


## LEMBAR PENGESAHAN

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UNIVERSITY OF LAMPUNG



# PROCEEDINGS ICCTEIE 2021

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## Foreword from Rector of University of Lampung

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Assalamu'alaikum warrahmatullahi wabarakatuh

All praise be to Allah SWT who has given us all salvation and blessing in Life. The Lord who created this word.

I'll never forget to sholawat and salam to our beloved Prophet Muhammad SAW who really loved by ALLAH SWT and saved the human life from destruction in the safety, that's the right path of ALLAH SWT.

I would like to say welcome to the First International Conference on Converging Technology in Electrical and Information Engineering (1st ICCTEIE 2021) with the theme: "Converging Technology for a Sustainable Society".

The University of Lampung is very committed to advancing research and international collaboration as an effort to advance world civilization. ICCTEIE is an international conference co-sponsored by The IEEE Indonesian Section and organized by the Department of Electrical Engineering and Informatics – University of Lampung. The conference is held on October 27-28, 2021, in Bandar Lampung, Indonesia, on a virtual meeting base. This event provides a good platform for researchers, scientists, and the entire engineering community to meet virtually and exchange their ideas on electrical engineering, control engineering, electronics, telecommunications, computer science and engineering, cyber-physical system, informatics, sustainable energy and environment-related fields and their applications.

I do expect this conference will give imperative contributions to the development on the aspects of researches, academics, and industries nationally and globally. I hope that all participants have fruitful and technical discussions and please enjoy the meeting.

See you on next 2<sup>nd</sup> ICCTEIE 2023.

Thank you for your excellent attention.

**Prof. Karomani – Rector of University of Lampung**



## Welcome message from General Chair of 1<sup>st</sup> ICCTEIE 2021

---

*Assalamu'alaikum Warrahmatullahi Wabarakatuh*

Peace be upon you and God's mercy and blessings

On behalf of the committee, I am very pleased to welcome you to the 1st ICCTEIE 2021, The International Conference on Converging Technology in Electrical and Information Engineering, 2021.

We are very grateful for all the support from the Rector of the University of Lampung, all vice-rectors, director of the research institute and dean of faculty of engineering. I would also like to extend my sincere gratitude to IEEE Indonesia Section, Advisory Committee, Technical Program Committee, Steering Committee, and Organizing Committee for their support and efforts so that this event can be successfully conducted.

I welcome all the eminent speakers and guests from all over the countries from different walks of life you had come here virtually to share the knowledge and experience among the scientific community.

The conference will highlight recent and significant advances, the state-of-the-art, current status and future challenges on all aspects related to the research and development in the field of Electrical and Information Engineering including:

- Communication, Networking & Broadcasting,
- Components, Circuits, Devices & Systems,
- Computing & Processing (Hardware/Software),
- Engineered Materials, Dielectrics & Plasmas,
- Power, Energy, & Industry Applications,
- Robotics & Control Systems,
- Signal Processing & Analysis,
- Information Technology,
- Internet of Things, and
- Artificial Intelligence

The call for the paper was issued on the 25th of May, 2021 and closed on the 15th of October 2021. There are 46 submissions papers during that time. 31 papers are presented today. After this conference, the reviewing process will continue to ensure each article is ready for submission in the IEEXplore or otherwise it will be excluded.

As The University of Lampung is progressively expanding its research network and contributions to the world of science and technology, it is expected that the conference will significantly provide means to both UNILA's researchers and other researchers to engage in a fruitful discussion during and after the conference.

The 1st ICCTEIE is starting this year as the 1st year and it is projected to continue every 2 years. Hopefully, the Covid-19 pandemic soon subsides so the next conferences would be able



to commence in the real meeting. This year our theme is Converging Technology for a Sustainable Society, and we are very happy the experts from the field of electrical and information as well as computer technology are with us today. We cordially welcome our keynote speakers:

1. Dr Laksana Tri Handoko, M.Sc., as the Head of National Research and Innovation Agency Republic of Indonesia,
2. Ir. Bob Saril, M.Eng.Sc., Director of Commerce and Consumer Management Indonesian National Grid Company,
3. Prof. Yasunori Mitani, The President of Kyushu Institute of Technology, Japan,
4. Prof. Prashant Pillai, University of Wolverhampton, England,
5. Prof. Jing-Ming Guo, National Taiwan University of Science and Technology, Taiwan, and
6. Dr Daniel Eghbal, Manager Future Network Strategy at Energy Queensland Australia and Australia Council Chair Institute of Electrical and Electronics Engineers (IEEE)

Also, let me inform you that all of our local committees are now registered as IEEE members as well as 15 of our electrical and informatics students are now also registered. Next month we plan to launch the IEEE Student Branch of Lampung, we hope through this endeavour will be able to broaden their horizons to the international society.

Before coming to a close with these remarks, I would also like to remind you and especially our moderators to strictly stick to our schedule and not to let any session overrun. I sincerely hope you will enjoy today of discussion, debate and networking.

I am sure you will have fruitful and rewarding exchanges on this conference day. I wish you all the best and success.

Thank you.

**Dr. Khairudin – General Chair 1<sup>st</sup> ICCTEIE 2021**



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## Author Index

Abdullah Siregar, Zunaidy	36	Harahap, Charles	138
Adi, Panggih Nur	36	Hasim, Sitronella	73
Aji, Rizal	112	Hikmarika, Hera	54
Alam, Syaiful	123	Husin, Zaenal	54
Alfaresi, Bengawan	106	Indra, Made	25
Andrian, Rico	14	Khairudin, Khairudin	1
Annisa, Resty	14	Kitagawa, Akio	36
Arifin, Zainal	97	Komarudin, Muhamad	102
Ashar, Muhammad	19		78
Bagaskara, Albi	118	Kurniawan, Ridwan	1
Balqis, Ginza	87	Mardiana, Mardiana	14
Dani Prasetyo Adi, Puput	36		68
Despa, Dikpride	42	Martinus, Martinus	14
Djausal, Anisa	14	Muda, Mona Arif	25
Dwijayanti, Suci	54	Muhammad, Meizano	14
Falaq, Handika	10		68
Ferbangkara, Sony	14	Mukti, Fransiska	36
Fitriawan, Helmy	128	Muladi, Muladi	19
	73	Mulyani, Yessi	14
Gusmedi, Herri	132		68
	82	Nama, Gigih	25
Haberler, Markus	142		14
Hakim, Lukmanul	1		42
Hamdani, Fadil	123		31
	73	Naoya, Kasai	25



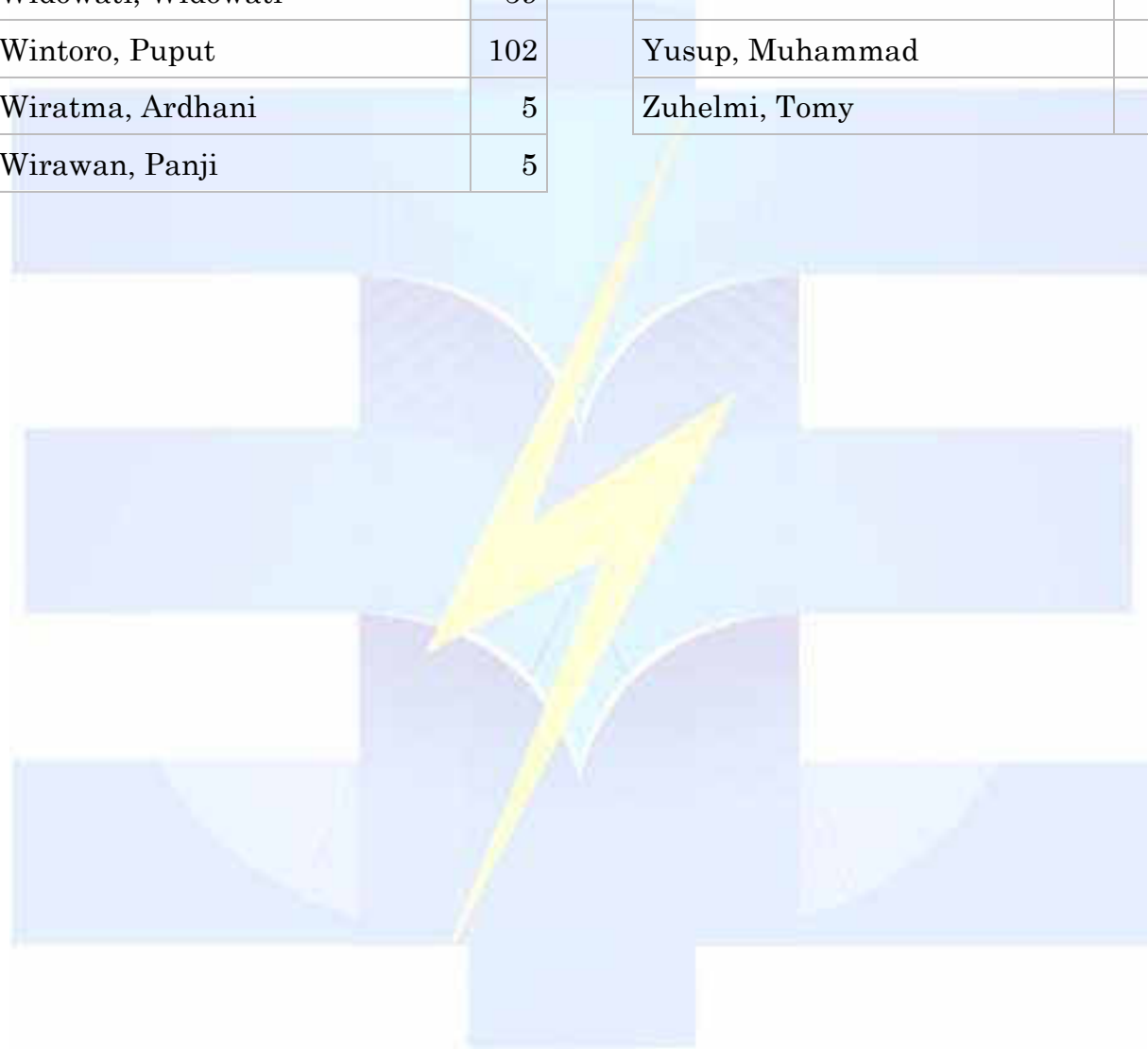
Nasution, Fandy Hakim	1
Nawawi, Zainuddin	106
Permata, Diah	10
	138
Prabantoro, Rifqi	112
Prasetiyo, Sandy	42
Prasetyo, Heri	118
Pratama, Bagus	48
Pratama, Mahendra	78
Purwasih, Nining	25
	138
	10
	31
Purwiyanti, Sri	63
	132
	82
	128
Roza, Dona	138
Rozie, Ade	82
S, Ghuffrony	14
Sabella, Soraida	123
Sailer, Norbert	142
Salamah, Umi	118
Samosir, Ahmad Saudi	132
	82
Septama, Hery Dian	78
	102

	14
Septiana, Trisya	42
Setyawan, Arinto	128
Siegl, Inge	142
Sihombing, Volvo	36
Sinaga, Herman	138
	10
Sintyaningrum, Desti	19
Sitepu, Rehmadata	87
Sitorus, Henry B. H.	138
Steffan, Christoph	142
Sudjarwanto, Noer	31
Sulistiono, Wahyu	102
	14
Sulistiyanti, Sri	128
	63
Suprpto, Bhakti	54
	106
Supriyanto, Eko	97
Susanto, Misfa	132
	123
	82
	73
Sutrisno, Sutrisno	59
Swastika, Windra	87
Tjahjana, Heru	59
Toni, Toni	36



Triyono, Nugroho Adi	97
Walter-Tscharf, Viktor	91
Widiawati, Vina	31
Widodo, Romy Budhi	87
Widowati, Widowati	59
Wintoro, Puput	102
Wiratma, Ardhani	5
Wirawan, Panji	5

Yanris, Gomal Juni	36
Yudamson, Afri	78
Yuliani, Oni	48
Yulianti, Titin	102
	78
Yusup, Muhammad	54
Zuhelmi, Tomy	78



# Table of Contents

<b>The Application of Complex Morlet Wavelet for Estimating Damping Ratio and Detecting Inter-Area Oscillation Mode of a Real Power System</b>	<b>1</b>
Khairudin Khairudin (Lampung University, Indonesia), Lukmanul Hakim (Universitas Lampung, Indonesia), Ridwan Kurniawan (Sumatera Institute of Technology, Indonesia), Fandy Hakim Nasution (PT. PLN (Persero), Indonesia)	
<b>Remote Usability Testing of Tour Guide Application</b>	<b>5</b>
Ardhani Putra Wiratma (Diponegoro University, Indonesia), Panji Wirawan (Diponegoro University, Indonesia)	
<b>Water Treatment Using Plasma Generated by High Voltage Tesla Transformer to Eliminate Escherichia Coli Bacteria</b>	<b>10</b>
Herman H Sinaga (Universitas Lampung, Indonesia), Handika Falaq (Universitas Lampung, Indonesia), Diah Permata (Universitas Lampung, Indonesia), Nining Purwasih (Universitas Lampung, Indonesia)	
<b>Virtual Reality as Learning Media for Lampung Historical Heritage</b>	<b>14</b>
Wahyu Sulistiono (University of Lampung, Indonesia), Sony Ferbangkara (University of Lampung, Indonesia), Meizano Ardhi Muhammad (University of Lampung, Indonesia), Rico Andrian (University of Lampung, Indonesia), Martinus Martinus (University of Lampung, Indonesia), Gigih Forda Nama (University of Lampung, Indonesia), Ghuffrony S (University of Lampung, Indonesia), Resty Annisa (University of Lampung, Indonesia), Yessi Mulyani (University of Lampung, Indonesia), Anisa Djausal (University of Lampung, Indonesia), Mardiana Mardiana (University of Lampung, Indonesia), Hery Dian Septama (University of Lampung, Indonesia)	
<b>The Encryption of Electronic Professional Certificate by Using Digital Signature and QR Code</b>	<b>19</b>
Desti Eka Sintyaningrum (State University of Malang, Indonesia), Muladi Muladi (State University of Malang & Universitas Negeri Malang, Indonesia), Muhammad Ashar (Universitas Negeri Malang, Indonesia)	
<b>Design and Implementation of Real-Time Reading System of Atmospheric Corrosion Sensor on Metal Material Using Internet of Things (IoT) Technology</b>	<b>25</b>
Gigih Forda Nama (University of Lampung, Indonesia), Nining Purwasih (Universitas Lampung, Indonesia), Made Indra (Universitas Lampung, Indonesia), Mona Arif Muda (University of Lampung, Indonesia), Kasai Naoya (Yokohama National University, Japan)	
<b>Developing a Prototype of Solar Tracking for Solar Cell Energy Optimization with Internet of Things (IoT) Technology</b>	<b>31</b>
Noer Sudjarwanto (Universitas Lampung, Indonesia), Vina Widiawati (Universitas Lampung, Indonesia), Nining Purwasih (Universitas Lampung, Indonesia), Gigih Forda Nama (University of Lampung, Indonesia)	
<b>ZigBee and LoRa performances on RF Propagation on the Snow Hills area</b>	<b>36</b>
Puput Dani Prasetyo Adi (University Of Merdeka Malang Jalan Terusan Raya Dieng 62-64 Malang, Indonesia), Akio Kitagawa (Kanazawa University, Japan), Volvo Sihombing (Universitas Labuhanbatu, Indonesia), Fransiska Sisilia Mukti (Institut Teknologi dan Bisnis Asia Malang, Indonesia), Zunaidy Abdullah Siregar (University	



of Labuhan Batu, Indonesia), Toni Toni (University of Labuhan Batu, Indonesia), Panggih Nur Adi (University of Labuhan Batu, Indonesia), Gomal Juni Yanris (University of Labuhan Batu, Indonesia)	
<b>Design and Implementation of Smart Energy Management System Integrated with Internet of Things (IoT) Technology in Engineering Faculty Unila</b>	<b>42</b>
Dikpride Despa (University of Lampung, Indonesia), Sandy Prasetyo (Universitas Lampung, Indonesia), Trisya Septiana (Informatics Engineering, Faculty of Engineering, Universitas Lampung, Indonesia), Gigih Forda Nama (University of Lampung, Indonesia)	
<b>Monitoring and Controlling Air Conditioner (AC) Using Improvised CNN and Internet of Things</b>	<b>48</b>
Bagus Pratama (Institut Teknologi Nasional Yogyakarta, Indonesia), Oni Yuliani (Institut Teknologi Nasional Yogyakarta, Indonesia)	
<b>Gyroscope Control System in Wave Power Plant Using PID Controller</b>	<b>54</b>
Muhammad Yusup (Sriwijaya University, Indonesia), Suci Dwijayanti (Sriwijaya University, Indonesia), Hera Hikmarika (Universitas Sriwijaya, Indonesia), Zaenal Husin (University of Sriwijaya, Indonesia), Bhakti Yudho Suprpto (University of Sriwijaya, Indonesia)	
<b>Robust Model Predictive Control Implementation to the Decision-Making Process in Inventory System with Uncertain Demands</b>	<b>59</b>
Widowati Widowati (Diponegoro University, Indonesia), Sutrisno Sutrisno (Universitas Diponegoro, Indonesia), Heru Tjahjana (Diponegoro University, Indonesia)	
<b>Temperature Measurement Using An Automatic Thermogun</b>	<b>63</b>
Sri Ratna Sulistiyanti (University of Lampung, Indonesia), Sri Purwiyanti (University of Lampung, Indonesia)	
<b>Library Attendance System using YOLOv5 Faces Recognition</b>	<b>68</b>
Mardiana Mardiana (University of Lampung, Indonesia), Meizano Ardhi Muhammad (University of Lampung, Indonesia), Yessi Mulyani (University of Lampung, Indonesia)	
<b>Interference Management with Relay-Based Clustering Method on Ultra Dense Networks of Femto-Macrocellular Network</b>	<b>73</b>
Sitronella Hasim (University of Lampung, Indonesia), Misfa Susanto (University of Lampung, Indonesia), Helmy Fitriawan (Lampung University, Indonesia), Fadil Hamdani (University of Lampung, Indonesia)	
<b>Air Quality Monitoring Device for Smart Health Solution during Covid-19 Pandemic</b>	<b>78</b>
Muhamad Komarudin (University of Lampung, Indonesia), Hery Dian Septama (University of Lampung, Indonesia), Titin Yulianti (University of Lampung, Indonesia), Afri Yudamson (University of Lampung, Indonesia), Mahendra Pratama (Universitas Lampung, Indonesia), Tomy Pratama Zuhelmi (Universitas Lampung, Indonesia)	
<b>Development of an IoT based monitoring system for Solar PV Power Plant Application</b>	<b>82</b>



Ahmad Saudi Samosir (Lampung University, Indonesia), Misfa Susanto (University of Lampung, Indonesia), Ade Rozie (University of Lampung, Indonesia), Sri Purwiyanti (University of Lampung, Indonesia), Herri Gusmedi (Universitas Lampung, Indonesia)	87
<b>The Effect of Regularization on Deep Learning Methods For Detection of Malaria Infection</b>	
Windra Swastika (Universitas Ma Chung, Indonesia), Romy Budhi Widodo (Universitas Ma Chung, Indonesia), Ginza Balqis (Universitas Ma Chung, Indonesia), Rehmadanta Sitepu (Universitas Ma Chung, Indonesia)	
<b>Practical Approach to Monitor Runtime Engine Statistics for Apache Spark and Docker Swarm using Graphite, Grafana, and CollectD</b>	91
Viktor Walter-Tscharf (University of Trento, Foundation Bruno Kessner, European Institute of Innovation & Technology & Exprivia, Italy)	
<b>Technology Selection of Solar PV for Household and Small Industries in Indonesia</b>	97
Zainal Arifin (Institut Teknologi PLN, PLN Indonesia, Indonesia), Nugroho Adi Triyono (PT PLN (Persero), Indonesia), Eko Supriyanto (UTM, Malaysia)	
<b>Combination of Best First and F-Score Image Feature Selection Methods for Beef Freshness Classification</b>	102
Hery Dian Septama (University of Lampung, Indonesia), Titin Yulianti (University of Lampung, Indonesia), Wahyu Sulistiono (University of Lampung, Indonesia), Muhamad Komarudin (University of Lampung, Indonesia), Puput Wintoro (University of Lampung, Indonesia)	
<b>Prediction of Path Loss Propagation in Case of Light Rail Transit (LRT) using Machine Learning Approaches</b>	106
Bengawan Alfaresi (Universitas Sriwijaya & Universitas Muhammadiyah Palembang, Indonesia), Zainuddin Nawawi (Universitas Sriwijaya, Indonesia), Bhakti Yudho Suprpto (University of Sriwijaya, Indonesia)	
<b>Cloud Computing Implementation to Support a Disaster Recovery Plan: A Case Study of Institut Agama Islam Negeri Manado</b>	112
Rifqi Prabantoro (University of Indonesia, Indonesia), Rizal Aji (University of Indonesia, Indonesia)	
<b>Quality Enhancement of Color-Embedded-Grayscale Image Using Convolutional Neural Network</b>	118
Heri Prasetyo (Universitas Sebelas Maret, Indonesia), Albi Revlin Bagaskara (Universitas Sebelas Maret, Indonesia), Umi Salamah (Sebelas Maret University, Indonesia)	
<b>Dynamic Radio Resource Allocation Based on Location for Mobile Femtocell in Cellular Network</b>	123
Misfa Susanto (University of Lampung, Indonesia), Soraida Sabella (University of Lampung, Indonesia), Syaiful Alam (University of Lampung, Indonesia), Fadil Hamdani (University of Lampung, Indonesia)	
<b>Measurement Instrument of Blood Glucose and Oxygen Saturation Non-Invasive by Using Oximeter Sensor</b>	128
Sri Purwiyanti (University of Lampung, Indonesia), Arinto Setyawan (University of Lampung, Indonesia), Helmy Fitriawan (Lampung University, Indonesia), Sri Ratna Sulistiyanti (University of Lampung, Indonesia)	





**Design of DC to DC Converter for Solar Photovoltaic Power Plant Applications** 132

Ahmad Saudi Samosir (Lampung University, Indonesia), Misfa Susanto (University of Lampung, Indonesia), Sri Purwiyanti (University of Lampung, Indonesia), Herri Gusmedi (Universitas Lampung, Indonesia)

**Analysis of Chemical-Physical Properties and Breakdown Voltage of Rubber Seed Oil** 138

Herman H Sinaga (Universitas Lampung, Indonesia), Dona Roza (Universitas Lampung, Indonesia), Henry B. H. Sitorus (Ecole Centrale de Lyon, University of Lyon, France), Charles R. Harahap (Universitas Lampung, Indonesia), Diah Permata (Universitas Lampung, Indonesia), Nining Purwasih (Universitas Lampung, Indonesia)

**A Floating Differential DAC Expands the Output Voltage Range for Electrochemical Measurements** 142

Norbert Sailer (Infineon Technologies Austria AG & Graz University of Technology, Austria), Inge Siegl (Graz University of Technology & Infineon Technologies Austria AG, Austria), Markus Haberler (Infineon Technologies Austria AG, Austria), Christoph Steffan (Infineon Technologies Austria AG, Austria)



# Library Attendance System using YOLOv5 Faces Recognition

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**Abstract**—Recognizing a large number of faces at the same time is an algorithmic and computational challenge. The integration of a facial recognition system with an existing automation system in a library is also a big challenge because of the many sub-systems that operate in it. The aim is to develop a prototype of a library attendance system to assist library management related to facial recognition of users who visit the library. This study uses image processing focuses on object detection using the YOLOv5 algorithm. The library attendance system integrates 3 sub-systems: API service, face recognition using YOLOv5, and visitor identification system. The results obtained are that the library attendance system can function properly, can read the API service, and display information on the results of face detection therefore the system can be used by the existing library automation system.

**Keywords**—library attendance system, face recognition, image processing, machine learning, YOLOv5, visitor identification system

## I. INTRODUCTION

Various kinds of research in the field of image processing, especially those related to face detection and face recognition, have been carried out. This research can be applied to help overcome problems that exist in libraries. Most of the librarian's works in libraries has been assisted by library automation systems [1]. However, visual tasks, such as recognizing the presence of users, still have problems. The presence of visitors is known from the use of RFID and barcode cards at the library entrance. The use of the card poses security problems in the form of card misuse by others. Computational technology and algorithms which able to recognize many objects need to be used to answer these problems. The existing library automation system needs to be integrated with other systems that function for facial recognition.

Several studies have been conducted to detect objects using YOLO. YOLO is one of the Convolutional Neural Network (CNN) algorithms [2] which was developed into several other algorithms, including R-CNN, Fast R-CNN, Faster R-CNN, and YOLO. Based on this research, YOLO has advantages that can be used to detect objects. As in studies that aim to detect objects in the form of road signs, the results show the YOLO algorithm can detect with an accuracy of 74% [3]. In addition, research that aims to detect spherical objects on humanoid robot soccer can detect with an accuracy of 60% [4].

The YOLO (You Only Look Once) algorithm is an algorithm developed to detect an object in real-time [5]. The detection system uses a repurpose classifier or localizer to detect. YOLO already has many versions, starting with the YOLO version, YOLOv2, YOLOv3 until the latest one is YOLOv5. However, the application of the YOLOv5

algorithm for the library attendance system has not been done much. So, it's an important thing to do.

The prototype library attendance system developed in this study will use the YOLOv5 algorithm because it is considered better than the previous version. With the technology, the system not only recognizes the user's face but can also store the recognized user data in a database. This will make it easier for librarians to process attendance data for recognized or unrecognized visitors.

## II. METHOD

There are three-part of development based on three sub-systems in the library attendance system: API Service, Face recognition using YOLOv5, visitor identification system. System model illustrated in Fig. 1. The stages of development are as follow:

1. Development of API Service for Library Attendance System
2. Building face recognition using YOLOv5
3. Development of Visitor Identification System
4. Comprehensive System Testing

Development of API Service and Visitor Identification System in stages 1 and 3 is carried out using general software development lifecycle. Building face recognition using YOLOv5 in stage 2 requires more careful consideration. YOLO (You Only Look Once) is a real-time object detection algorithm with a high level of accuracy. The YOLO algorithm uses a convolution neural network for object detection. YOLO uses an artificial neural network (ANN) approach to detect objects in an image. This network divides the image into several regions and predicts each boundary city.

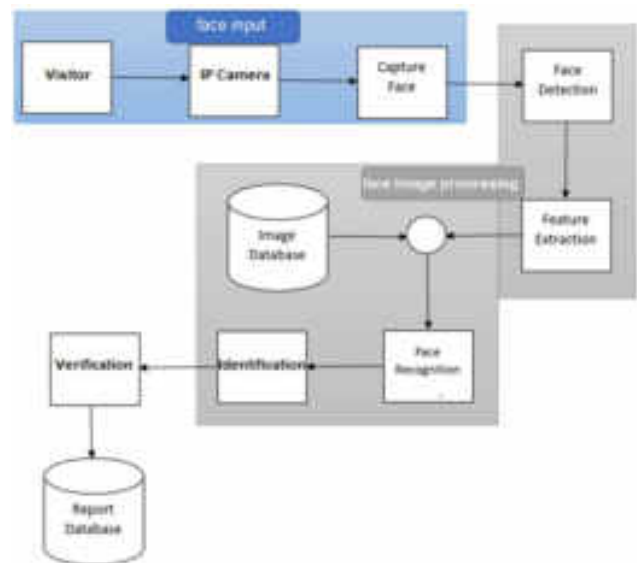


Fig. 1. Concept Model Library attendance system

YOLO is very good at predicting images and classifying images. YOLO can also detect multiple images at once[6]. YOLO v5 has 4 models for training data: YOLO v5-s, YOLO v5-m, YOLO v5-l, and YOLO v5-x [7]. The four models have differences in network architecture or the number of layers and the number of parameters. The YOLO v5 architecture has 3 parts: the Backbone Model, the Neck Model, and the Head Model.

1) Backbone Model

The backbone model is used to extract important features from a given input image. YOLO v5 uses the CSP (Cross Stage Partial) Network as the backbone to extract informative features from the input image.

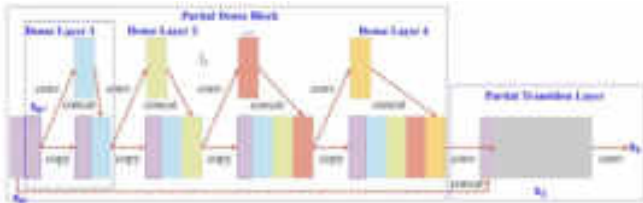


Fig. 2. CSPDenseNet [8]

Fig. 2. is a feature extraction process using DenseNet CSP. CSP (Cross Stage Partial) is based on the same principle from DenseNet except that the CSP input is separated into 2 portions, with some of it being forwarded through dense blocks which will perform convolution and part of it being sent directly to the next stage without being processed. Then the part of the block that performs the convolution will be combined (concat). Before entering the neck using FPN, additional blocks are added, namely the SPP (Spatial Pyramid Pooling) layer

2) Neck Model

Neck style on YOLOv5 using PANet which adopts the Feature Pyramids Network (FPN) structure. The PANet model is used to help the model generalize well for scaling objects. This is very helpful in identifying the same object with different sizes and scales. Fig. 3 is a PANet image for the neck, this PANet is used for feature classification.

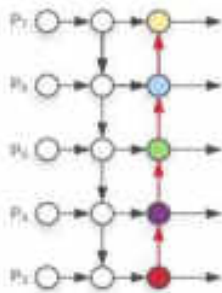


Fig. 3. PANET [9]

3) Head Model

Head model used to perform the final detection, this model applies anchor boxes to the features and produces a final output vector with class probabilities, objectivity scores, and bounding boxes. YOLOv5 uses leaky ReLU and Sigmoid as activation functions. The Leaky ReLU activation function is used in the middle layer or hidden layers while Sigmoid is used in the final detection layer. The activation function is a function to calculate the number of input weights and biases

in the artificial neural network so that it can activate and deactivate neurons.

The loss value in YOLOV5 is calculated based on objectivity scores, class probability scores, and bounding box regression scores. The stages for building face recognition using YOLOv5 can be explained as follows:

1) Building a Dataset

The first process is the process of building a dataset before training, with the steps in Fig. 4.



Fig. 4. Flowchart of Building a Dataset

To build the dataset, an Image collection is needed in the form of photos in JPG/Img format, then the photos are annotated or labeled with each photo using LabelImg. The result of the annotation is in the form of a file in XML format. Then the datasets with XML files are combined for image pre-processing.

2) Training Dataset

The second process is a training process using a custom YOLO v5-s model and the results of the training or YOLOv5 weight model are used for the detection process, as shown in Fig. 5.



Fig. 5. Training Dataset Flowchart

The dataset is read and a class is formed which will be used to create a YOLOv5-s custom detection model. Next, this file is used for training the dataset. After completing the training, the data from the training can be tested using photos and videos.

3) Object Detection Model Testing

The third process is the object detection process using a trained model.

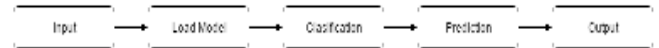


Fig. 6. Test Flowchart

Fig. 6 is the testing phase using photos and videos. Input can be photos or videos for testing. The detection process is carried out by loading the model that has been built, then classification and prediction are carried out using bounding boxes and confidence scores. The results displayed are in the form of prediction boxes, confidence values, and object classes. Stage 4 is Comprehensive System Testing. To evaluate the integrated sub-system, comprehensive system testing is conducted by incorporating the three-part sub-system. Fig. 7. represents the comprehensive system testing phase.

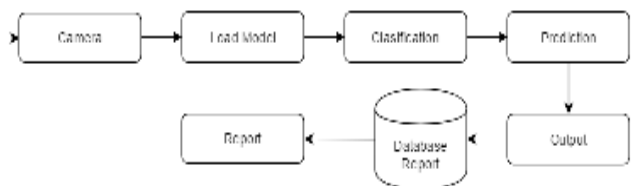


Fig. 7. Comprehensive System Testing Flowchart

First, the input is from a face captured by the camera. Then the detection process will load the model that has been built, then perform classification and prediction using bounding box and confidence score. The results displayed are in the form of prediction boxes, confidence values, and object classes.

The detection results in the form of an object class (cls) will be stored in the report database and then the data in the report database will appear on the report page. The report page is built to display data in the form of a number, user name, NPM, date of attendance, and time of attendance.

### III. RESULTS AND DISCUSSION

#### A. API Service for Library Attendance System

To send the results of the facial recognition sub-system, a request to the web service is submitted via the HTTP protocol. Response provided by the web service contains information about the time, the number of visitors (humans), and recognized users.

The nature of the web service API provided is agnostic so that it does not require the use of a particular programming language to access it. The Reader Attendance API service is accessed via JavaScript. The time required for each request in the 100x test is 500 milliseconds (ms).

#### B. Face Recognition using YOLOv5

The data used for the facial recognition sub-system is 1528 data consisting of 1420 training data, 69 validation data, and 39 test data. The percentage distribution is 92.9% training data, 4.5% valid data, and 2.6% test data.

##### 1) Building a Dataset

Data labeling is done manually using labellmg software which marks objects with rectangles as shown in Fig. 8. The object class used in this research is a total of 37 objects. Objects include general visitors (humans), and identified users.

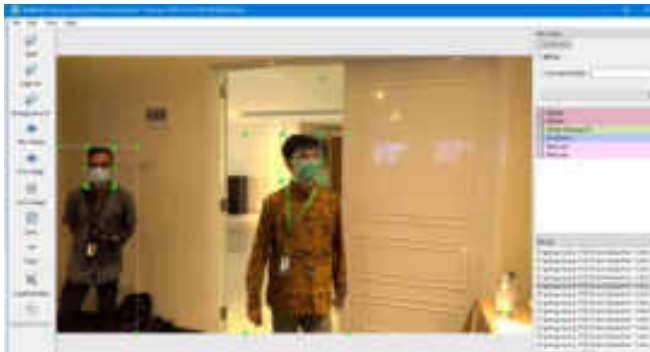


Fig. 8. Labeling using labellmg

##### 2) Training Dataset

YOLOv5 repository is used as the basic framework. all repositories and dependencies of YOLOv5 must be fulfilled. Dataset training for the face recognition sub-system was carried out on 1420 images that had been labeled. The object in the image is resized to 416x416. The training was carried out for 1000 epochs with a total of 16 batches. The basic model used is YOLOv5s.yaml. The computational specifications used for training are CUDA Nvidia Tesla T4 with 15079MB of memory. The training process was completed in 3.736 hours for 1420 images labeled with 1000 epochs. The resulting weight model is 14.9MB.

##### 3) Object Detection Model Testing

Based on the results of the training, it can be seen that the level of minimized return is achieved when the graph starts to form an elbow (elbow method) in 700 epochs at mAP@0.5, mAP@0.5:0.95, Precision, and Recall. The results can be seen in Fig. 9. Based on the results of the training as can be seen in Fig. 10, the highest value for precision is 0.5507 at 650 epochs. Thus, training for more than 650 epochs has experienced diminishing returns. Based on the results of the training as can be seen in Fig. 11, the highest score for Recall is 0.9546 at 607 epochs. Thus, training for more than 607 epochs has experienced diminishing returns.

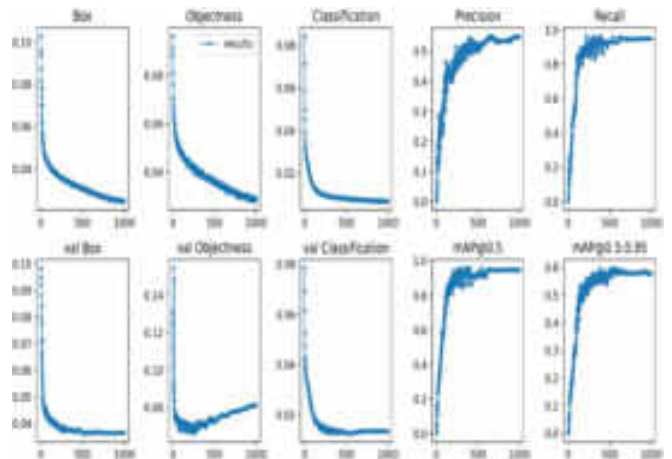


Fig. 9. The results of the Face recognition sub-system dataset training

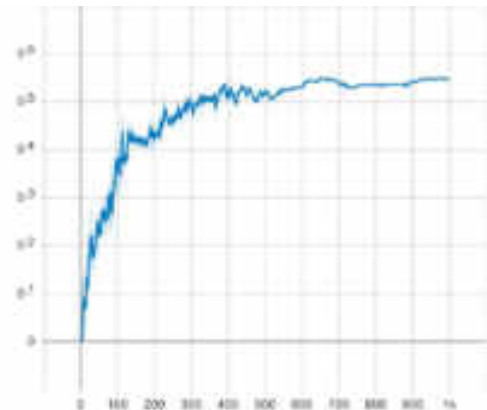


Fig. 10. Precision Face recognition sub-system

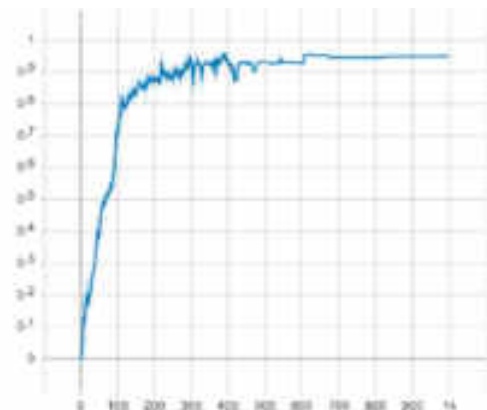


Fig. 11. Recall Face recognition sub-system

The method used to measure the Mean Average Precision (mAP) on multiple object detection for the face recognition sub-system is  $mAP@0.5$  and  $mAP@0.5:0.95$ . The face recognition sub-system on  $mAP@0.5$  has a high level of precision. The highest value as can be seen in Fig. 12, reached was 0.9884 in the 631st epoch and after that, the change was very small in the range of 0.02.

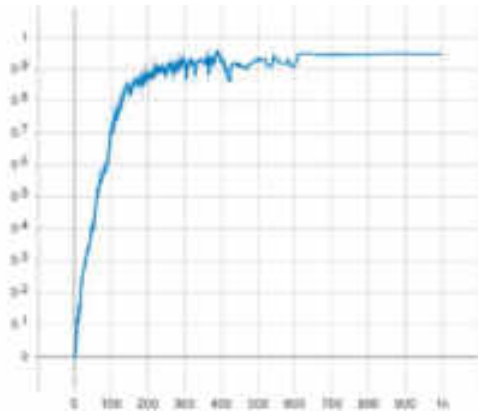


Fig. 12.  $mAP@0.5$  Face recognition sub-system

The face recognition sub-system at  $mAP@0.5:0.95$  has a lower precision level than  $mAP@0.5$  because the prediction threshold is increased by 0.05 from 0.5 to 0.95. The highest value as can be seen in Fig. 13, reached was 0.5986 at the 546th epoch which then tended to decline and stabilize at the range of 0.5800. The mAP value indicates the average precision value is far above the threshold of 0.4 so that the resulting model is feasible to use. Some of the Ground Truth of the Face recognition sub-system can be seen in Fig. 14. Some of the Ground Truth Augmented Training Data obtained from Machine Learning can be seen in Fig.15.

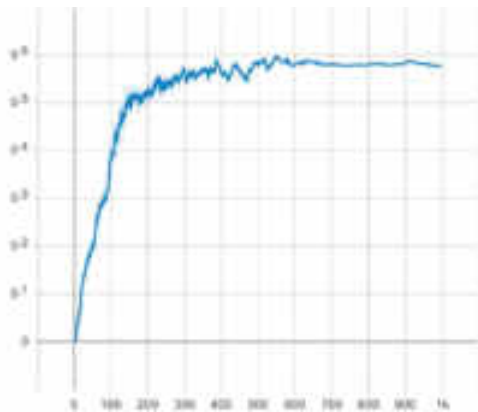


Fig. 13.  $mAP@0.5 :0.95$  Face recognition sub-system

Ground Truth compared to the results of object detection and found that the accuracy is quite good for large objects but on small objects, there is a tendency for the wrong detection or not to be recognized at all. The confidence threshold for the test is 0.4.

### C. Visitor Identification System

The Attendance System library pulls information from the Face recognition sub-system provided via a web service. The information available through the API is retrieved using JavaScript which is then displayed on the visitor identification sub-system. The information that has been processed and presented on the visitor identification sub-system can be seen in Fig. 16. Library Attendance System



Fig. 14. Ground Truth Face recognition sub-system



Fig. 15. Ground Truth Augmented Training Data Face recognition sub-system



Fig. 16. Visitor Identification System Output based on Web Service API

Library Attendance System testing is carried out on two media models, namely images and videos. Tests were carried out using a CUDA NVIDIA Tesla P100-PCIe-16GB with 16280MB of memory. The model used is the training model on the face recognition sub-system.

### 1) Image Object Detection

There are 39 images tested with more than one object in each image. Object detection on 39 images was carried out for 5.564 seconds, including the preparation process. The average object detection per image is 0.015 seconds. Some of the object detection results can be seen in Fig. 17. Video Object Detection



Fig. 17. Object Detection Results in Images

The video used for testing had a running time of 15 minutes 45 seconds. Detection of objects on 15 minutes 45 seconds of video with 23.623 image frames were carried out for 878.967 seconds, including the preparation process. The average object detection per image is 0.013 seconds. The number of frames per second (frames per second) is 76.92 fps which is faster than the standard 60 fps for video. Some of the object detection results can be seen in Fig. 18.

### 2) Library Attendance System Validation

Library Attendance System will validate the attendance for a confidence score of 0.9, the detection results will appear on the report page. The report page will display the data once even though the object is detected many times in one day. This is because the coding to save the database has been given a parameter not to save more than 1 cls at a time. The example of the report page can be seen in Fig.19.



Fig. 18. Object Detection Results on Video

## IV. CONCLUSION AND FUTURE WORKS

Library Attendance System is able to integrate three-part of sub-system which include a face recognition system based on YOLOv5. YOLOv5 face recognition subsystem which can detect multiple objects in images and videos has an excellent level of performance in terms of the average object detection time standard per image. A large number of face recognition systems with the YOLOv5 algorithm at the training stage took 3.736 hours for 1420 images with a total of 1000 epochs on a CUDA Nvidia Tesla T4 with 15079MB of memory. The mAP value indicates the average precision value is far above the threshold of 0.4 so that the resulting model is feasible to use. Detection of multiple objects with the YOLOv5 algorithm in the image has a good performance level, which is 0.14267 seconds. Detection of multiple objects with the YOLOv5 algorithm on video has a good level of performance, which is 76.92 fps. Further development for Library Attendance System, such as physical access control systems or security warning systems, all of which aim to assist library management, can be developed based on this study.

Fig. 19. Library Attendance System Report

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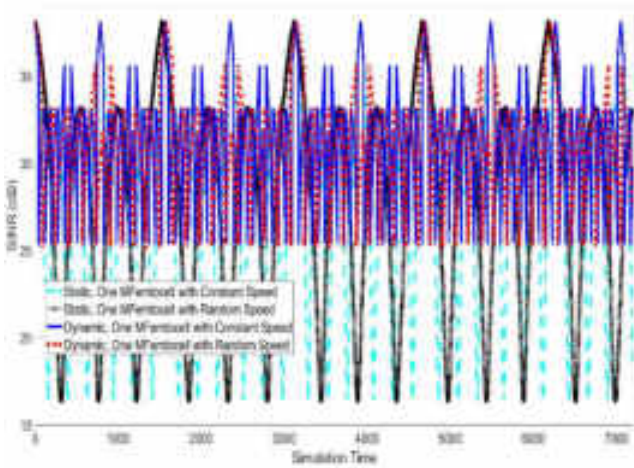


Fig. 4. The simulation results during the simulation time for Signal-to-Interference plus Noise Ratio (SINR) for both of static and dynamic resource allocations of one mobile femtocell with random and constant speeds.

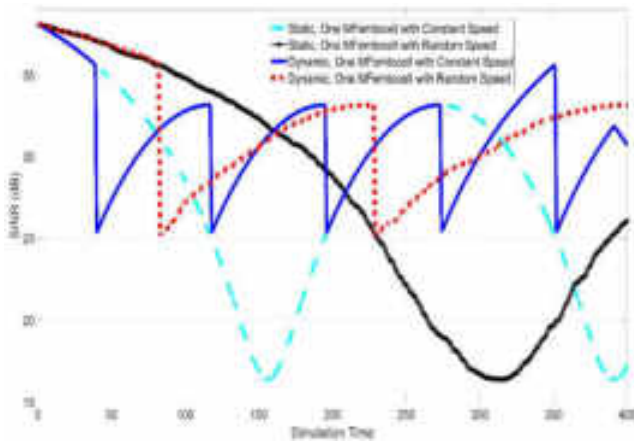


Fig. 5. The zoom in of the SINR values in Fig. 4 for the simulation times between 0 to 400 seconds.

We simulate two scenarios for the MFemtocell (bus) speed, i.e., the constant speed and the random speed. For the constant speed, the MFemtocell moves with the speed of 40 km/hour. For the random speed the MFemtocell moves with the variable speed with the values of speed varying between 0 and 40 km/hour which is randomly generated. Table 1 summarizes the values of parameter used in the simulation. In the simulation, the eNB of microcell 1 is set to the coordinate (0, 0). We use the hexagonal cell layout, by so the next microcell is positioned with no gap of cell coverage with the previous microcell. Therefore, the distance between two eNBs is  $500\sqrt{3}$  m. Two path ways of MFemtocell is set to be fixed in the area of 6 microcells. The starting point of MFemtocell, i.e., terminal A, is located on the x coordinate of 0 which means it is in the microcell 1's area. The MFemtocell will travel to terminal B which is located on the center of microcell 6 at 4330.127 m. The lane from Terminal A to Terminal B is straight line which is located at the y coordinate of 220. When the MFemtocell travels back from Terminal B to A will take the different lane which is located at the y coordinate of 200. Fig. 3 shows this scenario run from simulation program for this layout. The simulation program is run for 2 hour or 7200 seconds of simulation time. The SINR values during the simulation are collected.

TABLE I. SIMULATION PARAMETERS

No.	Parameter	Value
1.	Number of Macrocell (from reuse factor=4)	1
2.	Number of Microcells, Reuse Factor	6, 3
3.	Diameter of Microcell [ 10]	1 km
4.	Transmit Power of Microcell [12]	43 dBm
5.	Microcell Deployment Layout	Chain
6.	Number of Mobile Femtocell	1
7.	Diameter of Mobile Femtocell	20 m
8.	Transmit Power of Mobile Femtocell [12]	27 dBm
9.	Number of users in Mobile Femtocell [13]	8 (max)
10.	Vehicle Path Loss (VPL) [11]	25 (dB)
11.	The Speed of Bus (Mobile Femtocell) [10]	40 Km/hour (constant speed) and 0-40 Km/hour (random speed)
12.	System Bandwidth [12]	20 MHz
13.	Number of Resource Block [12]	100 RB
14.	Number of Sub-channel [12]	12
15.	Distance for one way trip of the Bus	4.33 km
16.	Bus dimension (L x W x H) [11]	12 x 2.5 x 2.5 m
17.	Simulation time	7200 seconds

### B. Simulation Results and Discussion

Fig. 4 depicts the simulation results for the SINR values during the simulation time for all static and dynamic resource allocations and with constant and random speeds. For the clarity, Fig. 4 is zoomed in for the simulation time between 0 and 400 seconds as shown in Fig. 5.

As we can see from Fig. 5, the range of SINR values for the same type of resource allocations varies on the same range of SINR values. It can be understood that the SINR value depends on the distance of HeNB and microcell's eNB, i.e., SINR value is sampled on the distance of observed FUE to the desired and interference signals. The different SINR values indicate that at a certain same simulation time the distance of MFemtocell to the microcell's eNB should not be the same. In order to analyze the distribution of SINR values for all simulated scenarios, the cumulative distribution function (CDF) of SINR is plot in Fig. 6.

As Fig. 6 shows, there is no different in the CDF of SINR for the constant and random speeds for both of static and dynamic resource allocation. These CDFs of SINR are consistent with the results in Figs. 4 and 5.

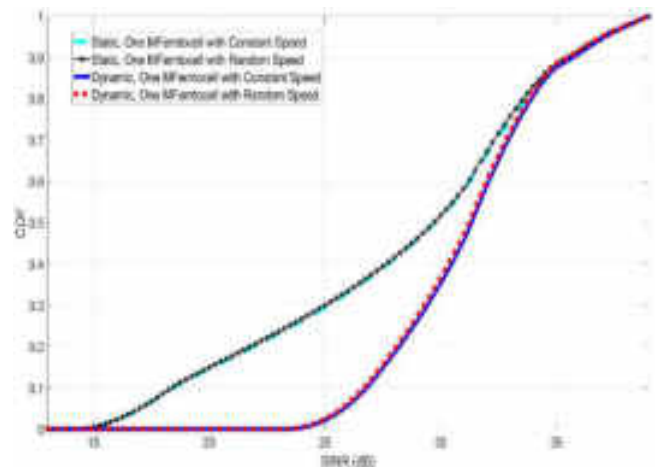


Fig. 6 The Cumulative Distribution Function (CDF) of SINR for the simulation scenario in Fig. 2 using the static and dynamic resource allocations, both with constant and random speeds of mobile femtocell.

Comparing the static and dynamic resource allocation schemes, the CDF of SINR results depict that there is significant gap for the performance improvement using the dynamic resource allocation (LDRRA algorithm) to the static resource allocation. Indicating the CDF for the SINR value of 30 dB in Fig. 6, the improvement achieved 15%. The static resource allocation indicates the upper bound of CDF of SINR, and the dynamic resource allocation with one MFemtocell implies the lower bound to enhance the number of MFemtocells deployed for the network scenario. It is subject to our further study.

#### IV. CONCLUSION AND FUTURE WORK

This paper proposes Location-Based Dynamic Radio Resource Allocation (LDRRA) algorithm for MFemtocell deployed in a chain of microcell network. Radio resource allocated dynamically to MFemtocell is according to the position of MFemtocell along its travel. Simulation experiment using MATLAB programming codes has been carried out for the proposed LDRRA with one MFemtocell deployed in six microcells contiguously positioned. The SINR parameter has been collected and its results compared to the static radio resource allocation (fixed during MFemtocell's operation). The simulation results show that there is a significant gap for the performance improvement. Considering at the value of SINR 30 dB, the improvement achieved 15%. The simulation results indicate the lower bound in deploying more MFemtocells. Increasing the number of MFemtocells and see how LDRR algorithm works are our ongoing study as well as finding another dynamic resource allocation algorithm.

#### ACKNOWLEDGMENT

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