2022 International Conference on Informatics Electrical and Electronics (ICIEE)

Conference Proceedings

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Conference Proceedings

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Welcome Message

Salam. Dear ICIEE participants,

Welcome to the ICIEE 2022!

On behalf of the Organizing Committee of the 2022 International Conference on Informatics Electrical and Electronics, it is our great pleasure to welcome you to our hybrid event in Yogyakarta. The aim of this event is to provide an opportunity to present and share the most current research in electrical engineering and informatics. We cordially ask you to join fellow researchers, academicians, scientists, and engineers on a full day occasion.

The ICIEE is a biennial conference, organized by the Department of Electrical Engineering, Universitas Sultan Ageng Tirtayasa (and partners), with previous successful events held in 2018 and 2020. Technically co-sponsored by IEEE Indonesia Section, this year the conference's theme is "Smart Technology Towards Smart Energy." The topics include but are not limited to: Power System, Control Electronics, Circuits, and Systems, Information Technology, and Telecommunication.

We will kick off our conference with keynote lectures from distinguished profiles: Professor Chii-Wann Lin from National Taiwan University, Professor Josaphat Tetuko Sri Sumantyo from Chiba University and Professor Hadi Suyono from Universitas Brawijaya. We thank them sincerely for dedicating their valuable time to give exciting talks to the conference audience. Then, technical sessions will follow and be presented in parallel. Most presentations will be given virtually, so in-person participation here does not necessarily reflect the actual scale of this conference.

Our conference this year received a total of 74 submissions, of which 47 will be presented during the conference. All contributed papers went through an independent peer-review process. Finally accepted and presented papers published in the Conference Proceedings will be submitted for possible inclusion into IEEE Xplore. Submissions were from academia (87.8%), research facilities and government laboratories (9.5%), and industry (2.7%). Those papers came from IEEE Region 8 (Africa, Europe, Middle East) and Region 10 (Asia Pacific).

Special mention should be addressed to Rector of Untirta Professor Fatah Sulaiman and Dean of Engineering Faculty Untirta Professor Asep Ridwan for their institutional backing. In addition, we are honoured to have support from Universitas Lampung, Universitas Tidar, Universitas Mataram, as well as FORTEI, APTIKOM and sponsors. It goes without saying that this event is made possible by efforts from hard-working committees and also our student volunteers. Of course, appreciation also goes to external reviewers whose major contribution in the peer-reviewing process is at the very core of scientific dissemination.

We hope you will find the conference experience both technically and socially informative. Moreover, our purpose is also to facilitate collaborations and connections. We look forward to your feedback on this event and we hope to see you in the future ICIEE 2024!

General Chair : Dr. Romi Wiryadinata

Technical Program Chair : Imamul Muttakin, Ph.D.

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Welcome Message

Assalamualaykum warohmatullahi wabarakatuh.

Distinguished keynote speakers and speakers, guests, ladies and gentlemen,

It is our great pleasure to join and to welcome all participants of the 2022 International Conference on Informatics Electrical and Electronics (ICIEE) in hybrid. I am happy to see this great work of the Department of Electrical Engineering on organizing this international event.

On this occasion, I would like to congratulate all participants for their scientific involvement and willingness to share their findings in this conference. I believe that this conference can play an important role to encourage and embrace cooperative, collaborative, and interdisciplinary research among the engineers and scientists. And as a leading state university in Banten Province and fast-growing university in Indonesia, through this international seminar, Untirta consistently serves a medium for the development of knowledge particularly in area of Electrical engineering.

I do expect that this kind of similar event will be held in the future by other department within Untirta as part of activities in education research and social responsibilities of universities, research institutions, and industries internationally. My heartful gratitude is dedicated to Organizing Committee members and the students of Department of Electrical Engineering for their generous effort and contribution toward the success of the ICIEE 2022.

And on behalf of Universitas Sultan Ageng Tirtayasa, by reciting basmalah, “Bismillahirrohmanirrohim” I officially declare to open the 2022 International Conference on Informatics Electrical and Electronics.

Thank you.

Wassalamualaykum warohmatullahi wabarakatuh.

Prof. Dr. H. Fatah Sulaiman, ST., MT.

Rector of Universitas Sultan Ageng Tirtayasa

Indonesia

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Rocky Alfanz
Deria Pravitasari
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Keynote Speaker

"Enabling Precision Health with Biomedical Electronics"

Chii-Wann Lin, Ph.D., *Professor, Department of Biomedical Engineering, National Taiwan University*

Biomedical electronics has been the corner stone of the healthcare with numerous innovative medical devices. Advances in miniaturization, heterogeneous integration, and hard/software co-development have enabled digital transformation of modern healthcare system. Artificial intelligence, big data analytics, cloud computing, low latency communications, and immersive interactions, all these emerging technologies will help to facilitate novel service models in healthcare for better clinical outcomes and in preventive care toward precision health. I will share a few current statuses of research projects from my laboratory, e.g. complex phase space differential (CPSD) for arrythmia detection, automation of surface plasmon resonance (SPR) biosensing system, reinforcement learning (RL) algorithm for closed-loop stimulator.

Chii-Wann Lin received the B.S. degree from the Department of Electrical Engineering, National Cheng Kung University, Tainan City, Taiwan, the M.S. degree from the Graduate Institute of Biomedical Engineering, National Yang Ming University, Taipei, Taiwan, and the Ph.D. degree from Case Western Reserve University, Cleveland, OH, in 1984, 1986, and 1993, respectively. He was with the Center for Biomedical Engineering, College of Medicine, National Taiwan University, Taipei, from September 1993 until August 1998. He is now a Professor in the Graduate Institute of Biomedical Engineering and holds joint appointments in the Department of Electrical Engineering and Institute of Applied Mechanics, National Taiwan University. His research interests include biomedical micro sensors, optical biochip, surface plasmon resonance, bioplasmonics, nanomedicine, and personal e-health system. Dr. Lin is a member of the IEEE Engineering in Medicine and Biology Society, the International Federation for Medical and Biological Engineering, and the Chinese Biomedical Engineering Society. He was the President of the Taiwan Association of Chemical Sensors from 2008–2010.

Keynote Speaker

"Development of Airborne Microwave Remoted Sensor and The Applications"

Josaphat Tetuko Sri Sumantyo, Ph.D., *Professor, Center for Environmental Remote Sensing, Chiba University*

Our laboratory developed airborne circularly polarized synthetic aperture radar (SAR) for disaster and environment observation. This lecture explains the experience to develop this sensor, investigation of scattering characteristics of circular polarization in the ground test, and flight test of circularly polarized SAR in the Hinotori-C2 mission onboard CN235MPA aircraft in March 2018 at Makassar, Indonesia. This lecture also explains the applications of SAR image analysis using differential interferometric SAR and permanent scatterer interferometric SAR to observe disaster and environmental change. Finally, the tips of how to to be researcher will be explain in the end of this lecture.

Josaphat Tetuko Sri Sumantyo was born in Bandung, Indonesia in June 1970. He received the B.Eng. and M.Eng. degrees in electrical and computer engineering (subsurface radar systems) from Kanazawa University, Japan, in 1995 and 1997, respectively, and a Ph.D. degree in artificial system sciences (applied radio wave and radar systems) from Chiba University, Japan, in 2002. From 2002 to 2005, he was a Lecturer (Post-doctoral Fellowship Researcher) with the Center for Frontier Electronics and Photonics, Chiba University, Japan. From 2005 to 2013, he was an Associate Professor (permanent staff) with the Center for Environmental Remote Sensing, Chiba University, where he is currently a Full Professor (permanent staff). He is Head Department of Environmental Remote Sensing and Head Division of Earth and Environmental Sciences, Graduate School of Integrated Science and Technology, Chiba University in 2019-2020. He is also Full Professor in the Department of Electrical Engineering, Faculty of Engineering, Universitas Sebelas Maret (UNS), Indonesia since 2020. Now he is Head Division of Disaster Data Analysis, Research Institute of Disaster Medicine, Faculty of Medicine, Chiba University since October 2021. His research interest is theoretically scattering microwave analysis and its applications in the microwave (radar) remote sensing, especially synthetic aperture radar, quantum radar, noise radar, and subsurface radar (VLF), including InSAR, DInSAR, and PS-InSAR, analysis and design of antennas for mobile satellite communications and microwave sensors, development of microwave sensors, including synthetic aperture radar for UAV, aircraft, high altitude platform system (HAPS), and microsatellite. He published about 900 journal and conference papers, invited talks, and 15 book-related wave analyses, UAV, SAR, space antenna, and a small antenna. He is General Chair of the 7th and the 8th Asia-Pacific Conference on Synthetic Aperture Radar (APSAR 2021), and more than 260 Invited Talks and Lectures. He is Chair of Technical Committee of Working Group on Remote Sensing Instrumentation and Technologies for UAV of IEEE-GRSS, Technical Committee on Instrumentation, and Future Technologies (IFT-TC), and Associate Editor of IEEE Geoscience and Remote Sensing Letter (GRSL).

Keynote Speaker

"Enhancement of Power Grid Resilience using Artificial Intelligence"

Ir. Hadi Suyono, Ph.D., IPU., ASEAN.Eng., *Professor, Department of Electrical Engineering, Universitas Brawijaya*

.

Prof. Ir. Hadi Suyono, S.T., M.T., Ph.D., IPU., ASEAN Eng. received his B.Eng. from Universitas Brawijaya, Malang-Indonesia in 1996; M.Eng. from Universitas Gadjah Mada, Yogyakarta-Indonesia in 2000 and Ph.D from Universiti Malaya, Kuala Lumpur-Malaysia in 2006. He is currently a Professor at the Department of Electrical Engineering, Faculty of Engineering, Universitas Brawijaya (UB), Malang, Indonesia.

He serves as the Head of the Department of Electrical Engineering, from 2017 up to 2021, and as the Dean of Faculty of Engineering, Brawijaya University, from 2021 up to now. He is also the Head of Power System Engineering and Energy Management Research Group (PSeeMRG), Universitas Brawijaya, since 2015 - now. In year 2013-2017, he served as the Vice Head of Department of Electrical Engineering, Faculty of Engineering, Universitas Brawijaya. In year 2010-2014 he served as Vice Head of the Master and Doctoral Program in the Faculty of Engineering, Universitas Brawijaya. He has been appointed as interviewer and reviewer of Indonesia Endowment Fund for Education, the Secretariat General of the Ministry of Finance of the Republic of Indonesia, since 2015-now. He holds professional engineer certificate from the Engineer Association of Indonesia since 2016-now. He has been appointed as the Auditor of the Quality Assurance Centre, Universitas Brawijaya since 2013-now.

He is a member of IEEE, IEEE Power and Energy (PES), IEEE Computational Intelligence Society (CIS), IEEE Dielectrics and Electrical Insulation Society (DEIS), International Association of Engineers (IAENG), Indonesian Renewable Energy Society (IRES), International Association of Computer Science and Information Technology (IACSIT). He is elected as vice head (2018-2020) and Head (2020-now) of Association of Higher Education in Electrical Engineering Indonesia (FORTEI). He is active as a reviewer of several international journals and conferences. He also serves actively as a senior consultant in industries, private companies and government institutions. His research interests cover the power system engineering, artificial intelligence, energy efficiency, embedded generation system, renewable energy, power system stability, power system planning and operation, and reliability studies in a deregulated power system.

Program

2022 International Conference on Informatics Electrical and Electronics (ICIEE)

Wednesday, 5 October 2022
Eastparc Hotel, Yogyakarta – Indonesia

08:00 – 08:30	Registration			
08:30 – 09:30	Opening			
09:30 – 10:00	Coffee break			
10:00 – 12:00	Keynote lecture			
12:00 – 13:00	Lunch and prayer break			
13:00 – 15:00	Parallel session			
	Power system I	Control, electronics, circuits, and systems I	Information technology I	Telecommunication I
15:00 – 15:30	Coffee and prayer break			
15:30 – 16:45	Parallel session			
	Power system II	Control, electronics, circuits, and systems II	Information technology II	Information technology III
16:45 – 17:00	Closing			

Technical Schedule

13:00 - 15:00	
Power System I	
Session Chair:	Alimuddin
Room:	A

957 (in person)	Thermoelectric Generator for Micropower Application Using Household Waste Munnik Haryanti, Wahyu Saputro and Bekti Yulianti
2072 (in person)	Thermal Monitoring System Phase Change Material Batteries Using Fuzzy Logic Hartono Hartono and Khen Nuhfus Sanjaya
5596 (in person)	Dynamic Stability Simulation Multimachine Power Generating System Sapto Nisworo, Deria Pravitasari and Zulfikar Aji Kusworo
6851 (in person)	Shaded Cell Random Model of Solar Cell Module on Energy Harvesting A.N. Afandi, Sujito Sujito, Mahmudin Yunus, Langlang Gumilar, Ana Nuril Achadiyah and Goro Fujita
9323 (in person)	Dynamic Thermal Line Rating Considering Cooling Impact on Conductor's Heating of Transmission Power Loss A.N. Afandi, Aji Prasetya Wibawa, Yuni Rahmawati, Sunaryono Sunaryono and Makiko Kobayashi
7457 (in person)	Acceleration of Rooftop Solar Power Plant Development as a Support of the Reduction of Greenhouse Effect Ibrahim Nawawi, Andriyatna Agung Kurniawan and Deria Pravitasari

15:30 - 17:00	
Power System II	
Session Chair:	Hartono
Room:	A

7591 (in person)	Study of Electrical Power System onTransmission and Distribution in PT Krakatau Daya Listrik (KDL) Alimuddin Alimuddin, Amil Mukrod, Irma Saraswati, Cakra Adipura Wicaksana, Heri Hariyanto and Ria Arafiyah
6671 (virtual)	Role of type-2 fuzzy algorithm to improve response of rectifier in HVDC-model I Made Ginarsa, I Made Ari Nrartha, Agung Budi Muljono, Ni Made Seniari and Osea Zebua
9341 (virtual)	A Development of a Low Cost Solar Irradiance Meter Using Mini Solar Cells Ferdian Ronilaya, Putra Fahri Ramadhani, Moh. Noor Hidayat, Sapto Wibowo, Irwan Heryanto Eryk and Stevanus Septian Vicky Putra Pratama

13:00 - 15:00	
Control, electronics, circuits, and systems I	
Session Chair:	Irma Saraswati
Room:	B

1954 (in person)	Determine of the Time Constant of Capacitance Applied to Electrical Capacitance Tomography Arba'I Yusuf, Wahyu Widada and Warsito Purwo Taruno
2750 (in person)	Active Front End with simple control for Improved Power Quality Asep Andang, Oriza Sativa and Abdul Chobir
3761 (in person)	Analysis of the Influence of Sun Intensity on Power on Coastal and High Lands using Solar Tracker based on Arduino Microcontroller Isra Nuur Darmawan, Kholistianingsih Kholistianingsih, Burhan Alnovda Azaria and Priyono Yulianto
5220 (in person)	Implementation of AHRS (Attitude Heading and Reference Systems) With Madgwick Filter as Hexapods Robot Navigation Ri Munarto, Romi Wiryadinata and Donny Prakarsa Utama
8746 (virtual)	The role of post-annealing treatment on ZnO:Co structure and magnetic transition grown by sputtering deposition Agusutrisno Marlis Nurut, Naoto Yamashita, Kunihiro Kamataki, Kazunori Koga, Naho Itagaki and Masaharu Shiratani
1530 (virtual)	Control of DC Motor Speed on Smart Gate System Using Fuzzy Logic Controller Wahyudi Wahyudi, Muhammad Rohman and M Arfan
2270 (virtual)	Dual Axis Solar Tracker With Fuzzy Logic Method Yustinus Bagus Arisotya, A. Bayu Primawan and Djoko Untoro Suwarno

15:30 - 17:00	
Control, electronics, circuits, and systems II	
Session Chair:	Ceri Ahendyarti
Room:	B

3057 (virtual)	Prototype of a Monitoring System for Temperature, Humidity, and Location of Reefer Container based on IoT Abdi Pratama Putra, Muhammad Yusro and Aodah Diamah
3772 (virtual)	Monitoring System Temperature and Humidity of Oyster Mushroom House Based On The Internet Of Things Irma Saraswati, Adhitya Rahma Putra, Masjudin Masjudin and Alimuddin Alimuddin
6252 (virtual)	A Real-time Performance Monitoring of IoT-based on Lithium-Ion Battery Pack Murie Dwiyaniti, Sri Lestari Kusumastuti, Luthfi Rahman Nova Kusuma, Achmad Rais Wiguna, Silawardono Silawardono and Tohazen Tohazen
6950 (virtual)	Internet of Things-based PDAM Water Usage and Quality Monitoring System using ESP32 Bramantyo Regowo, Muhammad Yusro and Jusuf Bintoro
6576 (in person)	Low-cost Impedance Measurement System for Determination of Condition and Oil Content in Wood Material Rocky Alfanz, Muhamad Fauzi, Imamul Muttakin, Rian Fahrizal and Yofei Okazaki

13:00 - 15:00
Information technology I
Session Chair: Muhammad Iman Santoso
Room: C

1310 (in person)	Energy Potential Estimation System Model To Produce Alternative Energy Briquettes Norbertus Tri Suswanto Saptadi, Ansar Suyuti, Amil Ahmad Ilham and Ingrid Nurtanio
7949 (in person)	Analysing Temporal Hotspot Occurance over Sumatera and Kalimantan Arie Vatresia, Ferzha Putra Utama, Aji Novriadi, Hendri Gunawan, Rendra Rais and Yudi Setiawan
388 (virtual)	Integrated Performance Appraisal System with Management by Objective Method Fitri Dwi Kartikasari, Susana Limanto and Nandya Cahya Puspita
3764 (virtual)	Graph-based Process Mining for Measuring Quality of Business Process Model Kelly Rossa Sungkono, Riyanarto Sarno, Fara Dinda Mutia Kinanggit, Irsyadhani Dwi Shubhi and Khofifah Nurlaela
4644 (virtual)	Role of Internet of Things in Aviation Industry: Applications, Challenges, and Possible Solutions Md Shaikh Rahman, Selvakumar Manickam and Shafiq Ul Rehman
6858 (virtual)	Modelling Flood Prone Area in North America with Geomorphic Flood Index Method Hanni Yolina, Edy Irwansyah and Rojali Rojali
7787 (virtual)	Mapping Graph-Based Process Model Into Discrete Event Simulation (DES) Riza Dwi Andhika, Kelly Rossa Sungkono and Riyanarto Sarno

15:30 - 17:00
Information technology II
Session Chair: Rian Fahrizal
Room: C

5548 (in person)	Performance Evaluation for Infrared Face Recognition using Convolutional Neural Network Muhammad Eka Setio Aji, Annisa Syakhira, Supriyanto Praptodiyono and Rocky Alfanz
8577 (In person)	Fake News Classifier with Deep Learning Abba Suganda Girsang
490 (in person)	Twitter Sentiment Analysis in Indonesian Language with Python using Naive Bayes Classification Method Cakra Adipura Wicaksana, Mohammad Fatkhurrokhman, Rinanda Febriani, Rifaldi Tryawan, Alimuddin Alimuddin and Hafiyyan Putra Pratama
673 (virtual)	Investigating the Influence of Layers Towards Speed and Accuracy of Neural Networks Kevin Bennett Haryono, Hizkia Christian Purnomo, Ryne Ferdinand, Henry Lucky and Derwin Suhartono
5935 (virtual)	Implementation of Feature Selection to Reduce the Number of Features in Determining the Initial Centroid of K-Means Algorithm Vincentius Riandaru Prasetyo, Fania Alya Miranti and Susana Limanto
6488 (virtual)	Clustering of Customer Lifetime Value With Length Recency Frequency and Monetary Model Using Fuzzy C-Means Algorithm Mirdatul Husnah and Rice Novita

13:00 - 15:00
Telecommunication I
Session Chair: Teguh Firmansyah
Room: D

4898 (in person)	5G Coverage Evaluation: A Systematic Literature Review Bayu Devanda Putra, Rizal Munadi, Syahrial Syahrial, Ramzi Adriman, Teuku Yuliar Arif and Melinda Melinda
9615 (in person)	Multi-Antenna Combination Visibility Analysis for Rocket Application using SDR Sri Kliwati, Romi Wiryadinata, Afrido Prayogi, Rustamaji Rustamaji and Wahyu Widada
1330 (virtual)	Design of Fiber-to-the-Home Network Deployment at the Ministerial Residential of IKN Nusantara Jeremy Baskoro, Fasya Tiarani, Naufal Alfarabay, Bintang Giani, Nurmuthia Oktovioletha and Catur Apriono
1510 (virtual)	Dual-Band Microstrip Antenna Array Design for Low Power Energy at Frequencies 900 MHz and 1800 MHz Priyo Wibowo, R. Harry Arjadi and Nur Adi Siswandari
1653 (virtual)	FPGA Implementation of OFDM-based Visible Light Communication System Rahmayati Alindra, Purnomo Sidi Priambodo and Kalamullah Ramli
1801 (virtual)	Techno-Economic Analysis of 5G Implementation at Frequency 2.3 GHz for Bandung City Merlyn Inova Christie Latukolan, Nachwan Mufti Adriansyah and Ahmad Tri Hanuranto
8995 (virtual)	Predicting Channel Gain Threshold for V2V Communications with Varying Doppler Shift Using Machine Learning Nazmia Kurniawati, Aisyah Novfitri, Rifqi Fuadi Hasani and Arti Suryaning Tyas

15:30 - 17:00
Information technology III
Session Chair: Suhendar
Room: D

5473 (virtual)	Effect of Visual Augmented Reality in the Transportation Sector I Putu Ronny Eka Wicaksana, Bertrand Bertrand, Jason Christian, Said Achmad and Rhio Sutoyo
5981 (virtual)	How is Smartphone Technology Changing Healthcare Azella Gania Mutyara, Brian Abiyyu Farras, Liauren Permata Sari, Said Achmad and Rhio Sutoyo
7301 (virtual)	Detecting Phishing Websites with Non-Parametric Machine Learning Bianca Chelsea Putri Nugroho, Josephine Florencia Chan, Valencia Vananda, Henry Lucky and Derwin Suhartono
8343 (virtual)	Important Security Factors for Implementing Internet of Things in Smart Home Systems Daniel Widjaja, Derrick Derrick, Muhammad Fathariq Dimas Octaviandra, Said Achmad and Rhio Sutoyo
8776 (in person)	Comparative Analysis of Radial Basis Method with Backpropagation for Signature Identification Siswo Wardoyo, Adi Nugroho and Suhendar Suhendar
8931 (virtual)	The Utilization of Content Based Filtering for Spotify Music Recommendation Jonas Theon Anthony, Gerard Ezra Christian, Vincent Evanlim, Henry Lucky and Derwin Suhartono

Room

Agenda	Venue	Zoom
Keynote Lecture	Main Venue “Garden Room”	Meeting ID: 927 2371 0736 Passcode: 438329
Parallel Session A	Breakout I “Orchid Room”	Meeting ID: 959 6751 2980 Passcode: 1234
Parallel Session B	Breakout II “Magnolia Room”	Meeting ID: 832 2435 0072 Passcode: 537443
Parallel Session C	Breakout III “Carnation Room”	Meeting ID: 883 9976 2136 Passcode: 544854
Parallel Session D	Breakout IV “Lotus Room”	Meeting ID: 921 5958 9210 Passcode: 887272

Implementation of Feature Selection to Reduce the Number of Features in Determining the Initial Centroid of K-Means Algorithm

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***Abstract*— Clustering is a data mining method to group data based on its features or attributes. One reasonably popular clustering algorithm is K-Means. K-Means algorithm is often optimized with methods such as the genetic algorithm (GA) to overcome the problem of determining the initial random centroid. Many features in a dataset can reduce the accuracy and increase the computational time of model execution. Feature selection is an algorithm that can reduce data dimension by removing less relevant features for modeling. Therefore, this research will implement Feature selection on the K-Means algorithm optimized with the Dynamic Artificial Chromosome Genetic Algorithm (DAC GA). From the experimental results with ten datasets, it is found that reducing the number of features with feature selection can speed up the computation time of DAC GA to K-Means process by 17,5%. However, all experiments resulted in higher Sum of Square Distance (SSD) and Davies Bouldin Index (DBI) values in clustering results with selected features.**

Keywords*— *K-Means, Dynamic Artificial Chromosomes Genetic Algorithm, Feature Selection

I. INTRODUCTION

Clustering is a method in data mining that is used to group data. According to Tan, 2006 clustering is a process for grouping data so that the data in one group has a close resemblance and the data between groups has a distant resemblance. One of the most popular clustering methods is K-Means.

The advantages of the K-Means method include: easy and easy implementation to run, the time required for the process is relatively fast, and it is easier to combine with other algorithm [1]. The K-Means algorithm works by forming clusters based on the distance of each data to the center of the cluster or its centroid. However, the determination of the initial random centroid becomes a drawback of this algorithm because this algorithm is very dependent on the centroid. Mursalim conducted a study to determine the center of the initial centroid with the Dynamic Artificial Chromosomes Genetic Algorithm (DAC GA) [1]. His research proved that incorporating the algorithm is better than the usual K-Means method.

From the results obtained, Mursalim, Purwanto, and Soeleman feel that this research can be further improved by adding a feature selection algorithm. This is intended to reduce the number of features to speed up the computing process. Feature selection itself is an algorithm used to select features that are considered to significantly affect the model [2]. Feature selection is divided into four methods: filter, wrapper, embedded, and hybrid [3]. One of the feature selection algorithms that has been widely developed is the distance-based feature selection included in the filter method [4].

Distance-based feature selection will select the feature based on the distance between the feature and its target class. Distance measures that can be used include Euclidean distance, Minkowski distance, Manhattan distance, and distance correlation. Feature selection based on distance correlation has recently received much attention [4]. Distance correlation itself is a method that can measure the distance between two random variables both linearly and non-linearly [5]. Examples of feature selection algorithms based on distance correlation are the Distance Correlation Sure Independence Screening (DCSIS) algorithm [6], Distance Correlation Maximization (DisCoMax) [7], and Distance Correlation Feature Selection (DCFS) [4].

Tan, et.al conducted trials with his proposed method, DCFS, a hybrid of the filter and wrapper method with five different datasets and compared the results with trials on several other algorithms, including the DCSIS and DisCoMax algorithms. Several test results show that implementing the DCFS algorithm, which combines distance correlation-based feature selection with forward and backward selection, can produce a lower Root Mean Squared Error (RMSE) value than the DCSIS and DisCoMax algorithms [4].

This study implements feature selection adapted from the DCFS algorithm [4] on the clustering model that has been proposed by Mursalim [1]. The implementation of feature selection is done to reduce the number of features in the test dataset by selecting features relevant to the target class. The research will be conducted by processing the selected feature dataset and the dataset with all the features in the clustering model proposed by Mursalim [1]. So the result of this research is the comparison of computational time and quality of clustering results between datasets with selected features and datasets with all features.

II. RESEARCH METHODS

This study consists of five main stages: collecting datasets, data preparation, selecting the optimum number of clusters, forming models, and evaluating. The stages of the research can be seen in Fig. 1 and discussed in detail in the sub-section in this section.

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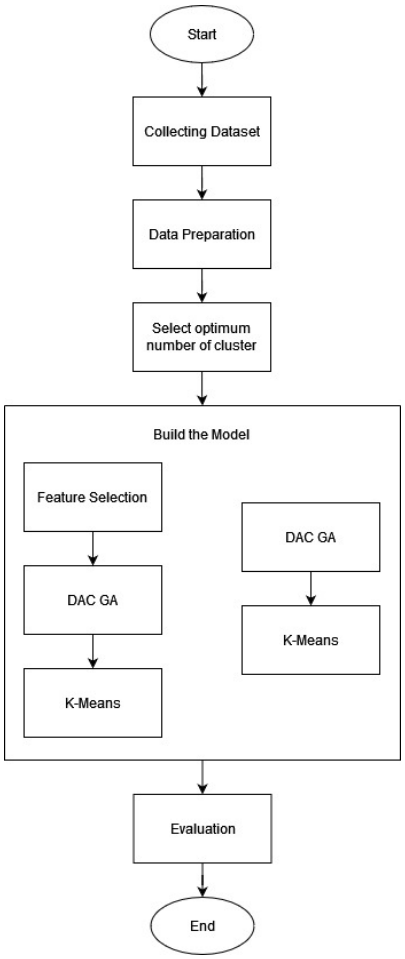

Fig 1. Research Method

A. Collecting Datasets

This study will use ten datasets for testing. The dataset consists of 3 synthetic datasets, two tuberculosis datasets from WHO [8], and five datasets taken from the UCI repository [10-14]. A summary of the dataset to be used can be seen in Table I.

TABLE I. SUMMARY OF 10 DATASETS

Dataset Name	Attribute Type	Numbers of Data	Number of Features
Synthetic 1	Continuous	1000	100
Synthetic 2	Continuous	1000	500
Synthetic 3	Continuous	1000	1000
Tuberculosis risk factors by age and sex	Mixed	7310	7
MDR tuberculosis caseload	Mixed	201	20
Dermatology	Discreate	366	34
Mturk User-Perceived Clusters over Images	Discreate	180	500
Detection of IoT botnet attacks N BaIoT	Continuous	2000	115
Sonar	Continuous	208	60
QSAR Biodegradation	Mixed	1055	41

B. Data Preparation

Before the data is processed on the created model, the encoding process, missing value handling, and normalization will be carried out. The encoding process is done by changing the value of several features with a discrete number that represents a specific category. The encoding process can be seen in Tables II and III.

TABLE II. ENCODING PROCESS 1

Feature	Actual Value	After encoding
age_group	0-4	1
	0-14	2
	15-24	3
	15plus	4
	25-34	5
	35-44	6
	45-54	7
	55-64	8
	65plus	9
	all	10
sex	f	0
	m	1
	a	2
risk fact	All (not based on any specifics)	1
	Alc (Alcohol use warning)	2
	Dia (Diabetes)	3
	Hiv (HIV)	4
	Smk (Smoking)	5
	Und (Malnutrition)	6

TABLE III. ENCODING PROCESS 2

Feature	Actual Value	After encoding
source_rr_new	Surveillance	1
	Model	2
	Survey	3
source_drs_coverage_new	National	1
	Sub 1	0
source_rr_ret	Surveillance	1
	Model	2
	Survey	3
source_drs_coverage_ret	National	1
	Sub 1	0

Next is the handling of missing values, which will be done with the help of the SimpleImputer module from the sklearn library. The missing_value parameter will be set to NaN and the strategy parameter to "most_frequent." The last data preparation is normalization which will be carried out using the MinMax Scaling technique, whose formula can be seen in Eq. (1).

$$X_{sc} = \frac{X - X_{min}}{X_{max} - X_{min}} \quad (1)$$

C. Select Optimum Number of Cluster

Before running the model, the best number of clusters will be determined using the elbow technique. The best number of clusters is determined to produce optimal clustering results. This process will be carried out by testing the number of clusters from 2 to 10. The number of selected clusters will later be used to determine the number of chromosomes in each individual in the DAC GA process and the number of clusters in the K-Means process.

This process will be carried out on each dataset so that each dataset may have a different optimal number of clusters. However, it will have the same number of clusters for the same dataset with selected features and the initial or without feature selection.

D. Build the Model

The model used will be divided into feature selection, DAC GA, and K-Means. First, the dataset will undergo a feature selection process to select the relevant features. The feature selection process is adapted from the method used in Tan's research [4]. Next, the DAC GA process will be carried out, which will select the center of the initial centroid. The DAC GA process was carried out [1, 9]. The initial centroid center obtained from the DAC GA process will be used as the initial centroid for the clustering process using K-Means. The whole model of the system can be seen in Fig. 2.

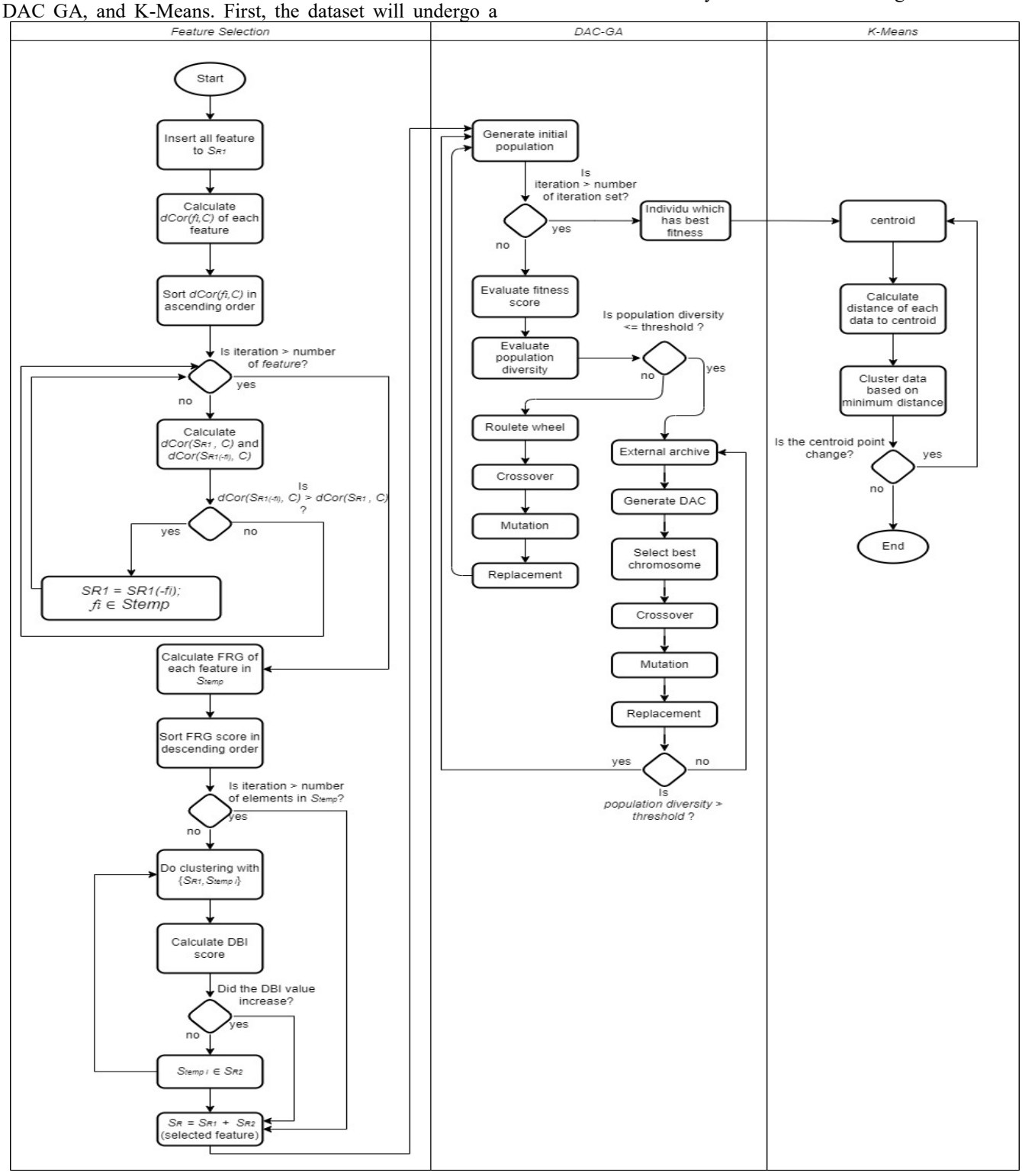

Fig 2. The whole process in the model

1) Feature Selection

The feature selection process begins by entering all the features in the dataset into SR1, which is the first subset of selected features. Furthermore, each feature (fi) in this subset is calculated by its distance correlation to the target class (C), which in this case is the result of the cluster. Distance correlation is a distance calculation proposed by Szekely [5] whose formula can be seen in Eq. (2) to (4). The features are sorted in ascending order or from the lowest to the highest correlation from the distance correlation calculation results. Furthermore, the distance correlation value is calculated between SR1 to the target class (C) and SR1 (-fi), which is a subset of selected features after the i-th feature, the feature with the lowest correlation, is deleted from the target class (C). If the value of dCor(SR1(-fi), C) is more significant than dCor(SR1, C), then change SR1 with SR1(-fi). Conversely, if it is smaller than before, then the i-th feature (fi) will be included in Stemp, a temporary subset to accommodate not selected features. Next, dCor(SR1, C) and dCor(SR1(-fi), C) is calculated again until all features in the dataset have been calculated.

$$dCor(x,y) = \frac{dCov(x,y)}{\sqrt{dVar(x).dVar(y)}} \quad (2)$$

$$dCov(x,y) = \frac{1}{n^2}\sum_{k,l=1}^{n} A_{kl}B_{kl} \quad (3)$$

$$dVar(x) = dCov(x,x) = \frac{1}{n^2}\sum_{k,l=1}^{n} A_{kl}^2 \quad (4)$$

Each feature in the Stemp has then calculated the value of the feature-relationship gain (FRG) and sorted in descending order or from large to small. This FRG value will be calculated according to Tan's research [4] with the formula seen in Eq. (5). Furthermore, the selected features on SR1 and SR1(+fm), a subset of selected features, are added with features on Stemp, which have the highest FRG value, clustering and evaluating with the Davies Bouldin Index (DBI). This is done until the DBI SR1(+fm) result is more significant than before. The best subset has the lowest DBI value and will be included in the SR2 variable. The final selected feature (SR) subset is the result of SR1 U SR2.

$$FRG = \frac{dCor\left(S_{R1}^{(+m)}, f_m\right) - dCor\left(S_{temp}^{(-m)}, f_m\right) + \exp[dCor(f_m, C)]}{dCor\left(S_{R1}^{(+m)}, S_{temp}^{(-m)}\right) + \exp[dCor\left(S_{R1}^{(-m)}, C\right) - dCor\left(S_{temp}^{(+m)}, C\right)} \quad (5)$$

2) Dynamic Artificial Chromosomes Genetic Algorithm

After obtaining the optimal features, the Dynamic Artificial Chromosome Genetic Algorithm (DAC GA) process will be carried out to determine the initial centroid center before clustering with K-Means. This process will be carried out on a dataset with selected features and an initial or without feature selection. The process begins by determining the initial population at random. The user can later set the number of individuals in this process. The individual in this process is the centroid used for clustering with K-Means. Furthermore, the fitness value of each individual will be evaluated.

The following process calculates the value of population diversity with a linear scale measure formula and a threshold of 0.5 [1]. Suppose the diversity value is less than the threshold. In that case, the dynamic artificial chromosome function will be executed by generating a new population in the external archive and calculating the fitness value of each chromosome. Individuals with low fitness values will be replaced with those with good fitness values in the external archive. Next is to carry out steps like genetic algorithms, namely individual selection, crossover, and mutation. The fitness evaluation process until the mutation is carried out to the maximum iteration limit.

3) K-Means

The K-Means process will be carried out on a dataset whose features have been selected with the initial dataset or without feature selection. The K-Means process begins with determining the number of clusters to be taken from the results of determining the best number of clusters taken from the previous process. Next is the determination of the initial center of the centroid taken from the best individuals in the DAC-GA process.

After determining the center of the centroid, the next step is to calculate the distance using Euclidean Distance for each data to the centroid. The next step is to group the data into clusters with the smallest distance between the data and its centroid. This process is carried out until there is no change in the cluster results.

E. Evaluation

The evaluation will compare three factors: computational time, Sum of Square Distance (SSD), and Davies Bouldin Index (DBI). These three factors will be compared between the implemented backward selection dataset and not the initial dataset. The computation time starts from the DAC GA process to K-Means for each dataset.

Evaluation with SSD is used to measure the error rate in clustering. So the lower the SSD value, the smaller the error in the clustering results. The SSD formula used can be seen in Eq. (6), where *K* is the number of data lines and x is the data while C_i is the cluster's center.

$$SSD = \sum_{i=1}^{K}\sum_{x \in C_i} d(x, \overline{x_{C_i}})^2 \quad (6)$$

Evaluation with DBI is used to measure the quality of clustering results. A good cluster quality is if the data in the cluster has a high similarity and the data between clusters has a distant similarity. The smaller the DBI value, the better the cluster formed. Equation (7) is the formula used to calculate the DBI value. Where *n* is the number of clusters, *s* is the average distance of each data in the cluster to its centroid, and Ci is the center of cluster *i*.

$$DBI = \frac{1}{n}\sum_{i=1, i \neq j}^{n} \max\left(\frac{s_i + s_j}{d(C_i, C_j)}\right) \quad (7)$$

III. Results And Discussions

The computational time results of the experiment with ten different datasets are summarized in Table IV. The trial is carried out with a maximum of 100 iterations. The number of individuals is 30, the probability of selection is 0.5, the probability of crossover is 0.3, and the probability of

mutation is 0.2. This computation time is calculated from the feature selection process. Next, the computation time is recalculated in the initial centroid selection process with DAC GA to clustering with K-Means on the dataset with selected features and the initial dataset or all features. Based on the experiment results, it can be seen that the average computational time required to determine the center of the centroid using the selected features is 57.35 seconds in all dataset tests. Meanwhile, the average computation time required to determine the center of the centroid using all the features in all testing datasets is 65.27 seconds.

TABLE IV. COMPUTATION TIME RESULT OF EACH DATASET

Dataset Name	Computation Time (in second)		
	FS	*DAC GA + K-Means (selected feature)*	*DAC GA + K-Means*
Synthetic 1	118.49	33.42	34.49
Synthetic 2	1141.89	36.62	82.29
Synthetic 3	3438.87	34.48	38.47
Tuberculosis risk factors by age and sex	217.86	206.39	214.04
MDR tuberculosis caseload	2.74	11.2	15.1
Dermatology	8.85	12.07	12.58
Mturk User-Perceived Clusters over Images	84.81	12.75	14.7
Detection of IoT botnet attacks N BaIoT	535.8	144.52	147.64
Sonar	6.41	7.11	15.21
QSAR Biodegradation	58.1	74.98	78.17

The following evaluation is to calculate the Sum of Square Distance (SSD) value. All SSD test results with ten datasets are summarized in Table V. The table also presents the optimal number of clusters in the data. From a total of ten trials, it can be seen that the entire SSD value from the clustering results in the dataset with selected features is greater than the SSD value from the clustering results in the initial dataset or without feature selection. This indicates that using the selected feature produces poor clustering results.

TABLE V. SSD RESULT OF EACH DATASET

Dataset Name	Optimal Cluster	SSD	
		DAC GA + K-Means (selected feature)	*DAC GA + K-Means*
Synthetic 1	3	3921.7	474.71
Synthetic 2	3	2623.85	2623.85
Synthetic 3	3	5173.3	5173.3
Tuberculosis risk factors by age and sex	5	2231.44	2063.08
MDR tuberculosis caseload	4	101.58	88.33
Dermatology	4	555.59	506.61
Mturk User-Perceived Clusters over Images	6	2459.24	2398.04
Detection of IoT botnet attacks N BaIoT	6	678.8	547.22
Sonar	3	443.39	383.14
QSAR Biodegradation	5	446.25	413.86

The last evaluation carried out was to calculate the Davies Bouldin Index (DBI) value. All the DBI test results with ten datasets are summarized in Table VI. In addition, the table also presents the optimal number of clusters in the data. From a total of ten trials, it can be seen that all DBI values from clustering results in the dataset with selected features are more significant than the DBI values from clustering results in the initial dataset or without feature selection. This also indicates that using the selected feature produces poor clustering results.

TABLE VI. DBI RESULT OF EACH DATASET

Dataset Name	Optimal Cluster	DBI	
		DAC GA + K-Means (selected feature)	*DAC GA + K-Means*
Synthetic 1	3	4,590116	0,298512
Synthetic 2	3	0,318914	0,318914
Synthetic 3	3	0,315767	0,315767
Tuberculosis risk factors by age and sex	5	1,801602	1,461114
MDR tuberculosis caseload	4	1,469063	1,373265
Dermatology	4	2,167067	1,481111
Mturk User-Perceived Clusters over Images	6	3,832341	3,514366
Detection of IoT botnet attacks N BaIoT	6	1,336656	1,024579
Sonar	3	2,56548	1,864598
QSAR Biodegradation	5	1,787479	1,52891

From ten experiments on different datasets and attributes, it can be seen that the computational time for the DAC GA to K-Means process on the dataset with selected features is faster than the DAC GA to K-Means process on the initial dataset or with all features. So it can be concluded that the implementation of feature selection can reduce the number of existing features and reduce the computation time required to run the DAC GA to K-Means process.

In addition, from a total of ten experiments conducted with different datasets, the Sum of Square Distance (SSD) and Davies Bouldin Index (DBI) values for the test results on the dataset with selected features are more significant than the test results on the initial dataset or with all of the features of the dataset. So it can be concluded that the implementation of feature selection does not improve the quality of the clustering results in the proposed model.

IV. CONCLUSIONS

Based on the experiment results, implementing feature selection in this study using a hybrid of backward selection can speed up computational time in the initial centroid determination selection using the DAC GA algorithm and clustering using K-Means. That is evidenced by the results of trials with ten different datasets, resulting in faster computational times in the DAC GA to K-Means process on datasets with selected features. However, implementing the feature selection model used in this study increases the SSD

and DBI values in the clustering results in the dataset with the selected features. That means that datasets with selected features produce a poorer quality of clustering results. So that the implementation of feature selection in this study does not improve the quality of clustering results using K-Means.

For future work, other feature selection models can be implemented to find a more appropriate model for further research. The computation time accelerates the computation time and improves the quality of the clustering results.

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