mammography image yielded an accuracy of 93% and ultrasound yielded an accuracy of 98% when combining the three feature extractions InceptionV3, VGG19, and Xception, so this study shows the potential of combining three feature extractions on MAMO and ultrasound to improve the accuracy of breast cancer classification, and the experimental results show that the accuracy of combining 3 models is the highest.

Keywords – *Breast Cancer; Deep Learning; Mammography; Ultrasound; Feature Fusion*

[IB-25]
3D Reconstruction Techniques for Visualization of the Internal Carotid Artery in the Brain Vascular System

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Abstract – This study explores the integration of 3D Time-of-Flight Magnetic Resonance Angiography (TOF MRA) and advanced 3D reconstruction techniques to improve the visualization of the internal carotid artery. Utilizing DICOM data, the research involved preprocessing steps such as skull stripping using the HDBET algorithm, denoising with morphological operations, and optimizing window width and center to prepare high-quality imaging data. The post-processing stages included 3D reconstruction via the Marching Cubes algorithm, meshing to form detailed polygonal networks, and smoothing with the Laplacian filter to enhance the model's geometric accuracy. The study demonstrates significant advancements in medical imaging, providing a clearer, more detailed anatomical representation, crucial for accurate diagnosis, surgical planning, and treatment of cerebrovascular conditions.

Keywords – *3D TOF MRA; DICOM; 3D reconstruction; Marching Cubes algorithm; Skull stripping*

[IB-26]
Deep Learning on Automatic ICD Coding for Clinical Decision Support Systems: Review

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Abstract – International Code of Disease is a coding method for diagnosing diseases using a clinical text has a lot of benefit uses such as insurance claim, medical bill, and finance of hospital. However, this coding method is a high complexity process with high risk of failures. Recently, researcher has explored the use of Natural Language Processing and various Classification Model in order to develop Automatic ICD Coding to encounter the manual coding process by giving assistant for doctor and medical staff. This literature review's objective is to analyze and provide comprehensive overview about Automatic ICD Coding research. We conducted Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram as guiding principle and created keyword to search relevant paper between 2021 and 2024 on SCOPUS database. Our review included 25 relevant paper to be reviewed. This literature review shows: the 10th version of ICD code is the most popular version with 15 studies; 17080 categories have employed on Automatic ICD coding systems; MIMIC-III have been used by 14 studies and the others used private dataset from different sources; 18 studies conducted Automatic ICD code with English dataset; 17 studies used Tokenizing to preprocess dataset; Word2Vec have been used by 13 studies to extract information from dataset; Researcher has been conducted their own novel classification model to be implemented on Automatic ICD Coding Systems. Our review shows prospective findings for future research. Future research still can explore to implement various dataset, languages, NLP technique, classification model for developing automatic ICD Coding systems.

Keywords – *ICD; CDSS; Automatic ICD Coding; Clinical Notes.*

[IB-27]
SurgiColab: Collaborative Mixed Reality for Enhanced Pre-Surgical Planning with 3D Anatomical Models

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Abstract – Mixed Reality (MR) merges the physical and virtual worlds, allowing real and virtual objects to interact in real-time. This research explores a novel Mixed Reality (MR) application for collaborative surgical planning. Traditional surgical planning with 2D medical imaging poses challenges in visualising complex anatomical details. An effective collaborative planning between multiple doctors involved in the procedure requires them to easily visualise a 3D anatomical structure in a common space. The MR solution, SurgiColab, discussed in the paper allows surgeons to interact with patient-specific 3D models in an immersive environment using Microsoft HoloLens 2. SurgiColab offers key features like importing intricate 3D organ models, manipulating them for in-depth analysis (position, scale, rotation), and a clipping function to visualise internal structures. Doctor testing confirmed the application's effectiveness, where compared to traditional methods, it enhanced and facilitated teamwork. Surgeons reported a minimised cognitive workload and improved preoperative visualisation, streamlining surgical planning.

Keywords – *Mixed Reality; Augmented Reality; Microsoft HoloLens 2; Pre-Surgical Planning; Preoperative Planning; Spatial Anchors; Collaboration*

[IB-29]
Skin Cancer Segmentation and Feature Extraction of Dermatoscopy Images Based on Deep Learning U-Net

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Abstract – The Global Burden of Cancer Study (Globocan) by the World Health Organization (WHO) reported that the number of cancer cases in Indonesia in 2020 reached 396,914, with total cancer-related deaths reaching 234,511 cases. Skin cancer accounted for 5.9 - 7.8% of the total cancer cases. The cure rate can increase up to 90% with early detection, but early detection is considered complex and subjective, often leading to delayed skin cancer diagnosis. Consequently, a Computer-Aided Diagnostic (CAD) system, designed to enhance diagnostic accuracy, has been developed. Automated diagnosis of dermatoscopic images faces challenges due to complex variations in appearance. In this study, a system is proposed consisting of image preprocessing which is done to improve image quality, image segmentation using U-Net which is done to separate the lesion from the image background, and feature extraction using the ABCD method which takes several shape and color features in the image, namely asymmetry (A), edge or border (B), color or color (C), and diameter (D). From the tests carried out, the U-Net model used uses an epoch parameter of 50 with a learning rate of 0.0001. The evaluation value of this model on test data is 0.81 for DSC evaluation, 0.25 for loss evaluation, and 0.68 for IoU evaluation. Lesions with high asymmetry and large, irregular perimeters are often associated with malignant skin cancers such as AKIEC, BCC, and MEL. Additionally, high red color intensity in lesions may indicate inflammation or increased vascularization, which are important factors to consider in the assessment and diagnosis of skin lesions.

Keywords – *Skin Cancer; Segmentation; Feature Extraction; ABCD Method; Convolutional Neural Network; U-Net*

[IB-30]
Improving Conjunctiva Segmentation for Robust Anemia Detection Using Raspberry Pi's Camera and Macro Lens

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Abstract – Anemia is a global health concern with significant implications, particularly for vulnerable populations such as pregnant women and children. Due to its often asymptomatic nature, many individuals in developing countries remain undiagnosed. Additionally, invasive anemia testing can be uncomfortable. Conversely, conjunctival examination is frequently used as an initial screening method by physicians, given its closer proximity to the heart compared to the palms and nail beds. Therefore, this study aims to automatically segment the conjunctiva using an optimized UNBCSM (UNet Based Conjunctiva Segmentation) model. This approach could facilitate the development of non-invasive anemia detection methods based on the obtained segmentation results. Image augmentation and model adjustments were implemented to enhance data volume and model performance. The results demonstrate that the inclusion of various augmentations and parameter optimization yielded satisfactory Intersection over Union (IoU) values of 96.6% and 92.1% for training and validation datasets, respectively.

Keywords – *Anemia; Conjunctiva segmentation; Image processing*

[IB-31]
Design of A Biopotential Amplifier for ECG

Prapto Nugroho and Azami Muhammad Farraz (Universitas Gadjah Mada, Indonesia);
Sigit Basuki Wibowo (Gadjah Mada University, Indonesia)

Abstract – This article presents the design and development of a biopotential amplifier circuit for EKG data acquisition. The circuit method and design are detailed extensively. The circuit is subsequently assembled onto a Printed Circuit Board (PCB) and its functionality were tested. Test results indicate that the biopotential amplifier design for ECG functions well according to specified requirements, successfully displaying ECG signals clearly

Keywords – *Biopotential amplifier; Electrocardiogram (ECG)*

[IB-33]
Analysis of Deep Learning Models for Disease Diagnosis in Laryngoscopic NBI Images

Pratham Tejas Shah, Kanika Prasad Chitnis, Arjun Brajesh Pareek, Alfin Ashpak Patel and Narendra Shekokar (Mumbai University, India)

Abstract – In today's time, the number of cases of throat diseases has shown the significant increase. These changes are because of several reasons but mainly due to environmental pollution, increase in the aging population and abuse of toxic substances. Identification of these diseases in crucial due to their high impact on the human life. Throat diseases can often lead to severe symptoms including pain, difficulty in swallowing and breathing problems. Early diagnosis and treatment are essential to prevent complications, improve patient outcomes and enhance the quality of life. Contact endoscopy is a technique that was originally designed to visualize cervical and uterine epithelial cells in order to test for and diagnose cervical and uterine disease. Over time, it has been used as a diagnostic tool for a variety of laryngeal diseases. Contact Endoscopy of the Larynx, also known as Contact Micro-Laryngoscopy, is a minimally invasive procedure that provides real-time information regarding the cellular and vascular anatomy of the superficial layer of laryngeal mucosa. This research focuses on the use of Contact Endoscopy and Narrow Band Imaging (CE-NBI) to identify anomalies in the larynx or throat. Index Terms-laryngoscopy, benign, malignant, lesions Index Terms-laryngoscopy, benign, malignant, lesions.

Keywords – *laryngoscopy; benign; malignant; lesions*

[IB-34]
Optimizing Image Quality and Diagnostic Accuracy in Impedance Tomography with Gastric Phantom Model

Ridwan Wicaksono (Universitas Gadjah Mada, Thailand); Prima Nafisman, Muhammad Fathur R., Habib Fabian Fahlesi, Dheandy Keriswasiat and Chenaniah Chenaniah (Universitas Gadjah Mada, Indonesia)

Abstract – The phantom model imaging system enables real-time data processing and visualization through Electrical Impedance Tomography (EIT). In gastric impedance tomography, a series of electrodes placed around the phantom measure electrical impedance, thereby monitoring the distribution and motility of gastric contents. The diagnostic system's performance is evaluated based on accuracy, response time, and measurement reliability, with data analyzed using statistical metrics such as mean absolute error and correlation coefficient. Image reconstruction aims to obtain an optimal range of image values to ensure superior image quality. This process involves reconstructing the mesh area for analysis and determining computational speed in image reconstruction. The hyperparameter pVal is utilized to find the optimal value for the EIT image shape that approximates the boundary ground truth with the smallest pixel error, while lambVal is optimized for detail and accuracy of the image scale factor. Validation of image reconstruction results is conducted using qualitative methods, comparing the real image boundary and its convergence range, as well as quantitative methods, employing statistical techniques and numerical measurements for more objective validation.

Keywords – *Electrical Impedance Tomography (EIT); Phantom Model; Gastric Monitoring; Image Reconstruction; Hyperparameter Optimization*

[IB-35]
Application of Asymmetric Windowing Recurrence Plots in ECG Signal Encoding for Emotion Classification

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Abstract – Human emotions are influenced by various external stimuli but can often be concealed through facial expressions. Therefore, detecting emotions using physiological signals becomes a more reliable alternative, as humans cannot easily manipulate their subconscious responses. This study aims to classify human emotional states based on electrocardiogram (ECG) signals using the LeNet-5 model. The main contribution of this research is the improved accuracy in classifying valence and arousal based on ECG signals obtained from two public datasets, namely AMIGOS and DREAMER. The Asymmetric Windowing Recurrence Plots (AWRP) encoding technique is applied to transform the cardiac signals into two-dimensional (2D) images, enabling more in-depth and accurate analysis. The results show classification using the AWRP encoding technique outperforms recurrence plot performance even with a small amount of data. The accuracy results using the AWRP encoding technique were compared with the recurrence plots encoding technique. The AMIGOS dataset achieved its best accuracy with AWRP32 at 0.747896, while the DREAMER dataset achieved its best accuracy with AWRP98 at 0.856884. The results revealed that the AWRP encoding technique had a better capability than recurrence plots in transforming time series data into 2D image data.

Keywords – *emotion; ecg signals; asymmetric windowing recurrence plots; LeNet-5*

[IB-36]
A Novel Feature Representation Method for Automating Genetic Variant Classification

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Abstract – Automating genetic variant classification based on the American College of Medical Genetics and Genomics (ACMG) criteria is pivotal for ensuring consistent interpretation of genetic variants. This is crucial for accurate diagnosis and effective treatment. However, manual classification is labor-intensive and prone to errors due to the massive data generated by next-generation sequencing (NGS) technologies. This research aims to design and assess an AI-based system for automatically classifying genetic variants using ACMG criteria. Deploying AI in genetic variant classification presents several challenges. One significant issue is combining multiple features and designing effective feature representation. This paper proposes a novel feature representation method called cancer feature representation (CVR). We aggregated ACMG-related criteria and transformed them into 118,125 features. We evaluated our model with eleven machine learning algorithms using experimental data with 23,198 variants. The result showed that our method provided the highest performance with accuracy = 0.9966 compared to existing methods.

Keywords – *Variant Classification; Machine Learning; Artificial Intelligence; ACMG Guideline; Feature Representation*

[IB-37]
Relating Muscle Activity and Mouse Sensitivity in FPS Game Players Using Surface EMG Signals

Vaibhav Prajapati (Indian Institute of Information Technology, Sri City, India); Anish Turlapaty (Indian Institute of Information Technology, India); Himangshu Sarma and Mrinmoy Ghorai (Indian Institute of Information Technology Sri City, India)

Abstract – In the domain of first-person shooter (FPS) gaming, mouse sensitivity is crucial for performance. This paper presents an analysis showing the correlation between specific muscle activity and mouse movement. We analyzed mouse movements from twelve subjects with varying sensitivity levels. A new electromyography dataset on human activity related to e-sports is introduced which involved four mouse designs and two game modes: Medium (normal movement) and Hard (aggressive movement). Sensitivity settings were standardized using effective dots per inch (eDPI), calculated as Mouse DPI multiplied by in-game sensitivity. Hand muscle activity was measured using five Noraxon Ultium wireless surface electromyography (sEMG) sensors with Ag/AgCl electrodes. Various regression models, including Random Forest, Support Vector Regressor, K-Nearest Neighbors Regressor, MLP Regressor, and Gradient Boost Regressor, were used to predict eDPI from muscle movement patterns. Sequential feature selection identified the top ten features, highlighting the most significant muscles for predicting sensitivity. The results demonstrate that the Extensor Carpi Radialis (ECR) is the most active muscle, followed by the Extensor Digitorum (ED), while playing the chosen FPS game. These findings give insights for ergonomic and personalized equipment design to enhance gaming experience and performance.

Keywords – *First Person Shooter (FPS) Games; Electromyography (EMG); Sensitivity Prediction; eDPI (Effective DPI); Muscle Activation; Regression Studies*

[IB-38]
Enhanced Computer Vision Techniques for Differentiating Tremor Types

Chandra Reddy Gadhe (SRM University-AP, India); Sunitha K A (SRM University - AP, India)

Abstract – Tremors, involuntary rhythmic oscillations of body parts, can significantly impact individuals' quality of life and pose diagnostic challenges. This study focuses on differentiating among rest tremor, essential tremor, and cerebellar tremor, each associated with distinct neurological pathways and clinical characteristics. Clinicians face considerable challenges due to the similar symptoms exhibited by these tremor types. This paper aims to distinguish the characteristics of these tremors using an advanced algorithm developed with the CVZone library, based on the Mediapipe framework. The developed algorithm differentiates tremors by considering pose variations with 90% accuracy on PT data and CT data and 87.5% accuracy on ET data taken from multiple sources.

Keywords – *Tremor; parkinson's Tremor; Essential Tremor; Cerebellar Tremor; Computer Vision; Hand Tracking; Pose Tracking*

[IB-39]
Impact of Gender and Information Layout on User Experience and Gaze Patterns in a Fitness and Diet App Interface

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Abstract – Public interest in the mobile diet and fitness app has increased since the Covid-19 pandemic. Despite this fad, previous studies have not considered the impact of gender and information layout of the app on user experience measured using subjective and objective metrics. To solve this scientific gap, we conducted a novel investigation on a mobile app interface using eye tracking and the User Experience Questionnaire (UEQ). We implemented the Design Thinking method to produce a realistic fitness and diet app interface. The study evaluated two interface designs with 56 participants, equally divided into 28 men and 28 women. The participants were assigned four different tasks to complete. We found a significant difference in the Time to First Fixation metric during the fourth task on different information layouts ($p < 0.05$). In addition, we found that the grid layout was superior to the list layout in visual search with faster search time and fewer eye fixations. UEQ analysis reveals substantial gender differences: men prefer the grid layout because it emphasizes stimulation provided by the design. In contrast, women prefer the list layout because it prioritizes an overall attractive design. This study has successfully addressed the impact of information layout and gender on user experience on a fitness and diet app interface. Furthermore, this research serves as a valuable resource for considering information layout and evaluating the user experience of mobile applications using an eye tracker.

Keywords – *Eye tracking; User experience; Mobile application; Information layout; Gender*

[IB-40]
Precision Boundary Detection for EIT Leg Swelling Imaging Using Rotational ToF Sensors

Ridwan Wicaksono (Universitas Gadjah Mada, Thailand); Alfian Daffa Baihaqi and Adha Imam Cahyadi (Universitas Gadjah Mada, Indonesia)

Abstract – This study proposes a boundary sensor system for Electrical Impedance Tomography (EIT) to estimate the swollen area boundaries in legs affected by lymphedema. Lymphedema imaging poses significant challenges in defining accurate bound- ary geometry models, as conventional EIT systems often provide imprecise geometric data. The proposed system utilizes a Time of Flight (ToF) VL53L0X sensor mounted on a rotating platform, enabling the capture of variable data points independently of the number of sensors and thereby addressing the limitations of traditional methods. The experimental setup involved testing the VL53L0X ToF sensor for distance and angle variations, with the sensor mounted on a platform driven by a stepper motor for pre- cise angular positioning. Results revealed that the VL53L0X ToF sensor consistently misread distances with a mean absolute error of 32.0111 mm, and angle variations introduced a measurement error percentage of 8.2%. The system exhibited an average base platform rotation angle error of 0.65°, indicating precise angular shifts. Overall, the ToF VL53L0X-based boundary sensor system successfully estimated non-homogeneous body boundary shapes with an error percentage of 3.9751%. These findings suggest that while there is room for improvement in sensor accuracy, the proposed method provides a cost-effective and accurate means of obtaining geometric data, enhancing EIT imaging for better lymphedema diagnosis and monitoring.

Keywords – *Boundary reconstruction; Lymphedema; ToF sensor; Leg swellig; Area estimation*

[IB-41]
Ensemble-Stacking Machine Learning Model for Multi-Class Skin Diseases Identification

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Abstract – Algorithm development on skin diseases identification with high cardinality classification is still very challenging. In addition, the high similarity appearance among diseases makes the computer vision approach meet high difficulties on providing clear distinct feature representation. This paper elaborates the potential of ensemble machine learning approaches using stacking techniques on conducting feature extraction and classification model for identifying skin diseases based on dermoscopy images and mobile phone images. The proposed model combines three different CNN architectures, ResNet50, Xception, and VGG16 to extract features from the image then stacked as input for the model trained using five different algorithms, which are logistic regression, support vector machines, multi-layer perceptron, k-nearest neighbors, random forests and the combination of these algorithm in stacking classifier as the base estimators and final estimator. The simulation results present the proposed ensemble - stacking model succeeds to improve the identification ability in all utilized datasets. In addition, the proposed ensemble - stacking models show better recall which indicates good sensitivity on handling false negative. It is beneficial for medical application.

Keywords – *Skin Disease; Deep Learning; Stacking; Ensemble Learning; Pretrained Model*

III. EI.A

III.1. Energy System Resilience and Reliability

Techno-Economic Analysis of Hybrid Solar Photovoltaic and Microhydro Systems for Rural Areas of Tambrauw, Indonesia

lias Kondorura Bawan[1,2], Fransisco Danang Wijaya[1], Husni Rois Ali[1], Juan C.Vasquez[3]

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Abstract – One of the hardest issues many impoverished and developing countries confront is the absence of electricity in remote and rural areas. In these circumstances attention toward renewable energy sources as alternatives to produce electric power to contribute to the country's energy system needs to get momentum, although renewable energy sources are facing the problem of intermittency because of their dependence on climate conditions. To deal with these issues, this study presents an off-grid microgrid renewable energy system comprising of microhydro, solar PV, and batteries in HOMER Pro software for rural areas in Syujak district, Indonesia. Microhydro and solar photovoltaic (PV) are the primary sources to serve load demand, with batteries providing a backup. The optimal result of the hybrid renewable energy system (HRES) configuration has 163 kW of microhydro, 432 kW of PV, and 1,386 kWh of batteries. Considering technology and economy, the best design for the research area consists of a total net present cost (NPC) of $6.42 million and a cost of energy (COE) of $0.395. It then introduces the social, technical, economic, environment, and policy (STEEP) model to thoroughly investigate the failure sources from both technical and economic viewpoints. The model outlines the important dimensions and measures required to address the issue of microgrid failure in distant communities.

Keywords – *HRES, Renewable sources, PV, Microhydro, Techno-economic analysis.*

Harnessing E-Trucks as Mobile Microgrids: Enhancing Community Health Clinics' Resilience in Indonesia

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Abstract – Healthcare facilities often face difficulties in maintaining continuous operations during power outages caused by natural disasters or infrastructure failures. These disruptions can threaten critical medical services, impacting patient care and overall public health. This paper aims to address the challenge of providing reliable backup power to community health clinics in emergency situations. It proposes the use of electric trucks (E-Trucks) as mobile microgrids, equipped with batteries and photovoltaic panels, to supply electricity during outages. The study utilizes HOMER Pro and HOMER Grid software, and Python to simulate and evaluate various mobile microgrid configurations, assessing their effectiveness and economic feasibility. A case study focusing on health clinics in Indonesia is presented, highlighting the deployment scenarios for E-Trucks to ensure uninterrupted power supply. Results demonstrate that E-Trucks can provide sufficient power to small clinics for up to four days, while larger clinics may require multiple units. The findings demonstrate the economic feasibility and practicality of using E-Trucks as mobile microgrids, offering a scalable, cost-effective solution to enhance the resilience and continuity of healthcare services during power disruptions.

Keywords – *Ad-hoc Microgrid, Mobile Microgrid, Resilience, Electric Vehicle, Electric Truck (E-truck), Health Clinic*

Three-stage Planning of Networked Microgrids for Electrocution of Indonesia Islands Considering Earthquake Scenarios

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Abstract – This paper presents a three-stage stochastic optimization model for the planning of networked microgrids (NMG) that incorporates considerations for seismic activity. Utilizing a combination of Monte Carlo Simulation (MCS) and K-Means clustering, the model ejectively generates and reduces earthquake scenarios. An peak-ground acceleration based earthquake propagation model and utilizes fragility curves of critical infrastructures within power systems to develop a comprehensive component failure model are investigated. Monte Carlo simulations are conducted to determine the failure rates of utility transformers, distribution lines, and Distributed Energy Resources (DERs). The planning model is structured in three stages, each targeting specific aspects of microgrid planning. The first stage aims to minimize initial investment costs, the second stage focuses on reducing operational costs under various fault scenarios, and the third stage strives to minimize the unserved load during earthquake events. The model encompasses several investment and operational objectives, including the reduction of capital costs, CO2 emissions, load curtailment costs, and operational costs of DERs, while also considering power generation and flow constraints. The efficacy of the model is demonstrated through its application to a simplified distribution network in Tanjung KOTA on Lombok Island, a region prone to frequent earthquakes. The simulation results show that the proposed NMG not only achieves 100% electrification and significantly reduces CO2 emissions but also enhances the resilience of the power system. This contributes to facilitating a green transition, ensuring robust performance even under seismic challenges.

Keywords – *Networked Microgrids · Earthquake scenario · Peak-ground acceleration · Fragility curves · Three-stage planning.*

A Resilient Control Framework for Enhancing Cyber-Security in Microgrids

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Abstract – Microgrid security has become a critical concern due to the increasing reliance on communication technologies and a rising incidence of cyber-threats. While various attack detection and resilient control mechanisms have been developed to fortify microgrid defenses, most research still focuses on simplistic attack scenarios, often ignoring the complex interactions between multiple distributed generators within microgrids. To bridge this gap, this paper proposes a resilient secure control framework capable of addressing cyber-threats across multiple locations within a microgrid. The framework integrates state observations, robust control strategies, and time-varying graph theory to construct a robust defense mechanism. Simulation results are presented to validate the practicality and effectiveness of this approach, confirming its potential to enhance security for future microgrid against cyber-attacks.

Keywords – *Cyber-security · Microgrid · Secure framework.*

III.2. Digitalization of District Heating and Cooling Systems

Digitalization of District Heating: Transforming Heat Networks for a Sustainable Future

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Abstract – The district heating and cooling sector is experiencing new challenges with the current transformation of energy systems. The required decarbonization will result in a more complex heat energy system, as a few large plants which utilize fossil fuels will likely be replaced, mostly by smaller production plants distributed around the system, that use renewable or waste energy sources. Furthermore, district heating and cooling systems must be operated more efficiently and flexibly to ensure a consistent and cost-effective thermal energy supply, as well as effective participation in the power system balancing market. Because of the necessary changes in the energy system, district heating becomes increasingly beneficial to both end users as well as other energy sectors, and the number of connections is increasing in many countries in conjunction with the phase-out of fossil fuels such as oil and gas for space heating and hot water supply. In this changed environment, increased adoption of digital technology in the district heating and cooling sector provides a chance to make systems smarter, more flexible, efficient, and reliable, hence accelerating the necessary integration of additional renewable and waste energy sources into thermal supply systems. However, many existing systems still lack a high level of digitalization. With more complexity, flexibility, more powerful tools, and approaches (and hence increased digitalization) will be required. Aside from technology, the integration of new digital business processes will make deployment easier. However, new concerns, such as data security and privacy, as well as questions concerning data ownership, must be addressed. This paper reflects on the results of the research conducted as part of the IEA DHC Annex TS4 project and the depiction thereof in the “Digitalisation of District Heating Systems – Optimised Operation and Maintenance of District Heating and Cooling Systems via Digital Process Management” guidebook.

Keywords – *Digitalization of district heating; operation and maintenance; business processes and models.*

Multi-agent based modeling for investigating excess heat utilization from electrolyzer production to district heating network

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Abstract – Power-to-Hydrogen is crucial for the renewable energy transition, yet existing literature lacks business models for the significant excess heat it generates. This study addresses this by evaluating three models for selling electrolyzer-generated heat to district heating grids: constant, flexible, and renewable-source hydrogen production, with and without heat sales. Using agent-based modeling and multi-criteria decision-making methods (VIKOR, TOPSIS, PROMETHEE), it finds that selling excess heat can cut hydrogen production costs by 5.6%. The optimal model operates flexibly with electricity spot prices, includes heat sales, and maintains a hydrogen price of 3.3 EUR/kg. Environmentally, hydrogen production from grid electricity could emit up to 13,783.8 tons of CO2 over four years from 2023. The best economic and environmental model uses renewable sources and sells heat at 3.5 EUR/kg.

Keywords – *Power-to-X, electrolyzer, district heating, excess heat, waste heat, Power-to-Hydrogen.*

Fault detection in district heating substations: overview of real-life faults in residential heating installations

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Abstract – Heating, cooling and production of domestic hot water are the dominating energy uses in residential buildings. District heating (DH) provides the thermal energy for these uses to 65% of the Danish homes. However, 50-60% of the DH substations in these dwellings operate with an error, often leading to inefficient operations (i.e., high temperature or high-volume flow of the return heat-carrier fluid in the DH network). This hinders decarbonising the heating sector. The roll-out of smart heat meters allowed access to the hourly heat demand profiles of the DH customers. In turn, this unlocks the creation of data-driven methods for identifying faulty household systems. However, this cannot be done correctly without the knowledge of the fault types occurring in domestic installations. The present study analyzes 382 reports made by the DH technicians during onsite visits to the houses identified as “faulty” customers. The collected onsite information shows that more than 30% of faults stem from wrong control settings in the space heating or domestic hot water installations. These faults can be fixed with almost no additional cost to the building owner and with the immediate decrease of the return temperatures to the DH system.

Keywords – *Faults in heating installations, district heating substations, residential buildings, real-life faults.*

Using the flexibility in the network pipes and the buildings to reduce peak loads in a district heating network - final results of real-life case study

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Abstract – District heating (DH) networks are generally recognized as crucial systems to decrease the use of fossil fuels for the provision of heating and domestic hot water in large shares of the world. The intrinsic flexibility in the piping network and the connected buildings, offer interesting benefits for the efficiency of the network itself. Furthermore, the DH networks' flexibility can also be of benefit for electric grids, containing considerably less of it itself. Smart control of DH networks is therefore an important research topic for the overall efficiency of the entire energy system. This work presents the application of smart control of DH networks, in a real-life case study in the DH network of Brescia, in the north of Italy. A supervisory control system was developed, based on model predictive control, aiming to coordinate the control actions of the already existing controllers in the DH network. In this case study, the objective of the controller was to reduce the expensive and carbon intensive heat demand peaks in the network, making use of the available network flexibility. The project spanned several years, gradually improving the controller algorithms. In the presentation, the control methodology, test approach and the results of the final test year are presented. Three types of tests were performed, using as source of flexibility (i) the building mass (demand response); (ii) the piping network as a storage; and (iii) the combination of both. The results show a reduction of peak energy use up to 40% in the combined mode.

Keywords – *District heating, smart control, peak shaving*

The Role of Digitalization in Enabling the Transformation of District Heating and Cooling Networks

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Abstract – District heating and cooling (DHC) networks have traditionally relied on a limited set of controls to ensure supply and optimize both economic and ecological performance. This classical approach, however, lacks detailed insights into supply and utilization structures. Enhanced heat generation and overall network operation become feasible with comprehensive information on demand and flexibility options, leading to benefits like peak shaving, reduced use of expensive peak boilers, and the integration of fluctuating heat sources like solar thermal energy and power-to-heat applications linked to electricity markets. In the transition towards a 100% renewable energy system, the International Energy Agency's District Heating and Cooling (IEA DHC) research hub has prioritized the integration and demonstration of digital processes in DHC schemes. Digitalization is vital for future energy systems as it enhances DHC networks and optimizes their operations while improving control of heating systems within buildings and empowering end-users. The overarching goal of this new IEA DHC Annex TS9 is to address barriers hindering effective communication among various domains and stakeholders, thereby fostering advancements in DHC technology. This initiative aims to improve the efficiency and development of 4th Generation District Heating (4GDH) systems. Promoting better-informed decision-making processes and optimizing data utilization holds the potential to significantly enhance the performance of DHC networks.

Keywords – *Digitalization of district heating; operation and maintenance; 4GDH*

III.3. Energy Data and Consumer Behaviors

Occupants experiencing energy poverty: Where are they in energy datasets and Time Use Surveys?

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Abstract – Building operational data is widely used for the development and validation of models and good design practices. This paper aims to analyze the potential impact of inadequate representation of energy-vulnerable groups in residential building datasets and to demonstrate the diversity of occupancy behavior by analyzing national surveys. Emphasis is placed on the need to closely examine how these data sources can introduce bias, particularly in relation to the socio-economic realities of occupants. Biases can lead to policies that fail to address the needs of vulnerable populations, leaving gaps in our understanding of the real energy challenges these groups face. Based on an exploratory literature review, a reflection on the challenges associated with data collection, analysis, and use in this specific context is made. Furthermore, the diversity of occupant behavior is investigated using a Time Use Survey. The data were subjected to descriptive analysis, time-series K-means clustering, and decision tree classification to identify the socio-demographic patterns of occupants based on their activity and occupancy behaviors. Using the silhouette score and the elbow method, five clusters were identified. Based on the gain ratio (entropy) and maximum depth of the wanted decision tree, occupants' characteristics were associated to different clusters. However, due to the heterogeneity of occupants and the complexity of human behavior, accurately representing activity occupancy behavior is challenging. This underscores the significance of diversity in datasets for accurately simulating building energy consumption.

Keywords – *Occupancy Behavior, Time Use Survey, Energy Poverty, Time-series K-means Clustering, Decision Tree.*

Automation level taxonomy for time series forecasting services: Guideline for real-world smart grid applications

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Abstract – Achieving net-zero carbon emissions necessitates the major transformation of electrical grids into smart grids. In this context, urban districts play a crucial role in the flexible balancing of electricity demand and supply, which involves solving decentralized optimization problems. Such optimization problems rely on forecasts of local demand and supply, and require the systematic orchestration of data streams using cloud services. At the same time, it is necessary to automate both the design and operation of forecasting models in such services to keep pace with the increasing need for such locally adapted forecasts. Therefore, this paper proposes an automation level taxonomy to communicate the scope of automation in time series forecasting. Furthermore, we demonstrate a forecasting service that is used in a downstream demand-side management application and realized in the real-world project Smart East in Karlsruhe, Germany. Finally, we analyze existing forecasting services in the literature, categorize them according to the proposed automation level taxonomy, and compare them with our implementation.

Keywords – *automation · cloud service · forecasting · smart grid · taxonomy · real-world application*

Enhanced Consumer Segmentation through Load Profile Analysis Using Autoencoder and K-shape Clustering

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Abstract – In India, residential consumers are traditionally segmented based on their monthly energy consumption. The adoption of Advanced Metering Infrastructure offers an opportunity to utilize detailed smart meter data for more precise consumer segmentation, helping electricity distribution companies to implement tailored demand response policies. This paper presents an analysis of consumer segmentation based on the clustering of load profiles from 84 residential buildings in India using smart meter data. Unlike existing methods that apply clustering algorithms directly, this research incorporates a novel improvement through a two-stage clustering process combining an Autoencoder network with the K-shape clustering algorithm. In the first stage, the Autoencoder transforms the input load profiles into a lower-dimensional latent space, effectively capturing the most significant features of the data. In the subsequent stage, the K-shape clustering algorithm is applied to these latent space vectors. This approach leverages the Autoencoder's ability to reduce noise and highlight essential patterns, resulting in more accurate and efficient clustering of load profiles compared to using the K-shape algorithm alone. Our analysis demonstrates that the proposed two-stage clustering method enhances the performance of the traditional K-shape algorithm, as evaluated using clustering evaluation metrics such as the Calinski-Harabasz Index, Davies-Bouldin Score, and Silhouette Index. The results also indicate that rural consumers in Indian residential households can be effectively grouped into four distinct segments through this method. These clusters can be analyzed alongside the total load curve of a state or region for a given day to identify those contributing to peak demand. Subsequently, targeted price-based or incentive-based demand response schemes can be devised for these consumer clusters.

Keywords – *Demand response, time-series analysis, load profile clustering, machine learning, deep learning, k-shape clustering, customer segmentation, load profile analysis, time series clustering, time series representation, smart meters, renewable energy, clustering validation*

Extracting Daily Aggregate Load Profiles from Monthly Consumption

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Abstract – Consumer load profiling involves examining patterns of energy consumption using available data. With smart meter data available at (sub-)hourly intervals, it is possible to use the it to generate daily load profiles that capture the typical consumption behavior across a representative day. Previous work has shown how fine-grained smart meter data and monthly consumption data separated by time-of-use can be translated into representative load profiles for a given group of consumers. In this work, an approach for load profile generation is proposed which only uses monthly energy consumption data without breaking it down further based on time-of-use such as peak, off-peak and mid-peak hours. Performance of data-driven models using random forest, XGboost and multi-layer perceptron is studied by reconstructing the load profiles on a known smart meter dataset. A comprehensive assessment of how the shape of the reconstructed load profile compares with the actual profile is provided by evaluating amplitude errors, time shifts and slope variations. Our investigations provide insights on the role of the cluster size on load profile reconstruction: predictions of profiles for large cluster sizes show improved accuracy in terms root mean-square errors and less bias. By gaining insights into when and how energy is consumed, utilities can implement measures to reduce costs, mitigate peak demand and enhance overall energy efficiency.

Keywords – *Load profile generation · Monthly electricity data · Multilayer perceptron · Random forest · XGboost*

III.4. Demand Flexibility and Energy Conservation Strategies

Impact of Demand Flexibility in Reducing Power Generation Costs for the Potential Future Energy Systems for Dubai

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Abstract – This article investigates and discusses possible energy scenarios and strategies for the emirate of Dubai in the United Arab Emirates (UAE), for the 2030 energy generation mix. An energy mix optimization model is used to analyse the projected 2030 generation mix scenario for Dubai, to explore how different sources of renewable energies can change the generation mix in 2030 and the opportunities and challenges that will come with it. With several large ongoing renewable energy projects in Dubai, there will be a high share of renewables in the future energy generation mix of Dubai by 2030. Considering these projects in the energy mix model, the time-varying generation cost of electricity for 2030 is calculated. Then, it is shown how the demand flexibility can be utilized to handle such time-varying cost profile, employing an energy model of a commercial building. A model-predictive control (MPC) technique is applied to optimize the energy performance of the building according to the predicted cost and weather conditions.

Keywords – *Energy mix model, Renewable energy, Demand flexibility*

Nurturing Youths for a Sustainable Future: Empowering Energy Conservation through Education and Technology

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Abstract – This paper presents Smart Energy Management Systems (SEMS) as an innovative educational tool to nurture the youth generation and empower them in fostering a carbon-neutral future. SEMS actively engage students in analyzing energy consumption patterns, identifying savings opportunities, and cultivating sustainable behaviors, equipping them with practical knowledge and skills to become responsible stewards of the environment. Through the seamless integration of SEMS into the school curriculum, students develop a deep understanding of energy conservation and the critical role they can play in contributing to a greener tomorrow. This paper advocates for the widespread adoption of SEMS across educational institutions as a strategic approach to nurture the youth generation and ignite their commitment to the collective effort towards a sustainable, carbon-neutral future. By investing in the education and empowerment of young people, this initiative aims to catalyze a transformative change, where the leaders of tomorrow become the driving force behind the realization of a carbon-neutral world.

Keywords – *Smart Energy Monitoring System (SEMS), Carbon Neutrality, Energy Management, Education, Engagement.*

Understanding Stakeholder Perspectives on Smart Home Technology Adoption: A Case Study of Mumbai, India

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Abstract – Smart home technology integrates various devices and systems that upgrade the convenience, security, and efficiency of a home. Due to these benefits, this technology is gaining global attention. In this paper, we have explored the perspectives of the residents of Mumbai on smart home technology adoption. A survey of 425 respondents was conducted, over a period of 3 months, covering demographics, awareness, preferences, concerns, and willingness to adopt. The key factors influencing their willingness to adopt such technology have been identified. The findings reveal insights into the perceived benefits, barriers, and demographic influences on smart home technology adoption in Mumbai. Most respondents show a high level of willingness to install smart home technology. More than 40% of respondents consider security their top priority when thinking about smart home features. Data privacy and security are the top concerns among the respondents, as they are worried about their personal data management and device vulnerabilities. The results are valuable for policymakers, advertisers, and developers working to promote smart home technology in the urban areas of India.

Keywords – *Smart Home Technology, User Awareness, Preferences, Energy Efficiency, Security, India.*

Recent Trends in Demand-Side Flexibility

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Abstract – Renewable energy generation is inherently stochastic, and it rarely aligns with the periods of peak demand. Consequently, and despite continuous developments in storage technology, there is still a significant potential in using demand-side flexibility to balance generation and demand. The flexibility arises in many contexts, e.g., in the heating of buildings, and by shifting the demand, we can substantially reduce the need for infrastructure investments. However, it is not trivial to utilize the flexibility in a scalable manner. Energy customers are highly diverse (residential, commercial, industrial, etc.), and in most cases, their energy demand cannot be controlled directly. Furthermore, flexibility is both adynamic and stochastic quantity. When the flexibility is used, it cannot be used at a later point in time as well. In this paper, we describe the Smart Energy Operating System, which is a framework for scalable exploitation of demand-side flexibility. It combines hierarchical forecasting with hierarchies of controllers and models. A key part of this framework is the Flexibility Function. It describes the energy demand of a flexible asset in response to a price signal, and it is continuously updated based on the actual demand. An aggregator can use it to predict the energy demand of the underlying flexible assets and participate in flexibility markets on their behalf. In other words, the Flexibility Function serves as a minimum interoperability mechanism (MIM). An important prerequisite is that markets must account for the dynamic and stochastic nature of flexibility, and we discuss current limitations and opportunities.

Keywords – *Smart Buildings · Smart Grids · Flexibility · Demand-Response*

III.5. IoT, Edge Computing, and Software Innovations in Energy

A Cost-Effective Edge Computing Gateway for Smart Buildings

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Abstract – The retrofitting of existing buildings with building management systems presents significant challenges, primarily due to the need for labor and cost efficiency. Wireless technology offers a promising solution to these challenges by minimizing the need for extensive wiring and structural alterations. However, achieving retrofitting in a cost-effective manner necessitates the use of low-cost wireless technologies. This paper introduces a framework for constructing a Zigbee gateway using open-source tools combined with low-cost hardware. The proposed architecture addresses large-scale IoT deployments within the Zigbee ecosystem. By leveraging edge computing with the robustness and scalability offered by Zigbee technology, this architecture significantly reduces the economic barriers to retrofit buildings with building management systems. The results underscore the potential of open-source Zigbee technology in aligning with sustainability goals, providing a cost-effective pathway for retrofitting buildings into smart, energy-efficient living environments.

Keywords – *Internet of Things · Zigbee · Smart Buildings · Open-source · Edge computing*

Leveraging Internet of Things Network Metadata for Cost-Effective Automatic Smart Building Visualization

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Abstract – In recent years, the building sector has experienced an increasing legislative pressure to reduce the energy consumption. This has created a global need for affordable building management systems (BMS) in areas such as lighting-, temperature-, air quality monitoring and control. BMS uses 2D and 3D building representations to visualize various aspects of building operations. Today the creation of these visual building representations relies on labor-intensive and costly computer-aided design (CAD) processes. Hence, to create affordable BMS there is an urgent need to develop methods for cost-effective automatic creation of visual building representations. This paper introduces an automatic, metadata-driven method for constructing building visualizations using metadata from existing smart building infrastructure. The method presented in this study utilizes a Velocity Verlet integration-based physics particle simulation that uses metadata to define the force dynamics within the simulation. This process generates an abstract point cloud representing the organization of BMS components into building zones. The developed system was tested in two buildings of respectively 2,560 m² and 18,000 m². The method successfully produced visual building representations based on the available metadata, demonstrating its feasibility and cost-effectiveness.

Keywords – *Building Management System, Internet of Things, Smart Building, Visualization, Metadata, Digital Twin, Simulation.*

Scheduling Electric Currents in Converter-Dominated Power Grids with Time-Slotted Energy Packets

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Abstract – Due to massive transformations in the energy sector, the power grid of the future requires new solutions. One possible novel building block of the future grid is the energy router. Energy routers are power electronic devices that can bridge previously unconnected parts of the power grid, in order to increase the use of power line capacity and to increase the power grid's resilience. Through the massive use of energy routers, the power grid will cease its traditional, hierarchical structure and transform into a 'network of cells', which requires new control approaches. This paper advances the Energy Packet Grid, an architecture of a future power grid, structured as a network of cells. The architecture is inspired by selected Internet design principles. In the Energy Packet Grid, all major power flows should be organized as energy packet transfers, short-term contracts between power electronic devices. This paper proposes the Time-Slotted Energy Packet Transfer Protocol (TEPT), a scheduling protocol that conducts energy packet transfers. Its goal is to efficiently use the power line capacity, to achieve fairness among competing transfers, and to sustain the power grid's safety in case of communication failures. We evaluated TEPT with our simulator and with our real-world power electronic devices, demonstrating TEPT's feasibility on hardware.

Keywords – *energy packet grid · scheduling · power electronics · energy router · network of cells*

Symbiosis: A Web-Based Decision Support Tool for Achieving Symbiosis in Industrial Parks

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Abstract – This paper presents Symbiosis, a web-based decision support tool developed to improve energy symbiosis within eco-industrial parks (EIPs). Symbiosis addresses the limitations of traditional desktop applications by offering a user-friendly, web-based interface that simplifies the modeling and visualization of energy flows among facilities. This tool is designed to be accessible to users with varying technical backgrounds. The effectiveness of Symbiosis was evaluated through a case study involving an industrial park with wind and photovoltaic energy sources and a greenhouse and brewery as energy consumers. The study assessed how replacing an existing greenhouse with a higher energy-consuming variant impacted the park's energy balance. Symbiosis successfully modeled energy flows and visualized changes in energy surplus and deficit resulting from this replacement. The tool demonstrated its capability to provide insights into energy dynamics and optimize facility configurations to improve energy efficiency. The case study highlighted that Symbiosis is effective in visualizing and analyzing energy flows, supporting better decision-making for EIP management. However, it also revealed some limitations, such as performance issues with large datasets and the need for support for additional energy types. Future research should explore case studies in various EIP configurations and consider integrating optimization algorithms to enhance decision-making.

Keywords – *eco-industrial park, industrial symbiosis, energy flow analysis.*

Process-to-Market: A Web-based Evaluation Tool for Electricity Market Participation

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Abstract – In deregulated electricity markets, large industrial consumers face significant challenges in participating effectively due to complexities in market regulations and diverse flexibility requirements. This paper introduces „Process2Market," a web-based evaluation tool designed to assist large electricity consumers in the Nordics by leveraging the Process-to-Market Matrix Mapping (P2MM) model. The tool employs a Python-based optimization program integrated with a comprehensive questionnaire and market data analysis to evaluate market participation feasibility. By providing an accessible online interface, Process2Market facilitates broader engagement and understanding among stakeholders, including researchers and electricity consumers. A case study involving a hypothetical Power-to-Hydrogen (PtH) facility demonstrates the tool's practical application, highlighting its potential to enhance grid stability through increased demand-side flexibility and optimized market participation. This paper contributes to the field by presenting a detailed methodology for developing a web-based tool, offering a practical application in a case study, and providing insights into the integration of industrial processes into electricity markets.

Keywords – *Demand response, web-based tool, electricity market, electricity consumers, optimization model, flexibility parameters, Power-to-Hydrogen*

IoT Based Smart Air Ventilation and Energy Management System

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Abstract – The integration of advanced ventilation systems with environmental air monitoring presents a major challenge in modern building management and urban development. The structure of buildings becomes more airtight, energy efficient indoor air quality (IAQ) becomes increasingly difficult. This paper investigates the need for ventilation strategies using real-time data and Internet of Things (IoT) technology to ensure a better environment. We introduce a decentralized smart ventilation system that employs control algorithms and localized sensor data to enhance ventilation performance. Our approach incorporates sensors in each room or zone to continuously monitor temperature, humidity, and occupancy levels. This data is transmitted to decentralized control units, which process the information to adjust ventilation settings according to the specific needs of each area. The above approach is useful and tested in the Earth air Tunnel cooling system on university premises.

Keywords – *Pollution, Quality and Metrics, Smart environment monitoring, Wireless Sensor Networks (WSN) Internet of things.*

III.6. Optimization of Energy Systems and Renewable Integration

Dynamic Phenotype Mapping in Evolutionary Algorithms for Energy Hub Scheduling

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Abstract – The integration of Renewable Energy Resources into the existing electricity grid to reduce Greenhouse Gas emissions raises several challenges, such as volatile generation. Optimized scheduling of Distributed Energy Resources (DERs) within the Energy Hub concept can address these challenges by increasing the flexibility in the grid. However, this scheduling task can be categorized as an NP-hard optimization problem and requires the use of powerful heuristic algorithms to solve it. One such heuristic approach is an Evolutionary Algorithm (EA), however, EAs solution quality may be poor w.r.t. solution time when considering complex scheduling tasks of DERs. In our work, we improve the applied EA optimization by considering the predicted optimization quality. More specifically, we use Machine Learning (ML) algorithms trained on previous solutions to forecast the optimization quality. Based on these predictions, the computational effort of the EA is directed to particularly difficult areas of the search space. We direct the effort of the EA by dynamic interval length assignment during the phenotype mapping of the solutions proposed by the EA. We evaluate our approach by comparing multiple ML forecast algorithms and show that our approach leads to a significant increase of the evaluated degree of fulfillment by up to 4.4%.

Keywords – *Evolutionary Algorithm · Forecast · Energy Hub.*

Analytical solution for the cost optimal Electric Energy Storage size based on the Effective Energy Shift (EfES) algorithm

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Abstract – The importance of Electric Energy Storage (EES) for the transformation to an energy grid with a large share of Renewable Energy Source (RES) has been studied and shown for many decades. While larger storage systems might provide more energetic benefits for the overall grid, they also require higher investment and capital costs. Hence the question of the cost-optimal size of EES and RES is commonly stated in public debates and the related literature. This minimization problem is mainly solved by combining simulation and optimization methods. Even though this enables the analysis of highly complex scenarios, the configuration and computation time are high, and many of the found methods are not reproducible. Within our paper, we introduce an analytical solution for calculating the cost-optimal capacity of an EES that is derived from results computed by the Effective Energy Shift (EfES) algorithm

Keywords – *minimal costs · optimal capacity · energy storage system · dimensioning · sizing · battery storage · electric energy storage · renewable energy · analytical solution*

Impact and Integration of Mini Photovoltaic Systems on Electric Power Distribution Grids

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Abstract – This work analyzes the impact of varying concentrations mini-photovoltaic (MPV) systems, often referred to as balcony power plants, on the stability and control of the low-voltage (LV) grid. By local energy use and potentially reversing meter operation, we focus on how these MPV systems transform grid dynamics and elucidate consumer participation in the energy transition. We scrutinize the effects of these systems on power quality, power loss, transformer loading, and the functioning of other inverter-based voltage-regulating distributed energy resources (DER). Owing to the rise in renewable output from MPVs, the emerging bidirectional energy flow poses challenges for distribution grids abundant with DERs. Our case studies, featuring sensitivity analysis and comparison of distributed and decentralized DER control strategies, highlight that autonomous inverters are essential for providing ancillary services. With the growing use of battery energy storage (BES) systems in LV grids for these services, the need for adaptable DER control strategies becomes increasingly evident.

Keywords – *Battery Energy Storage · Distributed Energy Resources · Mini Photovoltaic Systems · Voltage Control.*

Semi-supervised state classification in distribution systems with graph neural networks

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Abstract – With the wide penetration of distributed energy resources and renewables in the modern power grids, especially in the distribution and consumption levels there appears a high growth in uncertainty and the number of possible scenarios. Some of them may violate grid constraints and thus, have to be a subject of control. Considering the inherently low level of observability in distribution systems, estimation and assessment of their state becomes a significant challenge, that must be tackled before developing a control strategy. Moreover, the real time state estimation in partially-observable DS can be undetermined or timely infeasible in case of when the small time steps needed. In this paper we propose to use the graph neural network - based state classification, which identifies the possible grid limits violations in the distribution grid. The use of neural network in this case is in line with their main advantages over physical models - they are fast and adaptive. We benchmark several graph neural network approaches, that are based on the topology of the grid, which allows to derive information about unlabeled nodes and increase interpretability – one of the main obstacles on the way to wide neural network utilization in power systems. We set the problem in a semi-supervised manner, which allows us to use less labeled, metered data, as the large parts of modern distribution systems remain not measured. We show that graph neural networks are more precise and explainable in this task compared to the regular ones.

Keywords – *Deep learning · Graph neural networks · Physics-aware neural networks · State classification*

Comparison of optimal reactive power dispatch methods in IEEE 30 bus system

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Abstract – It has been noted that a number of metaheuristics are applied with success to power system optimal reactive power dispatch (ORPD) challenges. These algorithms' convergence rates are also determined to be low, and the results they provide are deemed to be inadequate. It suggests that there is insufficient investigation and exploitation in the algorithm. Therefore, an appropriate approach is needed to improve the algorithm's search performance. The enhanced butterfly optimization algorithm (EBOA) is used in this work to address the power system's ORPD problems. IEEE 30 bus network is chosen as a base network to test and validate the performance of the methods. On this systems, all three goals—Power Loss Minimization, TVD Minimization, and L-Index Minimization—are taken into account. The outcomes of EBOA have been equated with those of the novel BOA and additional modern heuristics. Additionally, statistical analysis is performed to evaluate the algorithm's resilience.

Keywords – *L-Index, EBOA, Power Loss, and ORPD.*

Comparison of Metaheuristic Techniques for Optimal Power Flow in Nordic Pricing Areas

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Abstract – As the energy transition accelerates worldwide, managing the intricacies of power flows is becoming a major challenge, particularly for complex grid systems like the Nordic grid. This paper details a comparative analysis of metaheuristic optimization algorithms—specifically, Particle Swarm Optimization (PSO), Cuckoo Search Algorithm (CSA), and Grey Wolf Optimization (GWO)—to optimize power flow across Nordic pricing areas. Utilizing the Reduced Nordic 44 Pricing Area Model (Reduced N44 PAM) along with the IEEE 14, 39, and 118 bus benchmark test systems, this study evaluates the effectiveness of these algorithms in minimizing power losses and enhancing the efficiency of the power transmission network. The analysis is focused on three scenarios of the Reduced N44 PAM which are a base case, a light load case, and a heavy load case. The comparative results show that GWO outperforms both PSO and CSA, achieving up to 11.5% better loss minimization in the base case and showing faster convergence speeds across all scenarios. This study provides insights into the potential of metaheuristic algorithms to significantly enhance power flow efficiency and suggests the broader applicability of these techniques in power systems for robust grid management.

Keywords – *Cuckoo search algorithm · grey wolf optimization · metaheuristic algorithms · optimal power flow · particle swarm optimization · reduced Nordic 44 model.*

Battery Life Prediction Using Physics-Based Modeling and Coati Optimization

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Abstract – Accurate remaining useful life (RUL) prediction is essential for ensuring the reliability and efficiency of Lithium-ion (Li-ion)batteriess. This paper presents an approach using the Coati Optimization Algorithm (COA) to optimize the physics-based model for RUL prediction of Li-ion batteries. This method combines COA to optimize the physics-based degradation model to improve battery aging predictions, considering factors like cycle time, rest time, temperature, state of charge (SOC), and load conditions. The model can more accurately simulate real-world battery usage patterns and degradation mechanisms by incorporating these variables. Simulation results show that COA enhances the accuracy of the model's calendar and cycle aging prediction, and reduces RMSE and MAE values for RUL prediction. Furthermore, the robustness of the proposed method is demonstrated through extensive testing under various operational scenarios, highlighting its potential for application in battery management systems to extend battery life and improve performance.

Keywords – *COA optimization · Battery RUL prediction · Physics based model.*

III.7. Digital Twin Technology and Energy Simulations

Leveraging Digital Twins for Sustainable District Heating: A Study on Waste Heat from Power-to-X Plants

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Abstract – This paper investigates the integration of waste heat from a Power-to-X (PtX) plant into a district heating system (DHS) using a digital twin (DT) approach to optimize energy efficiency and manage complex system dynamics. Focusing on a case study of a new PtX plant in Kassø, southern Jutland, supplying waste heat to the district heating network of Aabenraa, this paper combines model-based and data-driven techniques through business ecosystem mapping and multi-agent-based simulation to evaluate integration viability and efficiency. The results indicate significant reductions in natural gas consumption and operational costs, demonstrating the feasibility of PtX waste heat integration. The DT model's detailed simulations provide insights into optimizing operational strategies, balancing heat supply and demand, and ensuring system reliability. These findings underscore the critical role of DTs in advancing energy efficiency and decarbonization in urban heating systems.

Keywords – *Digital Twin, District Heating, Power-to-X, Waste Heat.*

Multi-Agent Based Simulation for Investigating Centralized Charging Strategies and their Impact on Electric Vehicle Home Charging Ecosystem

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Abstract – This paper addresses the critical integration of electric vehicles (EVs) into the electricity grid, which is essential for achieving carbon neutrality by 2050. The rapid increase in EV adoption poses significant challenges to the existing grid infrastructure, particularly in managing the increasing electricity demand and mitigating the risk of grid overloads. Centralized EV charging strategies are investigated due to their potential to optimize grid stability and efficiency, compared to decentralized approaches that may exacerbate grid stress. Utilizing a multi-agent based simulation model, the study provides a realistic representation of the electric vehicle home charging ecosystem in a case study of Strib, Denmark. The findings show that the Earliest-deadline-first and Round Robin perform best with 100% EV adoption in terms of EV user satisfaction. The simulation considers a realistic adoption curve, EV charging strategies, EV models, and driving patterns to capture the full ecosystem dynamics over a long-term period with high resolution (hourly). Additionally, the study offers detailed load profiles for future distribution grids, demonstrating how centralized charging strategies can efficiently manage grid loads and prevent overloads

Keywords – *multi-agent based simulation, multi-agent systems, agent-based modeling, electric vehicle, charging strategies, charging algorithms.*

Geospatial Semantic Enriched Digital Twin with Logical Reasoning Rules for Managing Control Loops

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Abstract – This study introduces a framework for the development of a geospatial semantic enriched Digital Twins (DTs) with integrated logical reasoning rules, aimed towards addressing the challenges associated with the manual-intensive scripting for the development and upkeeping of traditional building control loops. By leveraging on geospatial information as a higher-level semantic, this framework enhances the integration with existing building ontologies, thereby facilitating the creation of a dynamic and responsive DT environment. An experimental trial involving 120 participants was conducted to validate the practicality and effectiveness of the geospatial semantic enriched DT with integrated logical reasoning rules, for the development of various human-centric user interfaces, providing options for the diverse range of user preferences. The results demonstrated strong preference for these adaptable DT interfaces. Moreover, the application of geospatial semantics with logical reasoning rules in selectively displaying only the nearby devices based on users' locations not only enhances interface usability but also offers potential for reducing system misuse. These findings lay a robust foundation for future advancements in DT integration, emphasizing the transformative potential of integrating logical reasoning rules with geospatial semantics in the development of DTs

Keywords – *Digital Twin, Semantic Modelling, Ontology, Control Loop, Human Building Interaction.*

Challenges in Transitioning from Co-Simulation to Practical Application: A Case Study on Economic Emission Dispatch in a Greenhouse Compartment

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Abstract – Co-simulation is a widely applied method used to analyze the behavior of complex, interdisciplinary, and integrated cyber-physical control systems. Despite its prevalence, the transition from co-simulated control systems into practical applications is not discussed as much in the literature. This leaves a gap in the literature because practitioners may not be aware of these challenges. This paper aims to uncover and discuss some of the challenges that arise in the transition from a co-simulated control system to a practical application. A case study on economic emission dispatch in a Danish industrial greenhouse compartment serves as the fundament in studying these challenges. Economic emission dispatch is a method that can be used in a closed-loop arrangement to decrease costs and emissions of multiple energy production units. The case study is first implemented as a co-simulation which is subject to a subsequent practical implementation. The co-simulation implementation is governed by the open-source framework mosaik that is used extensively in smart grid applications. In contrast, the practical implementation is not governed by mosaik due to architectural design discrepancies. A key feature of the study is the use of software-in-the-loop, which means that the controller being tested is the actual software intended for deployment. The highlighted challenges include that the core abstractions (master algorithm, scenario-script, and protocol) of the co-simulation framework cannot be transferred to an operational context due to design discrepancies. Despite these challenges, the co-simulation can still serve as a baseline for comparing functional performance metrics during the transition.

Keywords – *Economic dispatch, co-simulation, software-in-the-loop, SIL, cyber-physical system, transition, challenges, greenhouse, simulation-to-reality gap*

Hardware-in-the-Loop-Based Validation of Distribution System Control Applications with Grid Operators, Customer & Market Participants

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Abstract – The flexibility potential of electric vehicles, heat pumps, photovoltaics, and storage systems allocated at customer premises raises attention to grid-serving and market-serving control applications. However, control applications vary as the kind of flexibility differs due to the complexity of interactions behind the meter, the actors involved, conflict of interests, regulatory requirements, and the number of systems to integrate. Consequently, the validation of applications across all phases of development reveals the potential bottlenecks of the application before deployment. This work presents the use cases for distribution system control applications and how they can be validated in a hardware-in-the-loop simulation environment. The validation environment covers the systems of a distribution system operator and its upstream grid operator, virtual field devices, a real-time grid simulation, the meter operator including the operation of an advanced metering infrastructure, as well as applications from market participants like aggregators. As a proof of concept, two use cases are selected to demonstrate how grid operator coordination and customer behaviour can be validated. Thereafter, it will be implied how the validation environment is suitable for future use cases, such as the coordination of grid-serving and market-serving control applications.

Keywords – *active distribution grid · flexibility · validation environment*

Data-Driven Digital Twin for Foundry Production Process: Facilitating Best Practice Operations Investigation and Impact Analysis

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Abstract – In the context of increasing environmental concerns, the iron and steel industry faces large pressure to reduce its energy consumption and carbon footprint while maintaining economic viability. This paper explores the implementation of best practice operations within foundry processes, specifically induction furnace melting, to enhance energy and cost efficiency and reduce CO2 emissions. A digital twin model is developed integrating discrete event simulation, system dynamics modeling, and symbolic regression to simulate the foundry production process and evaluate the impact of various operational practices. A large Danish foundry is used as a case study, providing data for induction furnace production incorporating various electricity market data sources. Symbolic regression models are deployed to accurately predict melt temperatures and energy requirements. Results indicate that adopting best practices can lead to significant savings - up to 21% in electricity costs and 14.2% in CO2 emissions - while improving productivity. The study also highlights a point of diminishing returns at 65% adherence to best practices due to existing production schedules. Furthermore, the study demonstrates the digital twin's potential as a decision-support tool in optimizing industrial process operations.

Keywords – *Digital twin, best practice operations, foundry production, induction furnace, melting process, energy efficiency, CO2 reduction, cost efficiency*

III.8. Energy Pricing, Trading, and Market Dynamics

Blockchain-Enhanced Energy Trading in Smart Cities and Grids: Advancements in Market Systems and Business Models

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Abstract – This study introduces a cutting-edge framework for renewable energy trading, optimized for smart grids and smart cities, and focused on enhancing the functionality and efficiency of energy markets. By leveraging blockchain technology and non-fungible tokens (NFTs), the framework ensures secure and transparent transactions within distributed energy networks. The deployment across multiple Ethereum Virtual Machine (EVM)-compatible platforms, such as Fantom, Polygon, and Celo, exploits their cost-effectiveness and supports broad adoption. The integration of blockchain into the energy sector, particularly within smart grids and urban energy systems, offers significant improvements in managing energy flow and consumer engagement. This research evaluates the economic impacts and business models facilitated by blockchain in the energy sector, highlighting the potential for scalable and sustainable energy solutions in smart cities. This paper is the first step to aiming for blockchain-based renewable energy trading based on detecting the most suitable platform for deployment via several analyses to prove the effectiveness.

Keywords – *Blockchain Technology; Renewable Energy Trading; Smart Grids; Smart Cities; Energy Markets; EVM-Compatible Platforms*

Characterizing energy spot-price data as a proxy for demand

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Abstract – Spot-price information from an energy market is a readily available signal in many locations. This information acts as a reasonable proxy for real-time demand data, data that is critical to any flexible demand strategy. This data is inherently random in nature, and in this note we develop a framework for describing daily fluctuations in a simple manner where prices at a particular settlement time can be estimated by draws from a posterior predictive distribution.

Keywords – *stochastic process, heavy-tail distribution*

Revolutionizing Renewable Energy Markets: A Cross-chain, Encrypted NFT, and IPFS Decentralized Trading Framework

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Abstract – This paper explores the integration of blockchain technology, smart contracts, encrypted Non-Fungible Tokens (NFTs), and the Inter-Planetary File System (IPFS) to enhance the management of renewable energy transactions. Leveraging the decentralized, immutable, and transparent nature of blockchain, we aim to address the challenges of data security, accessibility, and integrity in renewable energy trading. Our framework employs various encryption algorithms—RSA, RC4, DES, ChaCha20, Blowfish, and AES—to secure energy transaction records, ensuring that only authorized users can access them. The system's performance was evaluated across four EVM-compatible blockchain platforms: Binance Smart Chain, Polygon, Fantom, and Celo. Key functions such as recording energy data, creating and transferring encrypted NFTs were assessed to provide insights into operational speed, resource efficiency, and overall reliability. Additionally, transaction costs were analyzed to identify potential cost savings and improve efficiency. Our study highlights the potential of these integrated technologies to create a secure and practical system for managing renewable energy transactions.

Keywords – *Blockchain, Renewable Energy Trading, Non-Fungible Tokens, InterPlanetary File System, Smart Contracts, Energy Data Management, Decentralized Applications*

Securing Renewable Energy Transactions: Blockchain, RSA-Encrypted NFTs, and IPFS Integration

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Abstract – The integration of renewable energy sources is essential for addressing climate change and achieving sustainable energy systems. Traditional centralized methods for managing renewable energy data and trading present challenges in transparency, security, and efficiency. This paper explores the application of blockchain technology to address these challenges by providing a decentralized, secure, and transparent framework for renewable energy transactions. Specifically, we examine the use of smart contracts, RSA-encrypted Non-Fungible Tokens (NFTs), and the InterPlanetary File System (IPFS) within blockchain-based renewable energy trading platforms. The study includes a comparative analysis of transaction fees across Ethereum Virtual Machine (EVM)-compatible platforms to determine the most cost-efficient options for implementing these systems. Our findings suggest that the integration of these technologies can enhance the management and trading of renewable energy, ensuring secure and efficient operations.

Keywords – *Blockchain, Renewable Energy Trading, RSA Encrypted Non-Fungible Tokens, InterPlanetary File System, Smart Contracts, Energy Data Management, Decentralized Applications*

How Households Benefit from Pre-announced Electricity Price Information: A Rolling Horizon Simulation with a Battery Storage System

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Abstract – Residential storage relies on access to forward-looking information such as future prices, power demand, and supply to not only reduce the electricity bill but also help alleviate grid imbalances. Consequently, electricity providers might pre-announce and guarantee prices for defined periods, such as the upcoming six hours, to encourage storage to operate in a way that benefits the grid. This paper assesses the value of pre-announced price information for a household equipped with a photovoltaic roof and battery with a rolling horizon approach. The system predicts photovoltaic production, household consumption, and electricity prices beyond the pre-announcement period with autoregressive integrated moving average (ARIMA) forecasts. These forecasts allow the systems to find strategies that save up to 303C more per year than without foresight. Pre-announcing prices for only eight hours enables the system to devise strategies that already realize 90% of potential savings due to price information (20.37C with and 65.38C per year without photovoltaic unit under perfect price information). Extending the pre-announcement period further shows only negligible additional benefits. These findings and the proposed model allow households and electricity providers to formulate optimal structures for dynamic electricity tariffs.

Keywords – *Energy Storage, Uncertainty, Charging Strategy, Residential, Dynamic Pricing*

III.9. Big Data Analytics and Cybersecurity in Energy

DataPro – A Standardized Data Understanding and Processing Procedure: A Case Study of an Eco-driving Project

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Abstract – To extract knowledge from big data and make recommendations for operational decision-making, a systematic pipeline for data processing and knowledge discovery is essential. The CRISP-DM model is the de-facto standard for developing data-mining projects in practice. However, advancements in data processing technologies require enhancements to this framework. This paper presents the DataPro (a standardized data understanding and processing procedure) model, which extends CRISP-DM and emphasizes the link between data scientists and application stakeholders. Firstly, this model incorporates a "technical understanding" phase to align business demands with technical requirements, ensuring the technical team's accurate comprehension of business goals. Next, the "implementation" phase focuses on the practical application of developed data science models, ensuring theoretical models are effectively applied in business contexts. Furthermore, clearly defining roles and responsibilities in each phase enhances management and communication, leading to better coordination and collaboration among all participants. Afterward, a case study on an eco-driving data science project in the transportation sector illustrates the application of the DataPro model. Finally, the model is evaluated qualitatively, demonstrating its superiority over other data science procedures.

Keywords – *Data Analytics, Data Driven, Knowledge Discovery, CRISP-DM, Eco-driving Case.*

Leveraging Open Data for Energy Source Selection in Bi-Valent Industrial Processes

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Abstract – This paper presents a comprehensive methodology for optimizing energy source selection in bi-valent industrial processes. Leveraging open data from SMARD and ENTSO-E, and employing the Calliope framework for modeling and simulation, we integrate economic and environmental analyses to inform decision-making. Our approach compares the costs and CO2 emissions of using gas versus electricity, demonstrating potential for cost savings and reduced carbon footprints. Various use cases are explored, including cost efficiency, grid-serving behavior, and production adjustments.

Keywords – *open data · simulation · sustainability*

Legal overview of latest developments in the Energy Sector regarding data protection and cybersecurity

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Abstract – This paper seeks to obtain a better understanding of the latest developments and purposes of the EU regulation related to data in the energy sector. It shows that EU cybersecurity measures has increased, giving a broader and stronger coverage although the regulation has a general aim of being at use for industry as well as for the people, which still is the intended purpose of the GDPR and NIS 2. It also argues that the importance of a well-functioning energy grid demands a strong protection from unauthored use or access to energy data or energy systems.

Keywords – *Energy Data, Data protection, GDPR, NIS 2, Cybersecurity, Surveillance, Digital market act, Digital Service Act*

Energy Data Collection Protocol: A Case Study on the ADRENALIN Project

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Abstract – Effective data collection is crucial for the success of data science projects, ensuring that data is of high quality and sufficient quantity for practical applications. However, the process is often complex, time-consuming, and prone to yielding low-quality data if not well-organized. Despite its importance, standardized protocols for data collection are lacking, leading to inconsistencies across projects. This paper introduces a comprehensive data collection protocol aimed at streamlining the process and enhancing data quality. The protocol is exemplified through the ADRENALIN project, which focuses on developing advanced machine learning algorithms for smart control of heating and cooling systems. The case study demonstrates the protocol's practical application, showcasing its effectiveness in overcoming common data collection challenges and ensuring reliable outcomes. By providing a structured approach, this protocol improves the consistency and comparability of datasets, facilitating better benchmarking and more accurate data-driven solutions, thus filling a critical gap in the literature and offering a valuable tool for researchers and practitioners.

Keywords – *Data Collection Protocol, Data Quality Assurance, Data Harmonization, Privacy Compliance in Data Collection, Big Data in Energy Systems.*

Detection of Municipal Heat Plan Documents Using Semantic Recognition Methods

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Abstract – Municipalities in Germany are required by law to prepare a report on municipal heat planning by June 2028 at the latest, depending on their population. Due to the federal structure of Germany in some federal states there exist different regulations and due dates. Most of the municipalities with already completed municipal heat plans have published them on their respective websites. Neither the heat plans themselves nor the location of publishing follow generic templates and are therefore presented in different formats, lengths and places. In order to gain an overview of these heat plans in an effort to coordinate heat planning across municipalities in Germany, a data set referring to the available heat plans shall be created and regularly updated. The first step is to use an internet search engine and a web crawler to identify candidate documents for a municipality's heat plan. In a second step, the results are checked for plausibility, i.e. it is checked whether the candidate documents are actually municipal heat plans and whether they are assigned to the correct municipality. The third step involves semantic enrichment by a process that includes the normalization of time expressions to extract important information from the municipal heat plan documents that relate to time sequences, as well as the extraction of geographical units to link the document to the correct municipality. A Web interface provides access to the detected municipal heat plans for evaluation and research purposes.

Keywords – *Municipal Heat Planning · Document Crawling · Semantic Recognition · Data Enrichment · Web Crawling.*

III.10. Smart Buildings and Energy Communities

Building potential energy savings estimation through portfolio-based modeling

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Abstract – Buildings significantly impact global energy use and emissions. One potential way to improve performance and reduce energy demand is by applying advanced control algorithms. This, however, requires a detailed cost-benefit analysis. We present a data-driven methodology for assessing commercial buildings' potential savings with advanced control techniques, focusing on the EU context. The approach uses hourly energy consumption data from 15 buildings to identify consumption patterns, cluster buildings, and predict energy savings without the need for physical inspections. The proposed method is validated using shopping malls as a case study.

Keywords – *Energy flexibility · Energy savings · Consumption profiles · Building potential · Energy audit · Demand-side management*

Year-Round Appliance Electricity Monitoring of a Hybrid Ventilated Single-Family Residence in Hyderabad, India

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Abstract – This study aims to monitor the electricity consumption of a hybrid ventilated single-family household over one year, focusing on seasonal variations, peak load consumption and the impact of specific appliances on total energy use. The electricity data of the monitored house was collected using intrusive load monitoring at finer time intervals at household and appliance levels. The appliances monitored include an air-conditioner, geyser, television, refrigerator, kettle, dishwasher, washing machine, oven, water purifier, mixer, grinder, and space heater. Furthermore, the monitored data was analysed to identify trends and patterns in annual electricity usage. The findings indicate that total electricity consumption peaks during the summer and winter, primarily due to increased usage of cooling and heating systems, respectively. The refrigerator and geyser accounted for a significant portion of the household's annual electricity consumption among the monitored appliances. Moreover, it was observed that the refrigerator and geyser were used frequently throughout the year, while the air conditioner and the space heater were used only in the extreme summer and winter, respectively. In summary, this study provides a methodology to monitor and evaluate the electricity consumption in a house. It also discusses a method to study the seasonal variations and the impact of household appliances on annual electricity consumption.

Keywords – *Intrusive load monitoring · Appliance electricity consumption · Seasonal electricity consumption · Peak load analysis*

Large Language Models for Fault Detection in Buildings' HVAC Systems

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Abstract – The building sector accounts for almost 40% of global energy consumption. However, buildings' Heating, Ventilation, and Air Conditioning (HVAC) systems are susceptible to various faults and defects, causing significant declines in buildings' energy efficiency. This implies a critical demand for suitable fault detection and diagnosis methods. At the same time, Large Language Models (LLMs) evolved rapidly over the last few years and, especially since the release of ChatGPT in 2022, gained widespread attention. LLMs interpret and process natural-language content as sequence-like data. We utilize LLMs proficiency in dealing with sequential input to handle time series data of buildings' HVAC systems and develop a novel fault detection method, harnessing LLMs to detect faults in common HVAC systems, thereby helping to mitigate energy wastage in buildings. We use publicly available time series datasets from a collection of European buildings' most common HVAC systems, serialize them, and pass them to a pre-trained LLM (DistilBERT). By fine-tuning the model with a large number of labeled input data, we enable classification into either binary cases (faulty/fault-free) or multiple fault classes. The performance is assessed using a 5-fold time series cross-validation, yielding an F1-score between 82 - 99% for the binary fault classification and a macro-averaged F1-score of up to 99% for the multi-class classification tasks. The main advantage of using LLMs for fault detection is that in contrast to conventional fault detection methods, LLMs can naturally deal with noisy input data. This can reduce the required preprocessing steps such as removing randomly missing values, encoding categorical features, and normalization.

Keywords – *Fault Detection · Building HVAC · Large Language Models*

Under floor heating operation in NZEB buildings – to better understand occupant's comfort and reasons behind energy performance gap

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Abstract – Radiant heating is a well-established solution that is widely adopted in existing and new nearly zero energy buildings (NZEBs). Under floor heating (UFH) is known for its many advantages, e.g., allowing access to low-grade heat sources such as heat pumps and low temperature district heating (LTDH) systems, and secure comfortable indoor environment. This study presents a long-term monitoring campaign of an NZEB building fully covered with a UFH system. Monitoring covers approximately one entire heating season, with the experiment aiming to decrease the operational indoor temperature and energy use for space heating while investigating the occupants' acceptance to this new thermal comfort situation and registering their feedback about perceived thermal comfort. The experiment results show that there is a significant reduction in the operation of the hydraulic system and water circulation in the UFH that is negatively perceived by the occupants who are used to feeling the warm floor. The paper highlights that the UFH, in combination with occupant's comfort preferences, can be the reason for NZEBs to operate with elevated indoor temperatures and to use more energy than anticipated. Results indicate that UFH in bathrooms is operated all year long due to occupants striving to feel the warm floor. The findings can significantly contribute to the advancement of innovative control strategies for achieving thermal comfort in NZEB buildings with radiant water-based heating systems and consideration for other placement of radiant emitters in the spaces.

Keywords – *Underfloor heating, Nearly zero energy building, Energy performance gap*

Investigations on Community Energy Sharing in Indian Residences

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Abstract – Achieving decarbonization and promoting clean energy are critical goals in the transition towards a sustainable future. Net-zero energy buildings (NZEBs) play a crucial role in this process by minimizing energy consumption and adopting the use of renewable energy sources (RES). Energy storage is necessary for maximizing local utilization of RES especially in residential buildings and improving their grid interaction. Centralized energy storage (CES) helps share the surplus generation from households to those with deficits. This work investigates how CES with energy sharing protocols can reduce dependency on the grid and achieve a net-zero grid interaction scenario, where the community generates and consumes an equal amount of energy. Simulations results indicate that CES requires a smaller total battery capacity compared to individual systems even when no energy is shared. When energy sharing is also considered, the battery capacity requirement significantly reduces. The grid imports also drastically reduce but the exports cannot be completely eliminated – these help evacuate surplus solar back to the grid. Results based on actual recorded data from India demonstrate how residential communities can reap significant economic benefits by considering CES with energy sharing: a 40% reduction in size with improved battery utilization is presented in the results. The results are promising and provide several insights on grid interaction.

Keywords – *Battery energy storage, community energy storage, grid interaction, net-zero energy buildings, renewable energy sources*