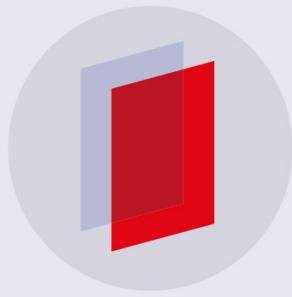


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## The 2nd International Joint Conference on Science and Technology (IJCST) 2017

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## Preface

**Ladies and Gentlemen,**

It is my great pleasure to welcome you all to The 2<sup>nd</sup> International Joint Conference on Science and technology –IJCST 20176 in Nusa Dua Bali-Indonesia 27-28 September 2017. This conference is multidisciplinary including engineering and social science and hope can dedicate a positive contribution to science and technology development. Hosted by Bali State Polytechnic (PNB) and other established university partner including UPNV Jatim, FMIPA-UNISA, FISH-UNESA, and UTM, this conference are attended by more than four hundreds participants who present their best research results.

Papers have been reviewed by peer reviewers and already presented orally in the conference and already selected to be published in **Journal of Physics: Conference Series** (<http://jpcs.iop.org>) These were then been reviewed again and final submission by IJCST 2017 Committee to the journal due date on 24 November 2017. With high confidence, depend on the paper topic and quality will can reach aim and topic of the conference “**As an international platform for scholars, researchers, practitioners, and government to discuss interdisciplinary research and practices that focuses in the theme of “Science, Technology, Innovation, and Culture for Sustainable Development: Challenge for Green Industry”**”.

We would like to extend our warm and sincere thanks to authors for great contribution in this conference. Hopefully all participants and authors can extend to build a networking each other in order to improve the research quality in future.

Sincerely yours,

IJCCST 2017 Committee



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## Remark from Conference Chair

The honourable Minister of Tourism Republic of Indonesia

Distinguish guest and participants of IJCST 2017

Welcome to Bali – a wonderful Indonesia



The past few years has witnessed the idea of “Green Economy” flowing out from its realm of environmental economics. It is now omnipresent in mainstream policy discourse, our popular culture, industries, and development of disruptive technologies. It has successfully won the headspace and commitments of the world leaders as reflected in the Paris Agreement, the United Nations Sustainable Development Goals, G20 communiques.

The time to debate about whether we should transition to a green economy has now ended. It has been agreed upon to be the only way forward. However; shifting from the traditional 20<sup>th</sup> century model to a new green society requires massive investment and transformative disruptions. Delivering this ambitious global project requires strong public-private-partnerships and cross-sector collaborations. The 2nd International Joint Conference on Science and Technology (IJCST) 2017 aims to advance both by providing a multi-stakeholder platform for concerted action, research, and sharing of best practices under the theme “Science, Technology, Innovation, and Culture for sustainable development: Challenge for Green Industry”

I would like to welcome all of you to the IJCST 2017 and express my gratitude for the expertise you bring to our gathering. You are truly our greatest asset today and I encourage you to stay engaged, keep us proactive, and help the world shape the future of green economy.

I wish you a great conference and wonderful time in Bali.

Sincerely yours,  
Conference chair  
Dr. Ir. Lilik Sudiajeng, M.Erg

### **Welcoming Addressed by Director of Bali State Polytechnic**

You're Excellency Minister of Tourism Republic of Indonesia  
Distinguish guest and participants of IJCST 2017

Good morning

It is my pleasure welcoming you in Bali-the wonderful Indonesia, to attend the International Joint Conference on Science and Technology (IJCST) 2017.



This is the 2nd IJCST, which is held by Bali State Polytechnic, in collaboration with University of Pembangunan Nasional Veteran-East Java; University of Trunojoyo Madura-East Java; State University of Surabaya-East Java; and National Cheng Kung University Taiwan.

The conference is to aim an international platform for scholars, researchers, practitioners, and government to discuss interdisciplinary research and practices under the theme of "Science, Technology, Innovation, and Culture for Sustainable Development: Challenge for Green Industry". This theme is raised as a manifestation of the academic community's sensitivity towards global environmental issues that are now shifting from the issue of global warming to green economics.

It is an honor for me to convey that over 350 participants attended this conference from 14 countries. I give highly appreciation for your attendance. Your presence at this conference is very important to help the world in formulating green industry that leads to green economy.

Finally, wishing you a great conference and enjoy Bali, the wonderful Indonesia.

Bali State Polytechnic  
Director,

Ir. Made Mudhina, MT.

## Speech by Minister of Tourism



### OPENING SPEECH

**MINISTER OF TOURISM, REPUBLIC OF INDONESIA**

*International Joint Conference on Science and Technology (IJCST),  
Nusa Dua Bali, 27 September, 2017*

First of all I would like to extend my appreciation and gratitude to the committee of International Joint Conference on Science and Technology (IJCST) for exposing the theme of the conference on Science, Technology, Innovation, and Culture for Sustainable Development: Challenge for Green Industry. The theme is strongly intersected with global tourism development, since tourism is an integrated economic development involving high technology, innovation, culture and natural sphere.

The theme has clearly revealed that sustainable tourism, as part of sustainable development, is a joint effort among stakeholders. Multi-disciplinary research has to be constantly and mutually done to create green tourism economy, where tourism can be a catalyst of natural and cultural preservation, at the same time improving people's quality of life. Tourism development requires advanced technology, in transportation, information, and communication sector to ease tourist movement in accessing main attractions. Culture and nature are the main attractions for tourism, the question is how are they utilised to generate foreign exchange earnings but at the same time managing its sustainability.

It is imperatively expected that this scientific gathering will bring about new ideas and solutions as well as mutual commitment among practitioners and academicians to make tourism more sustainable and responsible, as mandated by UNWTO. Sustainable development is dealing with present and future generations welfare. Sustainable tourism is actually defined by the resonance of its sustainable development, benefiting present and future tourists and communities and viable within indefinite time, maximizing its economic gains.

Indonesia's tourism is mainly based on culture and nature as its main portfolio products. Resources related with the portfolio products has to be carefully and responsibly managed to ensure its sustainability. Research in new technological inventions and innovations have to be continuously developed to promote better tourism for our present and future generations. We cannot avoid using technology especially for the connectivity and digital marketing of our tourism, but we have to manage it to maximize its economic, cultural and natural benefit. I do hope that this conference will provide a great opportunity for the participants to share and understand both local and global issues of tourism development.

Wishing you all a very fruitful and rewarding conference.

Greetings from Wonderful Indonesia

Jakarta 18 September, 2017

Dr. Ir. Arief Yahya, M. Sc.  
Minister of Tourism, Republic of Indonesia



## Speech by Rector of Trunojoyo University Madura

Guest of Honour, Dr. Ir. Arief Yahya, M.Sc.  
 Minister for Tourism, Republic of Indonesia.  
 Mayor of Denpasar City,  
 Ida Bagus Rai Dharmajaya Mantra, SE.,M.Si.  
 Distinguished speakers,  
 Researchers and Colleagues,  
*Assalamu'alaikum Warrohmatullahi Wabarakatuh.*



Praise goes to the most merciful God Allah SWT for the blessings of life and knowledge for us to gather on this meaningful occasion.

To start with we would like to warmly welcome the eminent speakers and delegates who have come from all over the world. We are indeed honoured to have you here with us, making this conference a truly international one.

Ladies and gentlemen,

The university of Trunojoyo Madura is located on Madura island as a part of East Java province area, and currently, it is on 16 years old. This university has committed to escalating its educational process and research activity. It is because those processes play a pivotal role to aim the vision of University of Trunojoyo Madura for a period 2014 – 2018. One of main strategies to achieve the University's vision is by implementing a cluster approach in order to increase the University of Trunojoyo Madura's competitive advantage. This approach is carried out by strengthening our research based on six potential sectors. These sectors are (1) salt and tobacco sectors, (2) food commodities sector (corn, cassava, cane, cattle, and sea commodities), (3) energy sector (oil and gas, renewable energy), (4) educational sector (formal and informal education), (5) social sector (worker and women studies), and (6) tourism and creative economic. All of these sectors are regarded to Madura resources.

Ladies and gentlemen

We do realise that the process of strengthening our research cannot be accomplished by ourself. It would be hard for the University of Trunojoyo Madura if only relaying it on our internal resources. A mutualism collaboration is needed, a collaboration which involves other external parties including universities, governments, businesses, and any other parties. Therefore, on this occasion, Faculty of Engineering, University of Trunojoyo Madura runs an International Conference for the second time called ICOSE (International Conference on Science and Engineering). The ICOSE is held in collaborating with several big universities namely Bali State Polytechnic, University of Pembangunan National Veteran of Surabaya, State University of Surabaya on one event named IJCST (International Joint Conference on Science and Technology) 2017. We hope that this conference will generate an advantageous knowledge sharing about previous research results and bright outlooks. Henceforward, University of Trunojoyo Madura wishes could achieve its vision with a better result.

In closing, we encourage delegates to participate actively in interesting discussions over the seminar periods. I wish everyone has a successful and fruitful conference.

Thank you very much

*Wassalamu'alaikum Warrahmatullohi Wabarakatuh*

## Speech by Rector of State University of Surabaya

It is with great pleasure that I extend my warmest welcome and best wished to all keynote speakers, presenters, and participants of the 2017 International Joint Conference on Science and Technology (IJCST), "Science, Technology, Innovation, and Culture for Sustainable Development: Challenge on Green Industry."



IJCST has worked with partners from higher education institutions and polytechnic from Indonesia and People's Republic of China, namely UPN Jawa Timur, Universitas Negeri Surabaya, Universitas Trunojoyo, Politeknik Negeri Bali, Politeknik Negeri Jember, and National Cheng Kung University. Each institution contributes largely to the success of the 2017 IJCST by gathering academics and professionals across the country and overseas with aims at sharing recent investigations of the theme and hoping they would fruitful to stakeholders in resolving challenges on green industry.

With regards to challenges that Indonesia and countries at the global level encounter particularly demographic plus in 2020 and a surge of primary needs including clean environment as well as increased international mobility of people from various cultures, the 2017 IJCST plays a crucial role in offering innovations and resolutions of those challenges. By so doing, proposals and recommendations withdrawn from the present conference will then serve as the basis for relevant stakeholders in policymaking.

I have always believed that IJCST has been an insightful platform for intellectuals and practitioners to continuously create breakthroughs in support of achieving sustainable development. My best wishes for a fruitful and productive conference.

With regards,

Prof. Dr. Warsono, M.S.  
Rektor

## Speech by Rector of University of Pembangunan Nasional Surabaya

Assalamualaikum Wr. Wb. , Good Morning

Honorable Guests:

Ministry of Tourism of Republic of Indonesia, "Ir. Arief Yahya, M.Sc"

Governor of Bali, "Made Mangku Pastika"

Directorate General of Research and Development, "Dr. Muhamad Dimyati, M.Sc."

Director of Bali State Polytechnic, "Ir. Made Mudhina, M.T."

Honorable Keynote Speakers :

Mayor of Denpasar City, "Ida Bagus Rai Dharmawijaya Mantra, SE, M.Si"

Head of Badung Regency, "Nyoman Giri Prasta, S.Sos"

Attache of Educational Affairs – Embassy of France in Indonesia, "Prof. Dr. Emilienne Baneth Nouailhetas"

Prof. Dr. Zakaria Hossain, Prof. Moonyong Lee, Prof. Jyh-Ming Ting, Dr. Yusri Yusof, Reviewers, and Last but not least beloved participants,

Thank God for granting us with blessings, that we could gather here today in this very special moment, "International Joint Conference on Science and Technology 2017" organized by UPN "Veteran" Jawa Timur, Bali State Polytechnic, National Cheng Kung University, University of Trunojoyo, Surabaya State University, and Jember State Polytechnic.

Ladies and Gentlemen,

Environmental problems has been a very significat issue for many parties, especially for business actors. Either help the environment and hurt your business, or irreparably harm your business while protecting the earth. With such problems, it might be wise for us to focus on the promotion of several environmental-friendly steps, some to mention are low-carbon paths to industrial development; efficient use of non-energy raw materials; adoption of relevant products and technologies to meet environmental standards; adoption of environmental and related management systems with a view to entry into global value chains; and creation of businesses that can offer services in these areas.

The theme chosen is concerning with the current problem, Green Industry which is related to the increasingly polluted environment as well as the increasingly expensive energy problems that needs finding ways of savings. It is gratifying to note that the agenda of the seminar covering a wide range of very interesting items relating to the theme.

We believe this seminar is a great opportunity for all delegates to discuss the existing problems concerning science, technology, innovation, and culture for sustainable development in answering challengess for green industry.

Distinguished guests,

I wish this moment not only could enrich a broader knowledge, but also make new friends, and build net working in crearting better future.

At last but not least, I would like to express my greatest appreciation to everyone who has supported and brought this seminar into success, and we truly apologize for any inconveniences may arise during the seminar.

Thank you

*Wassalamualaikum Wr. Wb.*

Denpasar, September 27, 2017

Rector of UPN "Veteran" Jawa Timur

Prof. Dr. Ir. H. Teguh Soedarto, MP



## Conference Photographs















## Sponsor or funding acknowledgements

We are delighted to acknowledge the financial support received from Bali state Polytechnic-Ministry of Research , Technology and Higher Education- Indonesian Government and also the excellent support received from Mayor of Denpasar City, Governoor of Bali Province, Rector of Trunojoyo University Madura, Rector of State University of Surabaya, Rector of University of Pembangunan Nasional Surabaya.

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- Prof. Renanto Handogo, M.Sc, Ph.D. (ITS Surabaya, Chemical Engineering)

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## Applying Evolutionary Prototyping In Developing LMIS: A Spatial Web-Based System For Land Management

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# Applying Evolutionary Prototyping In Developing LMIS: A Spatial Web-Based System For Land Management

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**Abstract.** Software development project is a difficult task. Especially for software designed to comply with regulations that are constantly being introduced or changed, it is almost impossible to make just one change during the development process. Even if it is possible, nonetheless, the developers may take bulk of works to fix the design to meet specified needs. This iterative work also means that it takes additional time and potentially leads to failing to meet the original schedule and budget. In such inevitable changes, it is essential for developers to carefully consider and use an appropriate method which will help them carry out software project development. This research aims to examine the implementation of a software development method called evolutionary prototyping for developing software for complying regulation. It investigates the development of Land Management Information System (pseudonym), initiated by the Australian government, for use by farmers to meet regulatory demand requested by Soil and Land Conservation Act. By doing so, it sought to provide understanding the efficacy of evolutionary prototyping in helping developers address frequent changing requirements and iterative works but still within schedule. The findings also offer useful practical insights for other developers who seek to build similar regulatory compliance software.

## 1. Introduction

There is no exact definition found in the literature of what is considered as a Regulatory Compliance Software (RCS). Instead, some of different terms and words are used by practitioners to represent this concept of RCS such as "Compliance software," "Legal Compliance Software" and "Regulatory Reporting Software." In particular, this paper defines an RCS as a computer application solution designed to enable individual or organizations perform their tasks required for regulatory compliance. Examples of RCSs may include e-tax filing systems [1], e-rulemaking [2] and e-participation [3].

Based on the above general definition, developing an RCS inherently presents unique challenges which could lead to the risk of failure if they are not carefully nurtured for some reasons:

- a. First, the software should adhere to and comply with the (stringent) provisions imposed by the relevant laws and regulations which may change during the development process. As a consequence the developers may take frequent iterative works and could face a risk of failure if they are unable to freeze the requirements within the project time.
- b. Second, if the software uses sensitive and personal information, then the developers need to ensure that the development process and the resulting systems must comply with various standards such as security, cryptography and privacy.



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- c. Third, in the case of developing RCS to support the enforcement of a newly passed law, the developers may need to build the software from scratch since there are no comparable software systems that match with such recent legal requirements. Therefore, the developers need to take iterative review to ensure the software meets with specified requirements.

Despite its unique nature, there is limited knowledge or technical guidance on how can developers build an RCS successfully. With regards to this gap, this study aimed to examine the implementation of one of software development methods called evolutionary prototyping in developing an RCS.

## **2. Related Works**

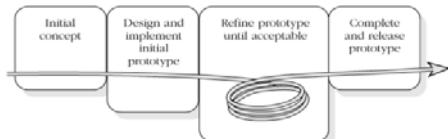
There has been growing number of works found in the literature researching the development of RCS due to the increasing demand on the software systems that adhere to legal compliance and accountability imposing by regulations or laws. A great deal of previous research in this area has focused on providing various frameworks and techniques that enable software developers to identify and analyze legal obligation and the refine into software requirements [4-6]. All these studies, while, provide us insights into the techniques used to gather the inevitable changing requirements of RCS development. Nevertheless, some interesting issues remain unclear from previous studies such as what method can help developers effectively incorporate the unknown requirements into the design and how to manage the unexpected change requirements during the development.

For several years, a great effort has been devoted studying the implementation of various software development methodologies. Especially since the introduction of Water fall model early 1970s to late 1980s, software development methodology has attracted much attention from software engineering researchers [7]. Despite its potential use, using waterfall solely may not work efficiently, especially in the software development with high complexity and frequent change in requirements. To overcome this, researchers and practitioners have proposed more agile development methods and some become popular for its applicability such as evolutionary prototyping, scrum and XP [8]. However, there is no method has been a silver bullet which can address all the problems in the software development. Instead, each of which may have strong and weakness and can complement each other.

As introduced above, this study aimed to investigate the implementation of Evolutionary Prototyping (EP) in a software development project. Although there has been a large volume of published studies in this area since several decades ago, current empirical researches describing the use of EP continue to progress [e.g. 9, 10]. However, due to the dynamic and constant change especially on today's software development landscape, there is a need for more study on the implementation of EP. Furthermore, as each software development project has different characteristics, it suggests that research on the implementation of EP within specific case could make a unique contribution to the current body of knowledge. For this reason, to advance our understanding and make an important contribution to the current knowledge, this research particularly looks at the implementation EP in a unique context of Regulatory Compliance Software (RCS) development project.

## **3. Proposed framework**

Given the unique challenges and circumstance surrounding the development of RCS, this research considered EP informed in the previous work [11] as an appropriate method. This is because, in the EP, developers start by designing and implementing the most prominent prototype and then continue adding to and refining the prototype based on user feedback and eventually evolves until agreed for release [11]. Figure 1 illustrates how this research adopted EP to build RCS comply with the existing provisions imposed by the relevant laws and regulations. It also shows how EP enables us to incorporate new requirements in the iterative prototype development.



**Figure 1.** Evolutionary Prototyping (EP) framework for RCS development [11].

#### 4. Applying the framework

This section follows on from the previous section, which applied the overarching framework to investigate an RCS development. Before employing the framework, it is necessary to briefly describe the case study to give an overview of the RCS investigated in this study. The description also provides an account of aspects of the project, which had relevance to the unique nature of RCS development.

##### 4.1. The case study

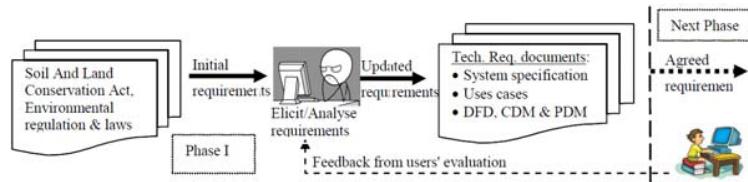
This research looks at software designed for complying regulation. In particular, it investigates the development of Land Management Information System (LMIS, pseudonym) initiated by a state Government in Australia. LMIS was chosen as an excellent case study for some reasons. First, the system was mainly designed as spatial web-based to enable farmers visualizing and measuring practically their current soil condition resulting farm practices (e.g. pesticide application, fertilizing and crop rotation) and then assist them in prioritizing necessary treatment plan as requested by Soil And Land Conservation Act. As such, there is a need for aligning this regulatory provision into the system for attaining compliance issues which matches with the nature of RCS discussed above.

Second, the government as the owner made LMIS as mandatory tool for various stakeholders in the agricultural sector (e.g., industry, agronomists, and farmers) who wish to access government-owned such as natural resource and soil map. The diverse range of stakeholders indicates that design process could present the complexity especially on how to define and incorporate those different and conflicting needs into acceptable requirements as it is usually found in the RCS.

Finally, at the time when the LMIS design project was initiated, there were no comparable or similar tools existed that gave users ability to record and share soil condition with other parties. Developing such new system also means that the requirements can be hidden, unknown and imperfect at initial phase but then become obvious, growing or even changing when it comes to the implementation. Therefore LMIS development is a suitable case given the uncertainty and changing of requirements which are similar to RCS. To address the challenges identified above, the LMIS design was undertaken using evolutionary prototyping which involves three processes as described below.

##### 4.2. Phase I: Requirements elicitation and analysis

Requirements elicitation is one of the critical parts in any software development, without which the developers are unable to produce expected system and comply with given regulation. Likewise in the LMIS design project, this phase was where developers attempted to define what the system should do. Using the framework illustrated in Figure 1 above, it can be thus explained that the process of requirements elicitation and analysis in the LMIS design project was started by reviewing related regulations and laws relating to the soil and land protection. Using legal text analysis, the developer team then identified and discussed law's elements that were transferable into technical or system specification. All the agreed requirements were then documented into Technical Requirement Documents such as System specification, Uses cases, DFD, CDM, and PDM. In some cases, the developer might receive feedback or additional information from the users that were useful for revising the requirements. Once the revisions were approved, the updated requirements documents were then used in the next phase for developing a working prototype as illustrated in Figure 2.

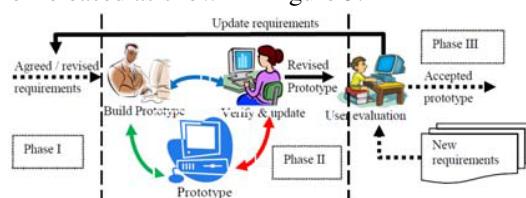


**Figure 2.** Phase I: Requirements elicitation and analysis process in LMIS design project.

#### 4.3. Phase II: Prototype development

Once the requirements were approved, the developer team started the second phase which aimed to develop a prototype. This phase mainly involved software building activities such as designing and developing architectural, database, module and user interface for LMIS based on the requirements specified in the technical documents. All the activities might be repeated until the software process design produce a working prototype which would be ready for internal verification by developer team. The prototype was modified if the result from the verification process was unsatisfactory. But, if the result was satisfactory and the prototype worked as expected in the requirements, the revised prototype then went through evaluation involving potential users (note: the evaluation process including how it was conducted and who are the participants will be discussed more thoroughly in section 4.4).

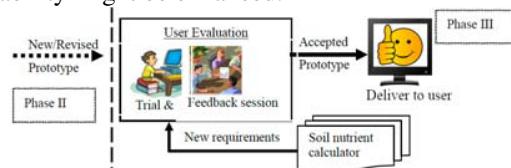
At the end of the evaluation, if the developer team and the user participants felt that the prototype was not satisfactory, then the software building process entered new iteration for aligning additional or new requirements as well as responding to feedbacks provided by users into the previous prototype. Having completed each development cycle, a newly evolved prototype was produced and sent to users for another round of evaluation. This cycle was still performed until the evolved prototype met the requirements and satisfied the users' needs or expectation. At this stage, if there were no more feedback or addition requirements to consider, the LMIS development was completed and ready to be delivered or released as shown in Figure 3.



**Figure 3.** Phase II: Development of LMS prototype.

#### 4.4. Phase III: User evaluation

As described in Section 4.3, when the initial prototype development was done, an intensive evaluation was run involving government staffs and farmers in trial feedback sessions. It aimed to seek how easy the prototype was to use; how this could be improved; and which parts were useful especially for measuring, monitoring reporting current soil condition requested by the government. In addition, the evaluation was also aimed at determining its suitability for farmers to comply with soil management act and how its usability might be enhanced.



**Figure 4.** Phase III: User evaluation of LMS prototype.

Results from this first round of evaluation showed that despite the prototype had demonstrated “proof-of-concept” of LMIS for helping farmers address the demand to report their soil condition, a

number of issues were identified which had reduced its suitability for farmers. The government staffs also suggested the need to incorporate nutrient calculator into the prototype. This feature could enable farmers to measure the optimum fertilizer quantities they should apply for paddocks to minimise excess amounts which resulted in wasted money and soil nutrient degradation. Further, it could also help them without expert assistance to reduce the paperwork or administrative burden of collecting, storing and reporting on soil nutrient index at their farm to potential regulators to reduce the likelihood of being audited but still demonstrate managing environmental risk factors.

Therefore in response to the evaluation results, the developer team planned to incorporate the additional requirements and recommendation in the next cycle round of development process (see section 4.3 above on how this iterative prototype development cycle was carried out) and aimed to produce an enhanced version of the prototype. Having completed a few cycles of prototype development-evaluation and when there were no more new requirements to add, the developer team concluded that the LMIS was complete, and was ready to be delivered to the government as the owner for further fully function release and roll out as shown in Figure 4.

## 5. Conclusion and further work

Overall, this study finds that the development of LMIS using EP has enabled the government to provide a tool for collecting, measuring and sharing soil condition practically. In particular, this shows that EP is potentially suitable for developing RCS under the changing and ambiguity environment (see Figure5). EP is also found can reduce defect, facilitate end user participation and produce an acceptable system. The analysis also identified challenges encountered during the implementation of EP such as delayed user feedback, difficult to freeze requirements and required the skilled team. To conclude, there is no method has been a silver bullet which can address all the problems in the software development, but EP can be very useful for developing software with highly changing requirements. Future study can address this by combining design methods for improving the development process and producing the quality software.

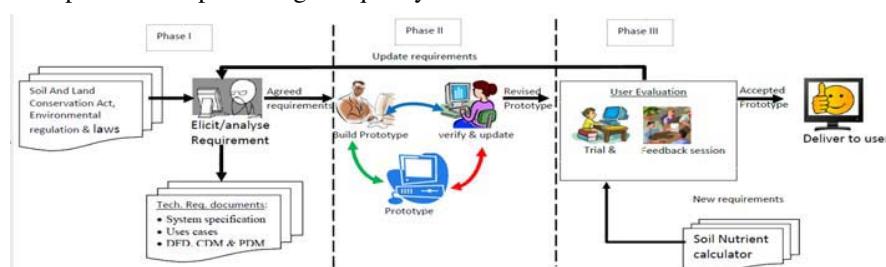


Figure 5. Applying EP throughout LMIS development project

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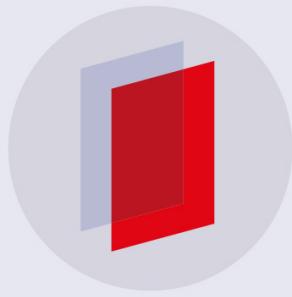
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## Development of esMOCA RULA, Motion Capture Instrumentation for RULA Assessment

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# Development of esMOCA RULA, Motion Capture Instrumentation for RULA Assessment

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**Abstract.** The purpose of this research is to build motion capture instrumentation using sensors fusion accelerometer and gyroscope to assist in RULA assessment. Data processing of sensor orientation is done in every sensor node by digital motion processor. Nine sensors are placed in the upper limb of operator subject. Development of kinematics model is done with Simmechanic Simulink. This kinematics model receives streaming data from sensors via wireless sensors network. The output of the kinematics model is the relative angular angle between upper limb members and visualized on the monitor. This angular information is compared to the look-up table of the RULA worksheet and gives the RULA score. The assessment result of the instrument is compared with the result of the assessment by rula assessors. To sum up, there is no significant difference of assessment by the instrument with an assessment by an assessor.

## 1. Introduction

An ergonomic assessment is conducted to ensure that the operator's work environment is ergonomically designed to minimize injury risk and maximize productivity. There are many methods of ergonomic assessment with specific objectives. Among the assessment tools for assessing musculoskeletal risk are Rapid Upper Limb Assessment (RULA). RULA provides an easily calculated rating of musculoskeletal loads in tasks where people have a risk of neck and upper-limb loading. The tool provides a single score as a "snapshot" of the task, which is a rating of the posture, force, and movement required. The risk is calculated into a score of 1 (low) to 7 (high)[1]

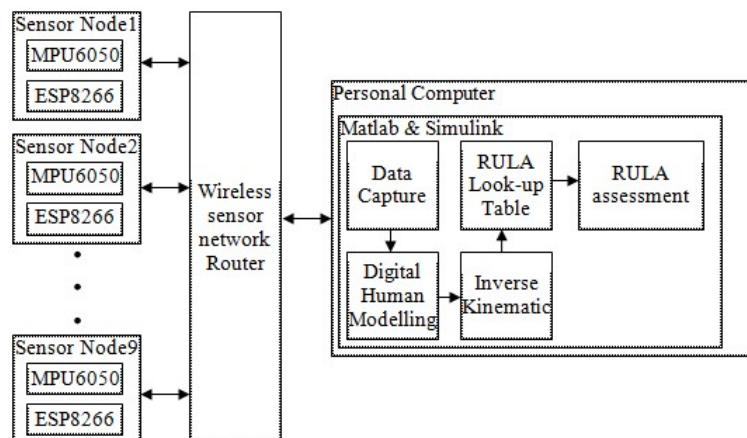
## 2. Related work

The limitations in the ergonomic assessment are the availability of qualified assessors. So some researchers developed a tool for conducting an ergonomic assessment [2,3,4,5,6,7]. Among the tools developed using motion capture-based cameras [2][8], and inertia measurement unit (IMU) based [3][5][9][10][11]. ergonomic assessment process automation always begins with capturing subject movement data. furthermore in computer applications built Digital Human Modeling (DHM) based on anthropometry data [4][7][11]. DHM receives body motion capture data and provides output data of the relative angle of the limbs, the force and moment at the joint, and the results of the ergonomic assessment.

Examples of motion capture system applications for posture reliability analysis work [12], for physiotherapy [13], for risk analysis on the shoulders and back [5]. The app is still in lab scale. However there are studies that apply ergonomic assessment to real activities. Golabchi uses his application for the assessment of construction workers [6]. Endo uses his application for the camera user's hand analysis [14][15]. Sinden performs fire worker's occupational assessment using the application it builds [8]. Even miller uses motion capture for analysis using a teleoperator arm [10]

### 3. Overview of system

The esMOCA RULA instrument is composed of two sub-systems, wireless sensor network subsystems and esMOCA RULA application subsystem (figure 1). The wireless sensor network subsystem consists of 9 sensor nodes and a wifi router to connect the sensors network to the computer. Sensor nodes have been built using MPU6050 sensor and wifi microcontroller ESP8266. The data communication between the sensor nodes and the computer runs through the UDP protocol on the IP network. The esMOCA RULA application is built using Matlab Simulink. Data capture to receive data from sensors is built using data acquisition toolbox while Digital Human Modeling (DHM) and inverse kinematic are built with simmechanic toolbox. The installation of 9 sensor nodes is schematically shown in Figure 2a. Figure 2.b shows the installation of each sensor on the low back, spine, head, hand, forearm, upper arm, and DHM illustration in Figure 2.c.



**Figure 1.** block diagram of esMOCA RULA



**Figure 2.** (a). Sensors placement, (b). Sensors installment, (c). Digital Human Modelling.

### 4. Experimental setup

This study aims to compare the RULA assessments performed by esMOCA RULA instruments with those done by RULA assessors. Three RULA assessors were involved in the study. They were asked to provide a simultaneous and independent RULA assessment of the two observed worker subject positions (figures 3, a and b). At the same time, the ESMOCA instrument captures the motion of the same observed subject and performs the RULA assessment. The ESMOCA instrument displays the

RULA score in real-time. After the subjects' observations were completed, the five assessors held a consensus of the RULA score. This consensus-based RULA score was compared with the RULA rating by the esMOCA instrument.



**Figure 3.** The two observed worker subject positions.

## 5. Result and discussion

Assessment of the limbs by the three assessors performed independently so that will produce a different score as well. Then they consensus for the final value of their RULA assessment. Table 1 shows the results of the RULA score score for posture 1 by three independent assessors and the final consensus by the three assessors. In the same table also presented the results of RULA assessment by esMOCA RULA. The same consensus score as EsMOCA RULA score is the lower arm score and wrist twist score. While upper arm segment, wrist, neck and trunk have different score between esMOCA RULA with consensus of assessors. Assessment of RULA for posture 2 by three independent assessors and their consensus including assessment by esMOCA RULA is presented in Table 2. Rula score of three assessors are 5,6,6 respectively, and they agree on a score of 6 by consensus. the RULA score consensus by these assessors is identical to the RULA score by esMOCA RULA. Consensus RULES score that is identical to ESMOCA RULA score is lower arm score and wrist twist score. While upper arm segment, wrist, neck and trunk have different score between esMOCA RULA with consensus of assessors.

**Table 1.** comparison of RULA scores by independent assessors, consensus of assessors, and esMOCA RULA for posture 1.

	Score				
	Assessor 1	Assessor 2	Assessor 3	Consensus	esMOCA RULA
<b>Upper Arm</b>	4	4	4	4	2
<b>Lower Arm</b>	3	3	3	3	3
<b>Wrist</b>	3	4	3	3	4
<b>Wrist Twist</b>	1	1	1	1	1
<b>Posture A</b>	5	6	5	5	5
<b>Muscle Use</b>	1	1	1	1	1
<b>Force/Load</b>	0	0	0	0	0
<b>Wrist &amp; Arm</b>	6	7	6	6	6
<b>Neck</b>	3	3	3	3	4
<b>Trunk</b>	3	3	3	3	1
<b>Leg</b>	2	2	2	2	2
<b>Posture B</b>	5	5	5	5	5
<b>Muscle Use</b>	1	1	1	1	1
<b>Force/Load</b>	0	0	0	0	0

<b>Neck, Trunk, Leg</b>	6	6	6	6	6
<b>RULA Score</b>	7	7	7	7	7

There are still differences in ESMOCA RULA score with consensus of RULA score of the assessors. This difference is encountered in the upper arm segment, wrist, neck and trunk. This difference comes from two causes are differences in perceptions of the assessors and the alignment sensor in the upper body limb arm, wrist, neck and trunk are less precise.

It was observed that esMOCA RULA instruments can perform real-time assessments with final RULA scores identical to independent assessors. Whereas independent assessors take 17 to 48 minutes to complete angle calculations and RULA assessments. From these results ESMOCA RULA instruments have the potential to be further developed into RULA assessment instruments or as a tool to train novice assessors in conducting RULA assessments.

**Table 2.** comparison of RULA scores by independent assessors, consensus of assessors, and esMOCA RULA for posture 2.

	Score				
	Assessor 1	Assessor 2	Assessor 3	Consensus	esMOCA RULA
<b>Upper Arm</b>	3	3	3	3	1
<b>Lower Arm</b>	3	3	3	3	3
<b>Wrist</b>	3	4	4	3	4
<b>Wrist Twist</b>	1	1	1	1	1
<b>Posture A</b>	4	5	5	4	4
<b>Muscle Use</b>	1	1	1	1	1
<b>Force/Load</b>	0	0	0	0	0
<b>Wrist &amp; Arm</b>	5	6	6	5	5
<b>Neck</b>	1	1	2	3	4
<b>Trunk</b>	2	2	2	2	1
<b>Leg</b>	2	2	2	2	2
<b>Posture B</b>	3	3	3	4	5
<b>Muscle Use</b>	1	1	1	1	1
<b>Force/Load</b>	0	0	0	0	0
<b>Neck, Trunk, Leg</b>	4	4	4	5	6
<b>RULA Score</b>	5	6	6	6	7

## 6. Conclusion

The esMOCA RULA instrument has been successfully built and is capable of performing real time RULA assessments with high precision. The initial phase of this development has the potential to be further developed to become a standard instrument in the assessment of RULA or developed to assist the learning process of novice RULA assessors

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## Determination System Of Food Vouchers For the Poor Based On Fuzzy C-Means Method

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# Determination System Of Food Vouchers For the Poor Based On Fuzzy C-Means Method

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**Abstract.** Food vouchers are government programs to tackle the poverty of rural communities. This program aims to help the poor group in getting enough food and nutrients from carbohydrates. There are several factors that influence to receive the food voucher, such as: job, monthly income, Taxes, electricity bill, size of house, number of family member, education certificate and amount of rice consumption every week. In the execution for the distribution of vouchers is often a lot of problems, such as: the distribution of food vouchers has been misdirected and someone who receives is still subjective. Some of the solutions to decision making have not been done. The research aims to calculating the change of each partition matrix and each cluster using Fuzzy C-Means method. Hopefully this research makes contribution by providing higher result using Fuzzy C-Means comparing to other method for this case study. In this research, decision making is done by using Fuzzy C-Means method. The Fuzzy C-Means method is a clustering method that has an organized and scattered cluster structure with regular patterns on two-dimensional datasets. Furthermore, Fuzzy C-Means method used for calculates the change of each partition matrix. Each cluster will be sorted by the proximity of the data element to the centroid of the cluster to get the ranking. Various trials were conducted for grouping and ranking of proposed data that received food vouchers based on the quota of each village. This testing by Fuzzy C-Means method, is developed and abled for determining the recipient of the food voucher with satisfaction results. Fulfillment of the recipient of the food voucher is 80% to 90% and this testing using data of 115 Family Card from 6 Villages. The quality of success affected, has been using the number of iteration factors is 20 and the number of clusters is 3

## 1. Introduction

Food vouchers are government programs to tackle poor communities by providing assistance to poor communities to meet basic needs. This program has been implemented by the government since 1998. Early on, the program was called as the Special Market Operation Program (OPK), then it has been changed to Rice Pad (RASKIN) in 2002 and at the end of February 2017, the government has officially converted the Raskin program into a voucher program Food by extending the function as part of the community's social protection program. The distribution mechanism of food voucher program has been conducted at 44 regencies in Indonesia[1]. Furthermore, acceptance mechanism of food vouchers becomes a complicated issue. The data dynamics of food voucher recipients require a local policy through village consultation. Moreover, the distribution of food voucher to the recipients is still through certain



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community groups so often it is still lack on target. Therefore, supportive factors are needed to overcome this in order to improve Indonesia's economic stability [2]. One of the policies taken by the government is by issuing aid program policies in the form of food voucher.

Several solutions to decision making for the determination of food voucher recipients have been widely implemented. However, the solution has not provided satisfactory success, so various improvement efforts in this research need to be done. Based on the literature review, the Fuzzy C-Means method is one of the clustering algorithms as part of the C-Means method. The C-means method is well known for its ease and ability to cluster large data and outlier data very quickly. However, the disadvantage of the C-Means method is the result of ever-changing clustering[3]. Therefore, this research using Fuzzy C-Means for the determination of food voucher recipients. Fuzzy C-Means method has some advantages including simple, easy to implement, able for grouping large data, and precise placing the objects exactly on one partition or located between two or more in other partitions. It also has better output in term of stability rates rather than conventional method approaches, such as the C-Means method [4]. In addition, the Fuzzy C-Means method is a suitable clustering method for the selection process by determining the number of clusters to be established [5]. The FCM method is a clustering method without new supervision that allows one data to be owned by two or more clusters and has high classification test efficiency [6]. There is some research about Fuzzy C-Means as following: [7] captures the application of a novel intuitionistic fuzzy c means clustering algorithm in medical images;[8] presents a modified possibilistic fuzzy c-means for bias field estimation and segmentation of brain MR image; [9] examine a fuzzy c-means based on nearest-neighbor intervals for incomplete data. Based on the previous research, there is still limited research about application of the FCM for determining food voucher recipient.

Process of determining the food voucher recipient using the Fuzzy C-Means method is influenced by several factors, such as: employment, monthly income, tax and electricity bill, house size, number of family members, education certificate and total rice consumption per week. The objective of this study using Fuzzy C-Means method is calculating the change of each partition matrix and each cluster will be sorted based on the proximity of data elements with its centroid cluster, where data that have the same characteristics can be grouped into one cluster and the same data differently grouped into other groups. Therefore, the results of this study were obtained by the ranking process based on the centroid of the cluster for decision-making which entitled the food voucher so that the program is right on target. Hopefully this research makes contribution by providing higher result using Fuzzy C-Means comparing to other method for this case study.

## 2. Methodology

The input data in this research are the criteria data from 6 Villages in Pragaan Sub-district, Sumenep Regency, East Java, Indonesia. Details of the data were collected from 44 candidates at Aeng Soka Village, 45 candidates at Maronggi Laok Village, 56 candidates at Dung Daja Village, 45 candidates at Dung Laok Village, 22 candidates at Maronggi Daja Village, 45 candidates at Mornangka Village) based on 8 criteria as shown in Table 1. Assessment is needed for determining the food voucher recipient, particularly the value in each aspect. The assessment in this model uses the weighting for each sub criterion on each criterion. The weight of the value, such as value of very good is 5, value of good is 4, value of enough is 3, value of less is 2, and value of very less is 1.

**Table 1.** Data Criteria of Voucher Food Programs

No.	Type's Criteria	Sub Criteria	No.	Type's Criteria	Sub Criteria
1.	Job	Farmer Fisher Asistant of house	3.	Salary	Income per month
			4.	Building Tax	Tax cost
			5.	Electricity bills	Monthly account fees

		Goverment Employees		
		Private Employees		
2.	Graduate Education	Not certified	6.	House size
		Primary school	7.	Rice Needs
		Junior high school / equal		Consumption of rice every week
		Senior high school / equal	8.	Number of dependents of family members
		Diploma/ Bachelor / Magister		family members

Decision support system is the process for selecting alternative ways of acting with an efficient method according to the circumstances that support a decision. It is solving a problem with system support in determining the taken solution [10]. Furthermore, decision support system for determining the voucher recipient is based on the fuzzy set of concepts that is the basis of the fuzzy logic system. Membership function is a curve showing the mapping of data points of input into its membership value. A fuzzy set can be defined based on linguistic variables that have a value of words in natural language [11] [12]. There are several data clustering algorithms, one of which is Fuzzy C-Means (FCM). FCM is a data clustering technique that the existence of each data in a cluster is determined by a certain value or degree of membership. The basic concept is to determine the center of the group that will mark the average location for each cluster. The output of FCM is a cluster of central clusters and some degree of membership for each data point. However, this information can be used to build a fuzzy inference system [12]. If there is a set of data (input or output data from the fuzzy system), then it can be seen in Equation 1. The objective function of the P threshold iteration P(c) in the partition matrix can be seen in Equation 4.

$$X = (x_1, x_2, x_3, \dots, x_N) \quad (1)$$

The degree of membership of k data point in the  $i^{th}$  cluster can be seen in Equation 2.

$$\mu_{ik} (x_k) \in [0, 1] \text{ with } (1 \leq i \leq c; 1 \leq k \leq N) \quad (2)$$

In the FCM method, the partition matrix can be seen in Equation 3.

$$\mu_f(c) = \begin{bmatrix} \mu_{11}[X_1] & \mu_{21}[X_1] & \mu_{31}[X_1] \\ \mu_{12}[X_2] & \mu_{22}[X_2] & \mu_{32}[X_2] \\ \mu_{13}[X_3] & \mu_{23}[X_3] & \mu_{33}[X_3] \\ \mu_{1N}[X_N] & \mu_{2N}[X_N] & \mu_{3N}[X_N] \end{bmatrix} \quad (3)$$

with  $\sum_{i=1}^c \mu_{ik} = 1$ , which means that the number of degrees of membership of a data in all clusters must be equal to 1.

$$Pt(c) = \sum_{k=1}^N \sum_{i=1}^c (\mu_{ik})^w |x_k - v_{fi}|, \text{ where } v_{fi} = \frac{\sum_{k=1}^n (\mu_{ik})^w x_k}{\sum_{k=1}^n (\mu_{ik})^w} \quad (4)$$

$|x_k - v_{fi}|$  is the normal form of Euclidean used as the distance between  $x_k$  and  $v_{fi}$  with  $v_{fi}$  is the center of the cluster on the  $i^{th}$  fuzzy and w is the weighted rank on the membership values. In the process of determining the food voucher recipient using FCM method, the data input will be clustered in the form of data from the population in the form of X matrix of size n x m, where n = number of data samples and m = attribute of each data.  $X_{ij}$  =  $i^{th}$  sample data ( $i = 1, 2, \dots, n$ ), j of attribute ( $j = 1, 2, \dots, m$ ). Then perform the following steps [7]: (a) initialization parameters, including number of clusters (c), weighted rank (w) = 2, maximum iteration (maxIter), least expected error ( $\xi$ ) =  $10^{-5}$ , initial objective function ( $P_0$ ) = 0, initial iteration = 1; (b) Generate random numbers  $\mu_{ik}$ , where  $i = 1, 2, \dots, n$ ;  $k = 1, 2, \dots, c$ ; as elements of the initial partition matrix ( $\mu_f(0)$ ). Calculate the number of each column (attribute) as shown in Equation 4, then normalized on  $\mu_{ik}$ , as shown in equation 5; (c) Calculate the center of the cluster for the partition matrix, as shown in equation 3; (d) Calculate the objective function in the t iteration; (e) Calculating error, can be seen in equation 6; (f) Calculating euclidean, where euclidean is the airspace value between the clusters to the center of the cluster, the distance is taken by a straight line and the rectilinear count, where rectilinear is the value, , can be seen in equation 7; (g) Calculating the change in matrix as shown in

Equation 8; (h) Checking the stop condition, If ( $|P_t - P_{t-1}| < \xi$ ) or  $t > \text{MaxIter}$  then stop and if it is not  $t = t + 1$ , repeat step (c). Equation 11 shows the calculating process for the success rate in the fulfillment of the food voucher recipients.

$$Q_j = \sum_{k=1}^c \mu_{ik} \quad \text{where } j = 1, 2, \dots, m \quad (5)$$

$$\mu_{ik} = \frac{\mu_{ik}}{Q_i} \quad (6)$$

$$P_t = \sum_{i=1}^N \sum_{k=1}^c [(\sum_{j=1}^m (x_{ij} - v_{kj})^2] (\mu_{ik})^w \quad (7)$$

$$\text{Euclidean} = \sum_{i=1}^k \sum_{i=1}^n \sqrt{(x_{[1,i]} - v_{[1,i]})^2 + (y_{[1,i]} - v_{[1,i]})^2} \times \text{weight}_i \quad , \text{and} \quad (8)$$

$$\text{Rectilinear} = \sum_{i=1}^k \sum_{i=1}^n |x_{[1,i]} - v_{[1,i]}| + |y_{[1,i]} - v_{[1,i]}| \times \text{weight}_i$$

$$\mu_{ik} = \frac{[\sum_{j=1}^m (x_{ij} - v_{kj})^2]^{-\frac{1}{w-1}}}{\sum_{k=1}^c [\sum_{j=1}^m (x_{ij} - v_{kj})^2]^{-\frac{1}{w-1}}} \quad (9)$$

$$\text{Percentage of result (\%)} = \frac{\Sigma \text{Proximity Feasibility Value}}{\Sigma \text{Value of Each Cluster}} \times 100\% \quad (10)$$

### 3. Results and Discussion

Determining process of the food voucher recipient has been conducted through several steps as following: entering the village proposal data, the criteria for each village and determining the parameters, then generating random numbers as the initial partition matrix element, calculating the number of each matrix column, counting the cluster center, calculating the objective function, calculating the change of each partition matrix. Check the stop condition, if ( $|P_t - P_{t-1}| < \xi$ ) or ( $t > \text{MaxIter}$ ) then stop, otherwise  $t = t + 1$  then it will be repeated to the cluster calculation. The cluster center has been obtained if the condition stops fulfilling. A data which has the greatest degree of membership belong to a cluster. Each cluster will be sorted based on the proximity of the data element to the center of the cluster to obtain the friction. While the implementation of the 8 criteria as the proposed data of the food voucher recipient and the FCM parameter as shown in Figure 1.

Several trials have been conducted in this study with data processing of 115 Family Card from 6 Villages. The condition of the data is greater than the number of iterations and the number of clusters are 3 and the maximum iterations are 20, resulting in data of 25 food voucher recipients. This study has been tested using 5 data sample as shown Table 2. Furthermore, it is a sample of FCM calculation for determining the food voucher recipients. Then, the next process is to generate a random value as the element of initial partition matrix ( $\mu_{25}$ ) after the candidate data is formed, such as:

$$\mu_{25} = \begin{bmatrix} 0.12 & 0.46 & 0.68 & 0.33 & 0.42 \\ 0.88 & 0.54 & 0.32 & 0.67 & 0.58 \end{bmatrix}$$

The next step are calculating the cluster center, then improving the degree of membership ( $\mu_{ik}^2$ ) and the objective function ( $P_t$ ) after a random number is created. As a results, two clusters in this study are shown in Table 3. Next, the matrix improvement as shown in Table 4. Finally, the last step is checking the stop condition ( $|P_t - P_0|$ ). The result shows that  $P_t$  in the 1<sup>st</sup> iteration is still greater than error (0.00001), therefore the next iteration has done. This is conducted repeatedly for the 25<sup>th</sup> iteration. When the 25<sup>th</sup> iteration of the cluster center is generated, it can be seen in Table 3. Table 4 shows the partition matrix information is obtained on the tendency of candidate receiving food vouchers to enter clusters with the highest membership level to become members of the selected group.



(a)

(b)

**Figure 1.** (a) Implementation of Criteria Candidate of the food Voucher Recipient, (b) Parameter of FCM**Table 2.** Data of the proposed food voucher recipients by weighting

No	Name	Job	salary	Tax	Billing	Number of Family	Rice needs	House Size	Graduated
1.	Suja'i	5	470000	5000	18000	5	6.2	63	7
2.	Moh. Syafi'e	2	2037000	12000	22000	3	1.5	102	5
3.	Nur Holis	5	260000	3600	8000	4	2.3	84	7
4.	Abdurrahman	4	320000	2500	10000	3	1.7	63	8
5.	Akhmad Faru	2	2700000	10000	23000	4	4.5	88	2

**Table 3.** Calculation of cluster center 1 and cluster 2

Iteration, Cluster	$\mu_{i1}^2$	$\mu_{i1}^2 \cdot x_{i1}$	$\mu_{i2}^2 \cdot x_{i2}$	$\mu_{i3}^2 \cdot x_{i3}$	$\mu_{i4}^2 \cdot x_{i4}$	$\mu_{i5}^2 \cdot x_{i5}$	$\mu_{i6}^2 \cdot x_{i6}$	$\mu_{i7}^2 \cdot x_{i7}$	$\mu_{i8}^2 \cdot x_{i8}$
$\sum \mu_{11}$	0.97	3.59	1069149.2	6312.09	13759.8	3.5887	2.44913	83.7159	5.6196
$\frac{\sum_{k=1}^5 (\mu_{11})^2 x_{12}}{\sum_{k=1}^n (\mu_{11})^2}$	3.6927	1098027.3	6482.58	14131.4	3.6856	2.5152	85.977	5.77138	
$\frac{\sum_{k=1}^5 (\mu_{25,1})^2 x_{25,2}}{\sum_{k=1}^5 (\mu_{25,1})^2}$	2.00002	2375287.8	10979.4	22510.2	3.5102	3.0308	94.8559	6.65836	
$\sum \mu_{12}$	1.953	7.4356	2036509.2	12226.0	33399.8	7.8487	7.75113	145.015	11.8596
$\frac{\sum_{k=1}^5 (\mu_{12})^2 x_{12}}{\sum_{k=1}^n (\mu_{12})^2}$	3.8059	1042385.8	6257.91	17095.6	4.0173	3.9674	74.2262	6.07032	
$\frac{\sum_{k=1}^5 (\mu_{25,2})^2 x_{25,2}}{\sum_{k=1}^n (\mu_{25,2})^2}$	4.6638	350924.30	3701.81	11995.9	3.9970	3.3935	70.020	7.1503	
$P_1$		2.79917E+12			$P_{25}$			2.36865E+11	
$= \sum_{i=1}^5 \sum_{k=1}^2 ([ \sum_{j=1}^8 (x_{ij} - v_{kj})^2 ] (\mu_{ik})^2)$					$= \sum_{i=1}^5 \sum_{k=1}^2 ([ \sum_{j=1}^8 (x_{ij} - v_{kj})^2 ] (\mu_{ik})^2)$				

**Table 4.** Members of groups selected as the food voucher recipients

Type's Data	Matrix of patition	Selected Candidat		
	Cluster 1	Cluster 2	Cluster 1	Cluster 2
1	0.0039	0.9960		3 <sup>th</sup>

2	0.9613	0.0386	1 <sup>st</sup>	
3	0.0018	0.9981		4 <sup>th</sup>
4	0.0002	0.9997		5 <sup>th</sup>
5	0.9812	0.0187	2 <sup>nd</sup>	

#### 4. Conclusions

The test results of the system for determining the food voucher recipient using FCM have conclusions as following: the cluster formed is influenced by some input criteria which is used as a reference in decision making based on 8 criteria. Furthermore, the determination of the food voucher recipient is affected by the maximum iteration and the smaller error value of the cluster's center result shows the correct position. In addition, the use of random matrices in the determination of cluster centers has significant impact to the calculation process for determining the proximity of proposals to a particular cluster center. The success rate of the food voucher recipient is 80% to 90% using 115 Family Card data from 6 Villages. Additionally, the quality of success affecting the number of iteration factors is 20 and the number of groups is 3.

#### Acknowledgment

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## Model For Marketing Strategy Decision Based On Multicriteria Decision Making: A Case Study In Batik Madura Industry

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# **Model For Marketing Strategy Decision Based On Multicriteria Decicion Making: A Case Study In Batik Madura Industry**

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**Abstract.** Selection of marketing strategy is a prominent competitive advantage for small and medium enterprises business development. The selection process is a multiple criteria decision-making problem, which includes evaluation of various attributes or criteria in a process of strategy formulation. The objective of this paper is to develop a model for the selection of a marketing strategy in Batik Madura industry. The current study proposes an integrated approach based on analytic network process (ANP) and technique for order preference by similarity to ideal solution (TOPSIS) to determine the best strategy for Batik Madura marketing problems. Based on the results of group decision-making technique, this study selected fourteen criteria, including consistency, cost, trend following, customer loyalty, business volume, uniqueness manpower, customer numbers, promotion, branding , bussiness network, outlet location, credibility and the inovation as Batik Madura marketing strategy evaluation criteria. A survey questionnaire developed from literature review was distributed to a sample frame of Batik Madura SMEs in Pamekasan. In the decision procedure step, expert evaluators were asked to establish the decision matrix by comparing the marketing strategy alternatives under each of the individual criteria. Then, considerations obtained from ANP and TOPSIS methods were applied to build the specific criteria constraints and range of the launch strategy in the model. The model in this study demonstrates that, under current business situation, Straight-focus marketing strategy is the best marketing strategy for Batik Madura SMEs in Pamekasan.

## **1. Introduction**

Batik industry plays an important role in the economy development in Madura. In the case of Madura island, batik industry has shown its potential to boost income and employment rate of the Madura's people through expansive domestic and international trade. Currently, Batik Madura industry is undergoing a transformation process, from home-based business entities into a more organized Small and Medium Enterprises (SMEs), capable of developing economies in the local villages in Madura. In order to improve the competitiveness of Batik Madura industry in the era of global trade and the implementation of ASEAN Economic Community (AEC) in 2015, SMEs involved in the batik industry must be able to manage their business processes and increase their efficiency, productivity, speed and flexibility.

Batik Madura should optimize their business process as an anticipation of AEC 2015 implementation and the international trade liberalization. This situation actually offer many opportunities for Batik Madura industry to expand their marketing areas in order to meet domestic and



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international customers' demand and trend. However, marketing of textile industry products is generally characterized by uncertainty and difficult to predict [1]. In particular, Batik industry endures high level of competition, which makes batik industry highly dependent to their consumers as their product price is wholly determined by the market [2]. This is due to the short life cycle of a product, since the types of products in the textile market vary widely from one place to another. Thus, the marketing strategies needs to be carefully developed so that textile industry can quickly meet their consumer demand and have better chances to compete [3]. Based on the above description, the characteristics of the batik industry, as a textile industry should focus on timely fulfillment of the market's demand which requires an accurate, precise and effective product marketing strategy.

Batik Madura industry poses many challenges, such as intense competition and ineffective marketing that will ultimately affect their business performance and reduce their profits. As a result, many Batik Madura companies would suffer losses, go out of business or switch to other types of businesses. In the long run, the sustainability of Batik industry in Madura Island is threatened. Management of marketing strategies will help SMEs to survive in an increasingly unpredictable business environment. A good marketing strategy is expected to help the parties involved in the supply chain of batik industry to improve the operational efficiency of the company and improve the existing marketing process. So that Batik Madura industry can maintain its profit and able to compete in free market. The strategy proposed in this research refers to Porter's [4] business unit level marketing strategies of differentiation strategy, focus and cost leadership, and people-based network marketing proposed by Van den Bulte [5].

Decision-making in selecting appropriate marketing strategy are influenced by many criteria. In this research, the integration ANP and TOPSIS is used to select the marketing strategy of Batik industry in Madura Island. ANP is an effective tool for evaluating the multicriteria decision making [6]. ANP can capture the outcome of dependence within and between cluster of elements [7]. ANP and TOPSIS can consider not only tangible and intangible criteria but also multi-choice aspiration levels [8]. The ANP method will generate the priorities of criteria and alternative that will be used as the input of the TOPSIS method. The result of TOPSIS method will be used in determining the priority of marketing strategy. Data processing to know the weight of each alternative marketing strategy based on existing criteria will be obtained, so that the optimal marketing strategy for Batik Madura SMEs can be selected based on the largest weight.

## **2. Methodology**

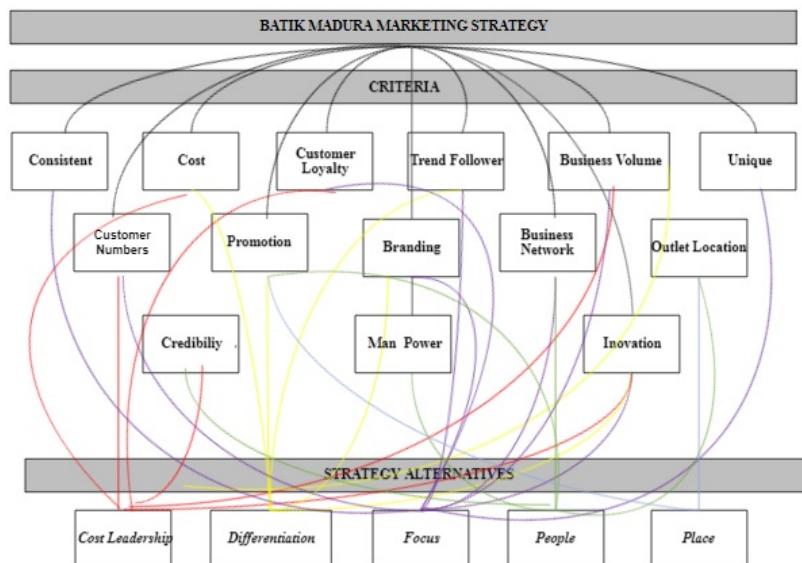
A survey questionnaire developed from literature review was distributed to a sample frame of Batik Madura SMEs in Pamekasan. The survey was conducted to identify the SMEs' marketing strategy and related criteria in selecting their strategy. Then, the marketing strategy alternatives and the selection criteria were consulted with the owners of the SMEs and government officials, considered as the experts of Batik Madura and relevant stakeholders of SMEs development in Pamekasan. The results from the interviews with those respondents were used to plot the relationships between the marketing strategy alternatives and the selection criteria. ANP methodology was employed to develop a model that reflect the interrelationships among criteria in marketing strategy selection. The ANP model is required to define the elements and their assignment to relationships, as well as their clusters. Moreover, the priority over certain marketing strategy was obtained through calculation of a supermatrix, which is a partitioned matrix of the interdependence influences among the criteria. The output from ANP model was carried upon TOPSIS methodology to determine an appropriate alternative that is farthest the negative-ideal solution and closest to the ideal solution in a multidimensional computing space as the preferred choice.

## **3. Results and Discussion**

The influence between criteria and marketing strategy has been explored in previous studies. There are 14 criteria considered in this research. Six criteria are derived from Puspitasari and Ciptomulyono [9] which includes consistency (A), cost (B), trend following (C), customer loyalty (D),

business volume (E), and uniqueness (F). Two criteria come from Fidian [10] consisting of manpower (G) and the customer numbers (H) and the rest of criteria from the group discussion were promotion (I), branding (J), business network (K), outlet location (L), credibility (M) and the innovation (N). According the literature review and interview results, this research adopted marketing strategies classified by Porter (1980), including cost leadership (P), differentiation (Q), focus (R) as well as People (S) and Place-based (T) marketing strategy coined by Puspitasari and Ciptomulyono [9].

A group discussion were conducted in order to determine the work structure or relationship in the considered criteria of marketing strategy alternatives. This research developed an interdependence relationship between the evaluation criteria, which was obtained from the interview results with the experts of Batik Madura in Pamekasan. The network model along with the influential criteria of marketing strategy alternatives were used as the foundation for ANP model development. The ANP model for Batik Madura SMEs in Pamekasan is shown in Figure 1.



**Figure 1.** The ANP model for Batik Madura SMEs in Pamekasan

The weighing evaluation of all proposed criteria were conducted by the respondents, pairwise without assuming their interdependence. The results were used to calculate the geometric means based on this formula:

$$U = \sqrt[n]{x_1 x_2 \dots x_n} \quad (1)$$

Table 1, 2, 3, 4 and 5 present the geometric mean of the evaluators' pair wise comparison values for the alternatives cost leadership, focus, differentiation, people, and place.

**Table 1.** Criteria pairwise comparison matrix for cost leadership alternative

Criteria	B	D	E	H	K	M	N
B	1	0.404	0.583	0.142	0.584	0.393	0.464
D	2.458	1	0.194	0.479	0.383	0.393	0.476
E	1.704	5.13	1	0.479	0.583	0.393	0.491
H	7.114	2.08	2.08	1	0.518	0.425	0.476
K	1.741	2.612	1.704	1.907	1	0.425	0.503
M	2.530	2.53	2.53	2.327	2.327	1	0.917

N	2.160	2.066	2.077	2.066	1.987	1.080	1
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**Table 2.** Criteria pairwise comparison matrix for focus alternative

Criteria	B	C	D	E	F	H	J	K	N
B	1	0.691	0.794	0.197	0.23	0.134	0.439	0.478	0.393
C	1.442	1	0.479	0.402	0.28	0.249	0.476	0.68	0.461
D	1.26	2.08	1	0.28	0.263	0.172	0.476	0.518	0.425
E	5.013	2.52	3.557	1	0.23	0.479	0.536	0.552	0.393
F	4.327	3.557	3.826	4.327	1	0.32	0.476	0.518	0.45
H	7.399	3.979	5.739	2.08	3.302	1	0.503	0.583	0.425
J	2.247	2.066	2.066	1.847	2.066	1.987	1	0.439	0.425
K	2.073	1.455	1.907	1.811	1.907	1.704	2.247	1	0.425
N	2.53	2.14	2.327	2.53	2.433	2.327	2.327	2.237	1

**Table 3.** Criteria pairwise comparison matrix for differentiation alternative

Criteria	B	C	F	I	J	N
B	1	0.249	0.11	0.116	0.116	0.11
C	3.979	1	0.23	0.507	0.28	0.281
F	9	4.327	1	0.383	0.331	0.243
I	8.653	2	2.612	1	0.23	0.249
J	8.653	3.42	2.99	4.327	1	0.331
N	9	3.78	4.16	3.979	3	1

**Table 4.** Criteria pairwise comparison matrix for people alternative

Criteria	G	I	K	L	M
G	1	0.997	0.478	0.731	0.296
I	0.997	1	0.209	0.263	0.168
K	2.073	1.437	1	0.691	0.249
L	1.382	3.979	1.437	1	1.116
M	3.42	6	3.979	8.653	1

**Table 5.** Criteria pairwise comparison matrix for place alternative

Criteria	I	L
I	1	0.2
L	5	1

Super Decision Software was used to construct ANP supermatrix based on the geometric means value of the alternatives under each of the individual criteria. Results from ANP methodology were used as input for TOPSIS methodology to determine the preference value of each criteria from the selected marketing strategy, in this particular case, a more focused marketing strategy. The TOPSIS method is started by constructing positive ideal solution matrix and a negative ideal solution matrix.

The positive ideal solution is the best value of each criteria in the chosen alternative, whereas the value of the negative ideal solution is the lowest value of each criteria (table 6).

**Table 6.** The overall priorities for the candidate marketing strategies

Alternatives	B	J	N	K	H	G	E	A	M	L	D	C	I	K
Cost leadership	0.195	0	0.159	0.223	0.26	0	0.81	0	0	0	0.1	0	0	0
Differentiation	0.805	0.099	0.464	0	0	0	0	0	0	0	0	0.28	0.5	0.3
Focus	0	0.9	0.77	0.458	0.74	0	0.18	1	0	0	0.8	0.72	0	0.7
People	0	0	0	0.19	0	1	0	0	0.45	0.8	0	0	0.23	0
Place	0	0	0	0	0	0	0	0	0.55	0.1	0	0	0.27	0
Value of positive ideal solution	0.805	0.9	0.464	0.457	0.74	1	0.81	1	0.55	0.8	0.8	0.72	0.5	0.7
Value of negative ideal solution	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0

The distances of each criteria to the ideal solution and the negative-ideal solution were calculated by using these formulas

$$S_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^+)^2} \quad (2)$$

$$S_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2} \quad (3)$$

The distances of each criteria to the positive- ideal solution ( $S_i^+$ ) and the negative-ideal solution ( $S_i^-$ ) were calculated by using these formulas and the result is shown in table 7.

**Table 7.** The overall priorities for the candidate marketing strategies

Alternatives	$S_i^+$	$S_i^-$
Cost leadership	2.515	0.910
Differentiation	2.482	0.806
Focus	1.832	2.108
People	2.384	1.454
Place	2.719	0.626

The preference value of each criteria is determined as follows:

$$V_i = \frac{S_i^-}{S_i^- + S_i^+} \quad (4)$$

The overall priorities for the appropriate marketing strategy were calculated by multiplying the weighted normalized decision matrix by the relative importance of the criteria considering interdependence. The result is shown in Table 8. In table 8, it can be seen that the focus strategy has the greatest preference value compared to the other alternatives which is 0.5350, followed by people strategy with preference value of 0.3788 and so on.

**Table 8.** The overall priorities for the candidate marketing strategies

Alternatives	Preference Value	Rank
Cost leadership	0.2657	3
Differentiation	0.2451	4
Focus	0.5350	1
People	0.3788	2
Place	0.1872	5

#### 4. Conclusion

When a company is going to sell their products to market, managers are always challenged with finding the appropriate marketing strategy. The selected marketing strategy adopted will determine whether a company succeeds or fails. In order to sustain their existence in current global trade liberalization, Batik Madura SMEs in Pamekasan should adopt the best method and accurate criteria to solve and determine proper marketing strategy. Using ANP and TOPSIS approach, this paper illustrates that Batik Madura SMEs in Pamekasan should concentrate on maintaining their consistency, which can be utilized in practice to leverage their focus marketing strategy.

#### 5. Acknowledgment

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## Development of esMOCA Biomechanic, Motion Capture Instrumentation for Biomechanics Analysis

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# Development of esMOCA Biomechanic, Motion Capture Instrumentation for Biomechanics Analysis

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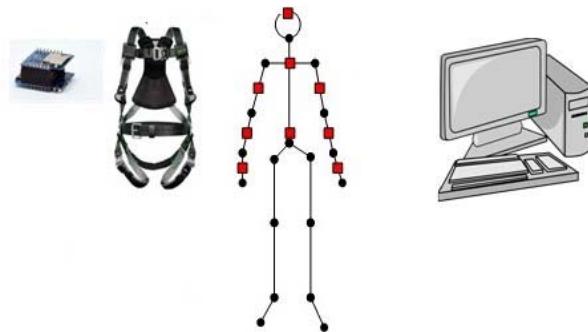
**Abstract.** This study aims to build motion capture instruments using inertial measurement unit sensors to assist in the analysis of biomechanics. Sensors used are accelerometer and gyroscope. Estimation of orientation sensors is done by digital motion processing in each sensor nodes. There are nine sensor nodes attached to the upper limbs. This sensor is connected to the pc via a wireless sensor network. The development of kinematics and inverse dynamamic models of the upper limb is done in simulink simmechanic. The kinematic model receives streaming data of sensor nodes mounted on the limbs. The output of the kinematic model is the pose of each limbs and visualized on display. The dynamic inverse model outputs the reaction force and reaction moment of each joint based on the limb motion input. Model validation in simulink with mathematical model of mechanical analysis showed results that did not differ significantly

## 1. Introduction

Biomechanic analysis is needed to understand the conditions of joint muscle tissue and bone tissue of workers in performing their duties [1][2][3]. But to know the actual working conditions of this body tissue is not an easy task. With a variety of approaches, many researchers seek to understand this phenomenon [4][5][2] with various approaches and objectives. In general, research on ergonomic assessment aims to improve work equality while increasing the productivity of work [6][7][8][9][10][11]

## 2. Related work

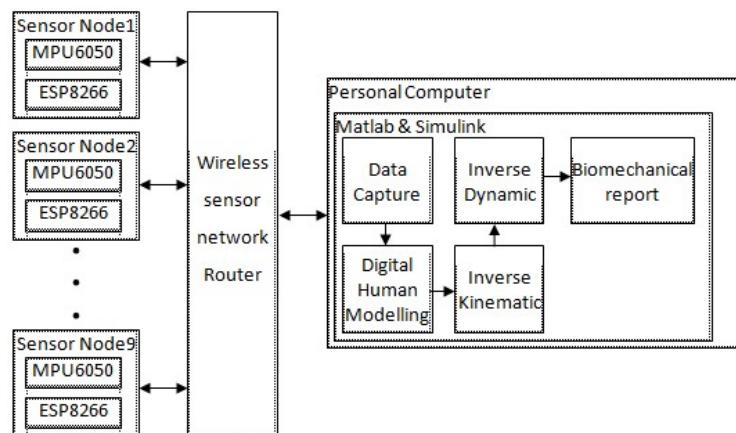
Development of biomechanics analysis tools has been conducted by several researchers [5][2][4][12][13][14]. Ricci performed an interaction analysis of upper limb biomechanics with a torax function in the lab scale [5]. Wagner analyzes the dynamics of motion in material handling jobs in the simulation of actual conditions [2]. Sinden runs a firefighter job simulation to observe the reaction moments and forces on the trunk and knees [4]. Not only the whole body can be observed. Specific observations of the hand gestures held by the camera have been made by Endo [10]. Even real work can also be observed as did Golabchi [12]. Similar to Sinden, Schall observed the moment and reaction force on the trunk and shoulders [4][13].



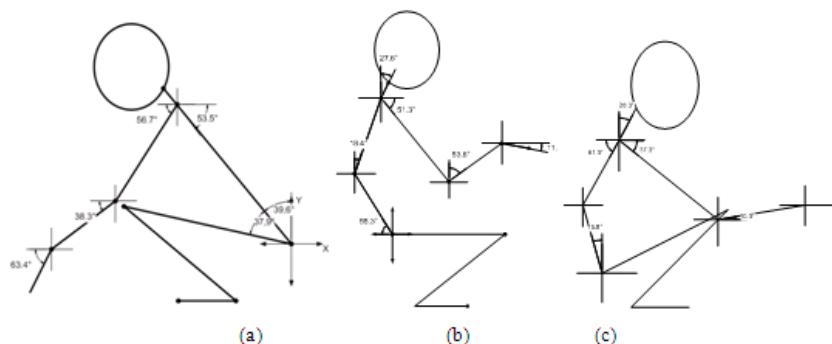
**Figure 1.** System overview of esMOCA Biomechanic using motion capture

### 3. Overview of system

The esMOCA Biomechanic is built from IMU based motion capture sensor devices that have been developed using the MPU6050 sensor and the ESP8266 wifi microcontroller. Each body limb observed attached one sensor node, picture 1. Processing orientation information of body limb is done in sensor node. Then this information data sent to computer data processing via wifi network. The computer receives all information from all sensors installed in the body limb of the operator. In computer applications EsMOCA Biomechanic consists of Digital Human Modeling block (DHM), a biomechanical block consisting of inverse kinematic and inverse dynamic calculations. The results of this biomechanical analysis are presented in the biomechanics work report, Figure 2. The biomechanical analysis report shown is the moment and reaction force in each joint.



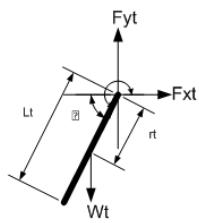
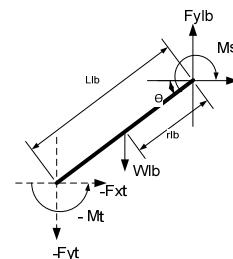
**Figure 2.** block diagram of esMOCA Biomechanic



**Figure 3.** Working posture for software verification

#### 4. Experimental setup

This research verifies biomechanics model in ESMOCA Biomechanic application. Verification is done by comparing the results of ESMOCA Biomechanic analysis with the result of mathematical model analysis. Mathematical models and esMOCA Biomechanic received the same posture inputs to calculate, then compared the results of mathematical model calculations with ESMOCA Biomechanic. The analyzed input posture is shown in Fig. 3. The mathematical model used to calculate the moment and reaction force in the joint is in following diagram.

**Figure 4.** Free body diagram of forearm.**Figure 5.** Free body diagram of upper arm

$$\begin{aligned}\sum F_y &= 0 \\ F_{yt} - W_t - W_0 &= 0 \\ F_{yt} &= W_t + W_0\end{aligned}\quad (1)$$

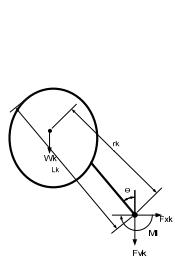
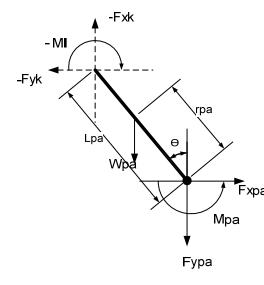
$$\begin{aligned}\sum M &= 0 \\ M_{pt} - (W_t \times r_t \times \cos \Theta) &= 0 \\ M_{pt} &= W_t \times r_t \times \cos \Theta\end{aligned}\quad (2)$$

$$\begin{aligned}\sum F &= 0 \\ -W_{lb} - F_{yt} + F_{ylb} &= 0 \\ F_{ylb} &= W_{lb} + F_{yt}\end{aligned}\quad (3)$$

$$\begin{aligned}\sum M &= 0 \\ M_s - M_{pt} - (W_{lb} \times r_{lb} \times \cos \Theta) - (F_{yt} \times L_{lb} \times \cos \Theta) &= 0 \\ M_s &= M_{pt} + (W_{lb} \times r_{lb} \times \cos \Theta) + (F_{yt} \times L_{lb} \times \cos \Theta)\end{aligned}\quad (4)$$

$$\begin{aligned}\sum F &= 0 \\ -W_{la} - F_{ylb} + F_{yla} &= 0 \\ F_{yla} &= W_{la} + F_{ylb}\end{aligned}\quad (5)$$

$$\begin{aligned}\sum M &= 0 \\ M_b - M_s - (W_{la} \times r_{la} \times \cos \Theta) - (F_{ylb} \times L_{la} \times \cos \Theta) &= 0 \\ M_b &= M_s + (W_{la} \times r_{la} \times \cos \Theta) + (F_{ylb} \times L_{la} \times \cos \Theta)\end{aligned}\quad (6)$$

**Figure 6.** Free body diagram of head**Figure 7.** Free body diagram of trunk

$$\begin{aligned}\sum F &= 0 \\ F_{yk} - W_k &= 0 \\ F_{yk} &= W_k\end{aligned}\quad (7)$$

$$\begin{aligned}\sum M &= 0 \\ M_l - (W_k \times r_k \times \cos \Theta) &= 0 \\ M_l &= W_k \times r_k \times \cos \Theta\end{aligned}\quad (8)$$

$$\begin{aligned}\sum F &= 0 \\ -W_{pa} - F_{yla_{ka}} - F_{yla_{ki}} + F_{ypa} &= 0 \\ F_{ypa} &= W_{pa} + F_{yla} + F_{yla_{ki}} + F_{yk}\end{aligned}\quad (9)$$

$$\begin{aligned}\sum M &= 0 \\ M_{pa} - M_{b_{ka}} - M_{b_{ki}} - M_l - (W_{pa} \times r_{pa} \times \cos \Theta) - (F_{yla_{ka}} \times L_p \times \cos \Theta) \\ &- (F_{yla_{ki}} \times L_p \times \cos \Theta) - (F_{yk} \times L_k \times \cos \Theta) = 0 \\ M_{pa} &= M_{b_{ka}} + M_{b_{ki}} + M_l + (W_{pa} \times r_{pa} \times \cos \Theta) + (F_{yla_{ka}} \times L_p \times \cos \Theta) \\ &+ (F_{yla_{ki}} \times L_p \times \cos \Theta) + (F_{yk} \times L_k \times \cos \Theta)\end{aligned}\quad (10)$$

## 5. Result and discussion

The calculation of reaction moments in each joint based on the mathematical model and based on the analysis of ESMOCA Biomechanic shown in the table and tested statistically there is no significant difference between the results of calculations based on mathematical models with analysis of ESMOCA Biomechanic

**Table 1.** Joint momen of posture A (N.m)

	<b>mathematic model</b>	<b>esMOCA Biomechanic</b>
trunk	87.64854959	57.52
neck and head	5.157113561	4.666
right upper arm	6.204648166	5.741
right fore arm	2.047886606	2.008
right hand	0.087044367	0.0853
left upper arm	6.204648166	5.741
left fore arm	2.047886606	2.008
left hand	0.087044367	0.0853

**Table 2.** Joint momen of posture B (N.m)

	<b>mathematic model</b>	<b>esMOCA</b>	<b>Biomechanic</b>
trunk	84.96095026		38.41
neck and head	4.016776624		3.637
right upper arm	6.935773166		6.41
right fore arm	2.201935967		2.159
right hand	0.190828324		0.1871
left upper arm	6.935773166		6.41
left fore arm	2.201935967		2.159
left hand	0.190828324		0.1871

**Table 3.** Joint momen of posture C (N.m)

	<b>mathematic model</b>	<b>esMOCA</b>	<b>Biomechanic</b>
trunk	53.54130588		53.14
neck and head	4.110344772		3.722
right upper arm	8.675423974		8.009
right fore arm	2.652735156		2.601
right hand	0.1944		0.1906
left upper arm	8.675423974		8.009
left fore arm	2.652735156		2.601
left hand	0.1944		0.1906

## 6. Conclusion

The ESMOCA Biomechanic instrument has been developed and verified that the results of the ESMOCA Biomechanic biomechanics analysis are not significantly different from the results of mathematical model-based analysis.

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## A Maze Game on Android Using Growing Tree Method

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# A Maze Game on Android Using Growing Tree Method

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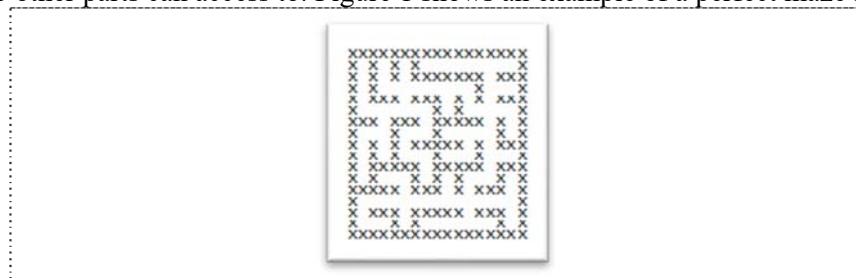
Email: yonathan.hendrawan@trunojoyo.ac.id

**Abstract.** A maze is a type of puzzle games where a player moves in complex and branched passages to find a particular target or location. One method to create a maze is the Growing Tree method. The method creates a tree that has branches which are the paths of a maze. This research explored three types of Growing Tree method implementations for maze generation on Android mobile devices. The layouts produced could be played in first and third-person perspectives. The experiment results showed that it took 17.3 seconds on average to generate 20 cells x 20 cells dynamic maze layouts.

## 1. Introduction

A maze is a kind of games where a player moves in pathways with many branches to find a way out/certain targets [1]. Maze and labyrinth are two different things. The labyrinth is not as complicated maze: labyrinth's path that a player can tread has no branching at all. But usually, people consider maze and labyrinth are the same [2].

Of the diverse types of mazes, the one commonly encountered by people is the perfect maze type. Perfect here means that the maze does not have not only loops/circular paths, but also insulated parts which no other parts can access to. Figure 1 shows an example of a perfect maze layout.



**Figure 1.** Maze in text mode 8 x 8 cell.

Maze-making process is the process of designing the position of paths and walls in the maze. There are many methods/algorithms to generate a maze, but essentially these methods can be categorized into two groups: step-by-step creating a path in the maze that is wholly covered by walls or building walls on the empty field/space. In both methods, random values are used in determining the next path or wall which is going to be built. Because of the randomness and the steps taken in the methods, computers are an appropriate tool for building mazes, since computers not only have the abilities in creating and using random values easily but also can execute certain steps of algorithm repeatedly without being exhausted.

There are many methods to create a perfect maze layout. Depth First Search, Prim, Eller, Kruskal, and Aldous-Broder are some of them. Each has advantages and disadvantages [3]. Many maze games have been created and explored: building dynamic maze in applet environment [4], making a social maze game to encourage training for multiple sclerosis patients [5], creating a maze based mobile application for learning foreign language [6], using 3D OpenGL ES gravity maze game to develop and apply built-in sensors in Android mobile phones [7], constructing maze games using an Android game framework as part of teaching programming for college students [8], and many other research that have a similar topic.

Mobile devices have been growing rapidly during the last decade. Computational power of mobile devices has increased considerably. This capability is needed by the operating system and various applications (e.g. 3D real-time games) to provide a rich and attractive user experience [9]. Android, as one of many operating systems used in mobile devices, has diverse game applications built on it. Several of them explore the serious side of game such as first aid education for Autism Spectrum Disorder people [10], and teaching forestry lessons in a quiz game [11].

In gaming, maze-making process is part of Procedural Content Generation field, since it creates the level/world to be played on the fly and in random manner by following a procedure/algorithm with no human intervention [12]. One of the advantages of this technique, compared to the manual making technique, is that the game makers do not need to create detailed assets for each part of the game. Game manufacturers just need to write a procedure for making the level once, and then the procedure is the one that will be making different kind of levels in relatively unlimited quantities. Each level generated can also be made such that the difficulty is different: either increasing or decreasing.

In this study, an app/maze game that can generate maze layouts dynamically on Android mobile devices was built. What is meant by the dynamic here is that the maze will be re-created each time the player enters the game levels. The process of making paths and walls of the maze occurs randomly, so the chance of a player getting the exact same maze in succession is small. The method used is the Growing Tree method. This application is also used to measure the level of performance the mobile device has in solving problems.

## 2. Method

This study uses the Growing Tree method, a list data structure, and Android as the operating system. The game system itself is a puzzle based game.

### 2.1 Growing Tree Method

Growing Tree method is a method that creates paths which resemble tree branches using a list as the main data structure [5]. Growing Tree algorithm is shown in figure 2.

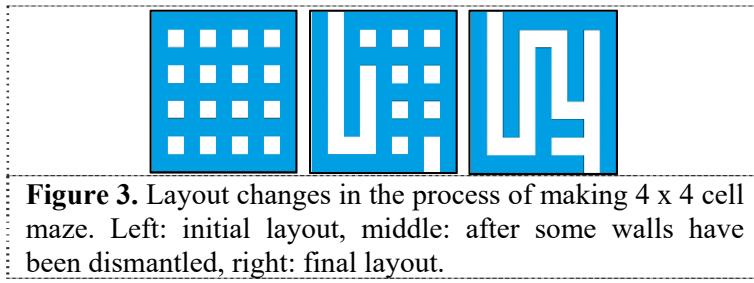
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Initialization: pick one cell as the current cell. Put it into a list.
While list is not empty:
  If there is (an) unvisited neighbour cell(s) to the current cell:
    - Randomly crave a path to the cell's unvisited neighbour cells:
    - Put the neighbour cell into the list.
    - Make the neighbour cell to be the current cell.
  Else (all neighbour cells are already visited):
    - Remove current cell from the list.
    - Pick a cell from the list and make it current.

```

**Figure 2.** Growing Tree Algorithm.

If the list has not been empty, the procedure will still be working by dismantling walls, swapping current cell, adding and removing cells to/from the list. Figure 4 shows the process of making a Growing Tree maze.

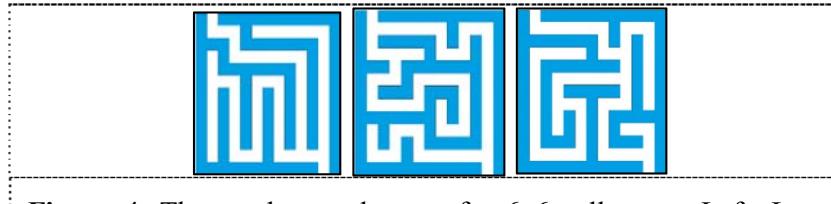


## 2.2 Three sub-types

There are three ways in picking a cell from the list:

1. Last added cell. The procedure picks the cells in the list using the Last In, First Out (LIFO) technique. The algorithm operates in the same way as recursive backtracker / Depth Search First algorithm. Layouts shown in figure 4 are created using this method.
2. First added cell. The procedure selects the cells in the list using the First In, First Out (FIFO) method.
3. Random. The procedure selects the cells in the list in a random manner.

Figure 4 shows layouts made by using three methods above.



**Figure 4.** Three sub type layouts for  $6 \times 6$  cell maze. Left: Last added cell, middle: First added cell, right: Random.

## 2.3 Gameplay

The shape used in the game is a square, where the number of cells on the vertical side of the maze is equal to the number of cells on the horizontal side.

There are 19 difficulty levels in the game. For each level increase, the number of cells on the vertical and horizontal sides each is increased by one. Starting with  $2 \times 2$  cells for the first level, the difficulty increases to  $3 \times 3$  for the second level, then increases up to the last level with  $20 \times 20$  cells.

After creating the maze, the application displays an avatar on the top left side of the maze (first row, first column). The task of the player is to navigate the avatar towards the exit located on the lower right side of the maze. As a characteristic of puzzle games, the player must solve puzzles presented: finding the right path among the many possible paths.

If the player successfully completes a level, the application displays a winning sign. After that, the player returns to the main screen to select other difficulty levels.

## 2.4 Mobile Device

This application is built on Android operating system. To display the maze images, the application uses OpenGL. There are two views:

1. Top view, where the player can see all parts of the maze. The player navigates the avatar in third person perspective.
2. Inside the maze, where the player is in the maze's path. The player navigates the avatar in first person perspective.

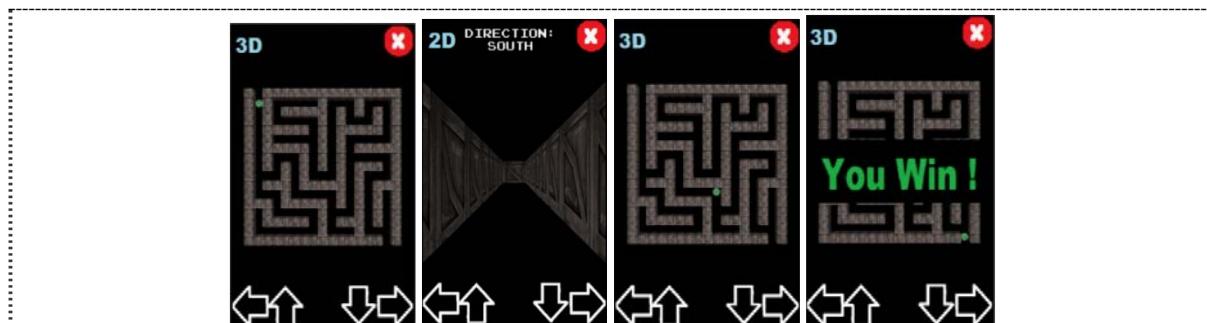
The game uses a touchscreen interface as its main controller. The player issues commands to the application by using the buttons. There are various buttons each with different function. For examples: to get into a certain level, player must press up or down arrows that set the level number. In the game,

navigation buttons use a familiar format of left, right, up, and down arrows located around the edge of the screen.

### 3. Results

When the application is started, it displays the main menu screen. From this screen, the player can select one of the available maze levels. There is also an option button to select which of the sub type method will be used to generate the layout.

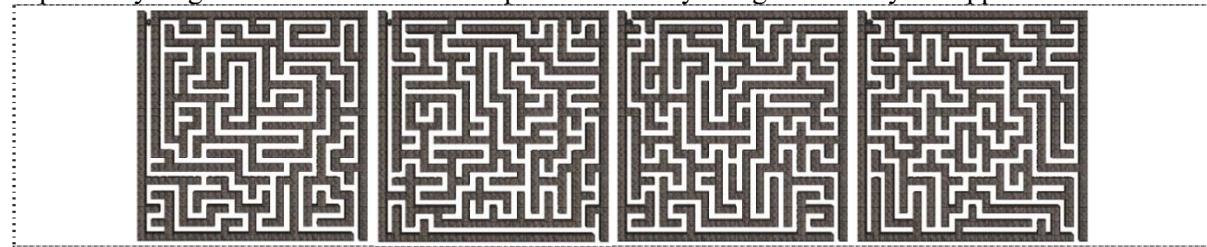
By default, the level starts from 4x4 cell maze. Figure eight shows the level number located in the middle of the up and down arrow buttons. Pressing the up-arrow button increases the level, and vice versa for the down arrow button. The “Last” word is an option button that shows what sub type of the Growing Tree is used by the application in creating the maze layout. Last represents LIFO method. Pressing this button changes the label to “First”, which denotes FIFO method. Pressing it again alters the label to “Random” method. Pressing the “Play” button takes the player to the game screen. On this screen, first the application presents the maze-making process as shown in Figure 4. Each process that changes the shape of the maze is shown one by one on the screen. After that, the avatar, in the form of a space ship, is displayed along the entry (top left) and exit (bottom right) of the maze. The player moves the avatar using the navigation buttons on the right and left sides of the screen. Figure 5 shows the game screen.



**Figure 5.** Game screen for 10x10 cell maze. Left to right: the game finished creating the layout and the avatar was placed on top-left cell; first person perspective; the avatar moved around; the avatar reached the exit on bottom-right cell.

The player can choose whichever perspective he or she wants to play the game. The controller adjusts the buttons’ function automatically. To switch between perspectives, the player just need to press the 3D/2D button located on the top-left of the screen. In the first-person perspective, the application displays the direction in which the avatar is currently facing on the top-centre of the screen. This information helps in reducing the player’s confusion in moving the avatar inside the maze.

Each time the player selects a level, the application creates a new maze pattern. Because of the random nature of the algorithm, it is less likely that the user encounters the same maze layout sequentially. Figure 6 shows several examples of maze layouts generated by the application.



**Figure 6.** Several 16x16 cell maze layouts. None of them are the same.

**Table 1.** Average time needed to create a maze.

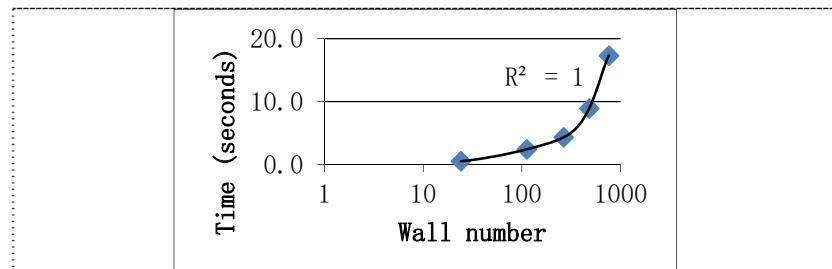
Level	Cell number	Wall number	Rounded average (seconds)
4 x 4	16	24	0.5
8 x 8	64	112	2.4
12 x 12	144	264	4.3
16 x 16	256	480	8.9
20 x 20	400	760	17.3

For speed testing, this study used Xiaomi Note 2 which has specifications as follows: Mediatek MT6795 Helio X10 as chipset, Octa-core 2.0 GHz Cortex-A53 as CPU, PowerVR G6200 as GPU, Memory 16 GB, 2 GB RAM, 1080 x 1920 pixels screen display.

Speed testing was done by recording the time it takes to make the maze. Recording is done five times for each level. Table 1 shows the average values of the recording results.

In general, the application produces maze layouts quickly. Players do not have to wait for a long time after he or she presses the play button to the point of being able to start moving the avatar.

Figure 9 displays the data in Table 1 in graphical form. The x-axis represents the number of walls (column 3 of table 1) in logarithmic scale format. It also shows a trend line that corresponds to the existing data:  $y = -2E^{-10}x^4 + 3E^{-7}x^3 - 0.0001x^2 + 0.0358x - 0.2834$  with R-squared value equals 1. This means that the running time of the application is in polynomial order to the number of the walls.

**Figure 7.** Line chart of table 1 in logarithmic scale.

#### 4. Conclusion and Future Work

The application that was built on Android platform can produce various proper maze layouts dynamically. The maze making process runs reasonably fast as can be seen that to generate 20 cells x 20 cells maze layout, it took 17.3 seconds on average.

From the gaming side, this application can be improved by adding extra challenges such as: putting a time limit for each level and placing bonus items randomly in the maze.

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## Comparasion of Password Generator between Coupled Linear Congruential Generator (CLCG) and Linear Congruential Generator (LCG)

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# Comparasion of Password Generator between Coupled Linear Congruential Generator (CLCG) and Linear Congruential Generator (LCG)

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**Abstract.** Password is needed to access the computing services. Text password is a combination between characters, numbers and symbols . One of issues is users will often choose guessable passwords, e.g. date of birth, name of pet, or anniversary date. To address this issue, we proposed password generator using Coupled Congruential method (CLCG). CLCG is a method to solve the weakness of Linear Congruential generator (LCG). In this research, we want to prove that CLCG is really good to generate random password compared to LCG method. The result of this research proves that the highest password strength is obtained by CLCG with score 77.4%. Besides of those things, we had proved that term of LCG is also applicable to CLCG.

## 1. Introduction

Text password is used to authenticate users to online services. Text password is a combination between characters, numbers and symbols. It has a weakness but text password is more widely used. Many attempts were made to replace simple password authentication, e.g. using biometrics, Tokens and multi-factor authentication. However, single factor password which is based on authentication remains very common [1]. Single-factor authentication is the simplest form of authentication methods[2]. A person uses Single-Factor authentication to verify himself online. The most popular example of single-factor authentication is a password. Most verification today uses this type of authentication method. In recent years the number of widely used password protection services has grown significantly, so the number of password users is expected to increase. There are various issues related to the use of text password. One of issues is users will often choose guessable passwords, e.g. date of birth, name of pet, or anniversary date [3]. Many people use passwords, for which most of them use a simple word such as “password” or numbers such as “1234.” Despite people already perceive that a simple password is not secure enough, they still use simple password because it is easy to use and to remember[4]. A malicious user who knows the user personally or able to find out certain things about user, such as the birthdate, favorite actor/actress or pet’s name, their password will be easily cracked. According to many service providers, awareness campaigns (US DHS), and government entities (US-CERT) stress two foundations for password security[5]:



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A1: Passwords should be random and strong; and

A2: Passwords should not be re-used across accounts.

To address this issues, password generator have been proposed, which generate strong password that is difficult to guess random-looking passwords and regenerate them whenever necessary. In this paper we provide the first detailed specification of password generator using coupled linear congruential generator, and also give a detailed analysis of its properties.

## 2. Related Work

The concept of Password Generator is not new and not too old . In 2016, Abderrahim et all [6] proposed scheme for strengthening authentication in the cloud environment using the password generator to surmount the security flaws of login/password scheme. Ani Ashish [7] presented A ‘Password Generator’ mobile app that can generate many passwords and store complex password for the above mentioned e-mailing sites, social networking sites and for debit cards.

## 3. Proposed Work

Password generator is created in order to generate a strong and secure password. One example of using this password generator is on any application that does not provide the user registration feature. The right to register a user is on the admin, so it needs a password generator. In this study, the coupled linear congruential generator method is used to generate strong passwords.

### 3.1. Coupled Linear Congruential Generator

The linear congruential generator (LCG) is a method to generates random sequences that are linear, fast, simple and easy to implement, thus they have wide range of uses in simulation applications. But recently there have been great demand for random generators by security applications like automatic password generation, on-line gambling, digital signatures, encryption algorithms etc [8]. All linear congruential generators use this formula:

$$X_{i+1} = aX_i + b \pmod{m} \quad (1)$$

Where:

- $X_0$  is a seed.
- $X_1, X_2, X_3, \dots$ , are the random numbers.
- $a, b$  and  $m$  are constant.

If one chooses the values of  $a$ ,  $b$  and  $m$  with care, then the generator produces a uniform distribution of integers from 0 to  $m-1$ . LCG numbers have poor quality.  $X_n$  and  $X_{n+1}$  are not independent, as true random numbers would be. Anyone who knows  $X_n$  can predict  $X_{n+1}$ , therefore LCG is not cryptographically secure. The weaknesses of a single LCG are removed by the coupling. This is primarily because solving inequalities modulo  $m$  can only be done by searching through the entire solution space[9]. Coupled LCG is defined as follows.

$$X_{i+1} = a_1 X_i + b_1 \pmod{m} \quad (2)$$

$$Y_{i+1} = a_2 Y_i + b_2 \pmod{m} \quad (3)$$

$$B_{i+1} = \begin{cases} 1 & X_i + 1 > Y_i + 1 \\ 0 & otherwise \end{cases} \quad (4)$$

We assume that  $a_1, b_1, a_2, b_2$  and  $m$  are known and the seed  $(x_0, y_0)$  is secret. Coupled LCGs turn out to be more secure than a single LCG [9,10]. According the result of equations, then we get a random number series that will be converted into matrix order. Order of matrix is obtained from the calculation modulus to number of lines, so that we obtain the equation (3):

$$M(x,0) = X_{n+1} \pmod{i} \quad (5)$$

Order of matrix obtained from the calculation modulus to number of column, so that we obtain the equation (4):

$$M(0,y)=Y_{n+1} \bmod j \quad (6)$$

The mathematical model to get a result from random number using a new matrix can be calculated by using equation (5) :

$$M_n=M[X_{n+1} \bmod i][Y_{n+1} \bmod j] \quad (7)$$

Where:

- i is row of matrix
- j is column of matrix

### 3.2. Algorithm

Password generator with Linear Congruential Generator works in the following ways. The determination maximum characters of the password (m) is generated in the first stage. After determination (m), a multiplier factor variable (a) is performed. The third stage is determination variable (b). The final stage is randomization Lower case, uppercase, number and symbol using equation (1).

Password generator using CLGC is different with LCG method . The first stage of CLGC is determination rows and columns of matrix A where the number of elements corresponds to length of a password that is generated. Then, calculating variables a, b, and m using similar ways as LCG must be repeated two times. The third stage is calculating random numbers x and y according to equation (2). Formation of  $M_n$  matrix and  $M_n$  matrix order adjustment with matrix A according equation (3-5) is the end of the process randomization letters, numbers and symbols into a passwords.he mathematical model to get a result from random number using a new matrix can be calculated by using equation (5) :

## 4. Results and Discussion

Password generator is generated using LCG and CLCG. Password is generated by using combination of characters, numbers and symbols.The results of this study are shown in the Table 1. Password Strength is measured by using a password meter[11] .The combination of passwords is obtained from calculations using  $a = 5$ ,  $b = 5$  and  $m = 8$ , where value of m is equal to the number of characters or length of password for LCG method. The values in the CLCG method we set  $a_1 = 5$ ,  $b_1 = 5$ ,  $a_2 = 5$ ,  $b_2 = 3$  and  $m = 8$ , the determination of this constant value are based on previous research conducted by Raj S Katti [6]. Table 1 shows the result of generate password using constant value in Raj S Katti research with average password strength for LCG method is 60.5% and using CLCG method is 77.4%.

**Table 1.** Comparison password strength of LCG and CLCG.

	LGC (a=5, b=5)	Password Strength (%)	CLCG (a <sub>1</sub> =5, b <sub>1</sub> =5 a <sub>2</sub> =5, b <sub>2</sub> =3)	Password Strength (%)
<b>1</b>	PpJKoveQ	34	bj!\$jd^e	57
<b>2</b>	ZMXe3v4A	68	ZpPkj2O#	72
<b>3</b>	qwAIJp@B	60	lzs%vTZ#	68
<b>4</b>	D41HI3pt	74	6#kWdOR6	77
<b>5</b>	AD6Su8KF	68	&cUH2\$@)	100
<b>6</b>	MHrI%LX1	70	#mTp9ZUj	72
<b>7</b>	RLxBVlee	30	esb6Tw%i	72
<b>8</b>	Hkh28hJz	67	oxN!nme7	68

<b>9</b>	e9kDuhaC	60	@&z%H\$o6	100
<b>10</b>	Bkl561Nv	74	p%#NAL8	88
	<b>Average</b>	<b>60.5</b>		<b>77.4</b>

In our experiment, we change value  $a$  and  $b$  to compare and determine its effect to complexity of password. In first test, we set  $a=5$  and  $b=5$  for LCG method and the result is show in table 1. Second test, we set value of  $a=a-1$  and  $b=b-1$ , so that with this reduction, the value of  $a=4$  and  $b=4$  for LCG method, and we set  $a_1=4$ ,  $b_1=4$   $a_2=4$ ,  $b_2=2$  for CLCG. The result of the second experiment is shown in the table 2.

**Table 2.** The comparison password strength between LCG and CLCG.

	LGC (a=4, b=4)	Password Strength (%)	CLCG (a <sub>1</sub> =4, b <sub>1</sub> =4 a <sub>2</sub> =4, b <sub>2</sub> =2)	Password Strength (%)
<b>1</b>	6xTJvXpn	58	SZ4Ezv6u	68
<b>2</b>	3jjbQJbb	49	\$jZPNJJv	54
<b>3</b>	QEZdmTfW	34	%lwIOz9f	70
<b>4</b>	^1jkq7pc	54	FT4f9DYr	68
<b>5</b>	xK(opp*g	70	@DPqt1pB	70
<b>6</b>	fBpEHNyq	34	)UJUYNwF	55
<b>7</b>	v9RHT&oO	72	IKn1Nq7S	70
<b>8</b>	s^Ibcdrq	55	*CbJNer^	68
<b>9</b>	jQDK7GSD	55	%ubTE2O1	70
<b>10</b>	VK9HK@7U	61	kv^C(\$m5	92
	<b>Average</b>	<b>54.2</b>		<b>68.5</b>

The second test shows that the reduction of  $a$  and  $b$  affects the average score of strength password. In the LCG method, it is decreased into 6.3%, and 8.9% for the CLCG method.

In the third test, we set value of  $a=a+1$  and  $b=b+1$ , so that with this addition, the value of  $a$  equals 6 and  $b$  equals 6 for LCG method, and we set  $a_1=6$ ,  $b_1=6$   $a_2=6$ ,  $b_2=4$  for CLCG. The result of the third experiment is shown in the table 3.

**Table 3.** The comparison password strength between LCG and CLCG.

	LGC (a=6, b=6)	Password Strength (%)	CLCG (a <sub>1</sub> =6, b <sub>1</sub> =6 a <sub>2</sub> =6, b <sub>2</sub> =4)	Password Strength (%)
<b>1</b>	WMnfdpNo	32	ag%^rmnw	44
<b>2</b>	MSGgfqhH	30	uCEdZFb#	60
<b>3</b>	ZzNpmD^r	64	iU8F2OpT	72
<b>4</b>	CwjghG6P	58	)wQ*Rge5	80
<b>5</b>	y4FFhofd	54	ZPN&ba&T	69
<b>6</b>	THDmQl5P	60	k6wtWqvk	57
<b>7</b>	9AHsCLtN	58	Gr(kS!Jd	76
<b>8</b>	3%rKCASr	67	*EI9t8!A	90
<b>9</b>	UavZO1Ab	60	AP!6fBH6	77
<b>10</b>	tpsi#NZe	58	iSEya8(g	72
	<b>Average</b>	<b>54.1</b>		<b>69.7</b>

The third test shows that the addition of  $a$  and  $b$  affect the average score of strength password. In the LCG method. it decreased into 6.4%, and 7.7% for the CLCG method.

## 5. Conclusion

Based on the tests that we had been done, it indicates that changes values of a and b on LCG or on CLCG influences the results of randomization generated. The determination values of a and b determines the passwords strength that is generated. Besides those things, password strength that is generated by using Coupled linear congruential generator (CLCG) method is also determined by the terms applicable to the LCG method. One of the term is a value of b which should have relatively prime to m. In the first test we set b=5, it means that b is relatively prime to m=8. The average score of password strength in the first test is highest than other, it proves that b should have relatively prime to m to get highest password strength. On the other terms, a-1 is a multiple of 4 if m is a multiple of 4, which is also proven to be applicable to CLCG. Meanwhile, the highest score is obtained at a = 5 or a-1 = 4 because m = 8.

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# Smart Garbage Based on Internet of Things (IoT)

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**Abstract.** Trash is one of serious problems in Indonesia. It leads to another problems which deal with social, culture and economic, most of cities in Indonesia have some problems in managing the trash. It is because the government doesn't have the standard of trash management. The schedule to take the trash usually discover a problems with a lateness. The lack of trashmanagement and people's habit who don't care about the trash impact effect to more serious problems that dealwith the trash. Such as, enviromental problems. Based on the problems the researcher makes a system called "Smart Garbage Based On *Internet of things*". The system applies the technology of temporary garbage used internal system. This system creates in order to fix the problem of punctuality. Which makes the trash management more effective and efficient. The process of uploading the information in the internal awerness of based on the "real time" activity this system can increase the purity and health. Because the trash is controlled and not accumulated around people. The ultrasonic sensor and nodeMCU are used as a module of IoT to discover the temporary garbage. Grapical user Interface desktop and android are also used in order to observe the level of trash in temporary garbage. The notification system can be access in mobile and desktop interface. Furthermore the temporary garbage location can find by using google map the result of research shows that the system is running well. The system can online 12 hours/day along 2 weeks in experiment. The data sent by online based on "real time" activity and the result of mapping and tracking on android show the location of garbage.

## 1. Introduction

Indonesia is the one of the country which has problem surroundings, especially of trash. Eventually, trash become the serious problem to all of the society, it's caused, the amount of the trash which resulted pile up from day to day. It's caused by the high of human productivity, increasing the amount of society, and the availability of the human living space which limited. The trash problem is often ignored by the. The trash is often thrown away or trash and or burned without think about how the effect to the environment. [1] Until now, trash still the problem surrounding which not yet solved to the big cities in Indonesia like as Jakarta, Surabaya, Bandung etc. This problem appear because the increasing of trash productivities, the limited land to final elimination, as well as delays of the schedules of removal garbage until the garbage pile up and cause many problem in the environment. [2] According to survey department oh hygiene Surabaya stated that the problem encountered in transporting waste as follows [3]:

1. The using of work time which is not efficient
2. The using load capacity of the vehicle which is not right
3. The route of carriage of which is not efficient

The problem which will discuss in this research is the delays in garbage transportation which full in the shelter trash temporary (garbage) and act of determining the route trash transportation which



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efficiently. The system of trash transportation which there now is trash employee just trade on the week schedule whereas if trade on this schedule there are probability the trash in the a matter of days had been full but still is not yet picked up to TPA (final shelter trash) as well as the route which pass by trash employee just trade on the stripe which appropriate with only the trash location. It's cause the trash will pile up in the city and caused many problem environment as follows, [1]

1. The decrease healthy of the society
2. Occur many disease which caused by trash.
3. The trash which had been the maximum place will spilled out from the container of trash and very disturb hygiene and beauty surroundings

From this problem, made the system smart garbage which the basis internet of things. It is the system organizer trash which give priority to precision time in take the trash which had been full on the shelter trash temporary. Without must to wait the trash pile up or exceed limit. The reading condition of when the trash is full using the ultrasonic sensor and arduino as the data organizer. The system of notification when the trash must take which had been full using online monitoring with exploit the internet connection. When the trash in the garbage was full so the trash employee that directly take this trash. In addition there are notification the full of the trash with automatic, the system also can directly determine the near stripe at trash can which was full with google map.

## 2. Methods

### 2.1. Trash

The trash is outcast which the result of the process of production either industrial or domestic. While in UU no 18 year 2008 about the organizer trash, mentioned that trash is the residue of the human daily activity or the nature process which solid or semi-solid like organic or anorganic essence is able to decompose or may not decompose which that are considered not useful anymore and thrown away into the environment [4]. The trash comes from some place that is waste from the residential area, the kind of waste produced usually tend to be organic such as food waste or garbage that is wet, dry, grey, plastic etc. The type of trash that is produced generally in the form of leftover food, rotten vegetables, dry waste, grey, paper plastic and cans as well as other junk. Inorganic trash can be divided into: metal trash and dairy products trash plastic, trash paper, trash glass and ceramics [2].

### 2.2. Internet of things

The internet of things (IoT) was first introduced by Aston in 2009. IoT can be described as 1 set of things connected through the internet . Things here can be in the form of tags, sensors, human etc. Internet of things or also known by the acronym IoT, is a concept that aims to extend the benefits of internet connectivity which is connected continuously [5]. As for capabilities such as data sharing, remote control, monitoring and so on, including also on objects in the real world. For example food, electronic, collection, equipment anything, including living things everything is connected to local and global networks trough sensors embedded and always active [6]. The ability of the IoT to communicate with each other this makes the IoT can be applied in all fields [7]. In field of health, sensors, the IoT can be used to monitor the condition of the patient, so that the condition of the patient remains monitored for 24 hours [8]. In agriculture, the IoT can be used as sensors to monitor soil conditions, temperature and moisture are important for plants. In the field of smart building IoT can be used to monitor the electricity usage of each building [9]. In addition, IoT can also be used in the fields of automation, transportation, smart grid and other [10]. The concept of the IoT is quite simple with the way of working refers to the 3 main elements on the architecture of IoT, namely: Physical goods that are equipped module IoT. Devices connection to the internet such as a modem and router wireless speedy as at home, and the cloud data center is an ideal place for storing application and data base [11].

### 3. Results and Discussion

#### 3.1. Sensory test

Testing of ultrasonic sensor on the type of trash is find out how precision sensors when the surface and properties of the detected objects are different. The experiments were starting from the type of plastic waste, Paper, Foliage, Iron and mixed waste. Here is the documentation of sensor testing shown in Figure 2.



**Figure 1.** Sensory test

The experiment by measuring one by one type of trash and comparing the measurement result of the sensor before it was filled with the result of sensor after being filled with different types of trash. Here is the result of sensor readings shown in table 2.

**Table 1.** Ultrasonic Sensor Testing Results.

No	Type of Trash	Set Level (cm)	Sensor readings (cm)	Difference (cm)
1	Plastic	20	20 ± 2 (18 - 22)	4
2	Papers	20	20 ± 1 (19 - 21)	2
3	foliage	20	20 - 21	1
4	Iron	20	20 + 21	1
5	Mixing	20	20 ± 2 (18 - 22)	4

From the results of table 2 above can be concluded that the readings of sensor that show the most precise value is when measuring the type of waste foliage and iron. This is because the surface of the waste is more flat, while the sensor readings on the type of plastic waste, paper and mixture shows the difference in larger numbers. This is due to the irregular trash surface.

#### 3.2. Delay Communication Testing

Delay is a time lapse comparison that occurs when there is data sent from one system to another. Delay testing in this study aims to find out how long the time lapse that occurs when the sensor sends data from the field to the show in the GUI. Delay System test results are shown in table 3.

**Table 2.** Testing Delay Communication

No	Data	Delay (s)
1	Sensor – Ubidots	2
2	Ubidots – GUI	4
3	Sensor - GUI	1-3

From table 3 can be concluded that the system delay has a value between 1 - 3 second. It is also influenced by the speed of the internet.

#### 3.3. GPS Tracking Testing

In addition to displaying the location where the full TPSS GUI android can also do tracking the full garbage of google map. Here is a GUI view when tracking the path taken at the location of TPSS Telkom Kamal.

**Figure 2.** Testing GPS Tracking

### 3.4. Implementation Testing

Tests on 3 prototypes in 3 locations, Kampus, Perumnas Kamal and Telkom Kamal. Goals of Testing is the system can work or not. Here is the result of system testing.

*3.4.1 The first test was at the Trunojoyo Madura University Electrical Laboraturium for 5 days.*

**Figure 3.** Testing on Campus

And here are the tables 4 that show the test results on campus.

**Table 3.** Campus Testing Results

Day Of	Sensor (cm)	Level (cm)	Condition
1	70	0	Empty
2	63	10	Filled
3	13	60	Full
4	70	0	Empty
5	10	64	Full

From the results of the test obtained that during the test on Campus Trash has been full as much as 2 times.

*3.4.2 The second test was in Perumnas Kamal for 5 days.*

**Figure 4.** Test at Perumnas

And here is table 5 that shows the test results during the perumnas.

**Table 4.** Perumnas Testing Results

Day Of	Sensor (cm)	Level (cm)	Condition
1	70	0	Empty
2	65	6	Filled
3	65	6	Filled
4	53	25	Filled
5	15	64	Full

From the results of the test obtained that during the 5-day test in Prumanas Kamal Trash has been full as much as 1 times.

#### 3.4.3 The last test was conducted in Telkom Kamal for 5 days.



**Figure 5.** Testing in Telkom

And here is table 6 which shows test result during Telkom.

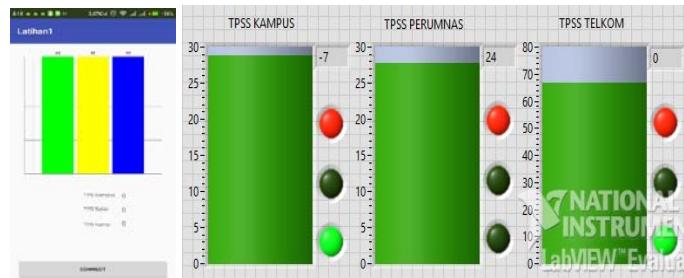
**Table 5.** Results Telkom Testing

Day Of	Sensor (cm)	Level (cm)	Condition
1	70	0	Empty
2	75	0	Filled
3	65	6	Filled
4	60	12	Filled
5	35	32	Filled

From the test results obtained that during the 5-day test at Telkom Kamal Trash Can not show full condition.

#### 3.4.4 Testing when 3 full together

In this test phase the authors conducted experiments by giving the full condition at 3 TPSS available. That is TPSS Campus, Telkom, and Perum. This experiment to see what the system will do when the 3rd TPSS is full together. In the testing process 3 TPSS reports the full state to the android and desktop interfaces.



**Figure 6.** Android and desktop Interface

Test results in the interface andriod show there are 3 notifiers at once and each notif will connect to google map to show the location where garbage is full. In this case the system does not show which garbage location full first but the system only gives notif depending on the condition of garbage. Whereas in the desktop interface the full TPSS location appearance is only selected whichever TPSS is first, if there is more than one location indicated there will be only one garbage.

#### 4. Conclusion

Based on the results of design, implementation, and exsperiment of the system that has been made conclusion as follows:

1. The results of this research can create a temporary garbage system (TPSS) in a timely.
2. Delivery of data in real time can be used the method of Internet of things, the method of sending data via the Internet that will be stored in the cloud server and can be accessed again at any time.
3. The results of ultrasonic sensor readings the type of trash show different results, the average error obtained is worth 1-2 cm. It is influenced by the surface of waste that is not always flat.
4. The results of the testing delay delivery of the data shows that in every change of data between a sensor contained in the field to appear in the GUI desktop and andarioid has a value of 1-2 seconds.
5. Resistance of the system shows satisfactory results because the system can survive during the testing period i.e. for 2 weeks. Resistance of the system shows satisfactory results because the system can survive 12 hours per during the 2 weeks of testing.

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## Analysis On Land Cover In Municipality Of Malang With Landsat 8 Image Through Unsupervised Classification

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# Analysis On Land Cover In Municipality Of Malang With Landsat 8 Image Through Unsupervised Classification

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**Abstract.** Remote sensing technology has been widely used in the geographic information system in order to obtain data more quickly, accurately and affordably. One of the advantages of using remote sensing imagery (satellite imagery) is to analyze land cover and land use. Satellite image data used in this study were images from the Landsat 8 satellite combined with the data from the Municipality of Malang government. The satellite image was taken in July 2016. Furthermore, the method used in this study was unsupervised classification. Based on the analysis towards the satellite images and field observations, 29% of the land in the Municipality of Malang was plantation, 22% of the area was rice field, 12% was residential area, 10% was land with shrubs, and the remaining 2% was water (lake/reservoir). The shortcoming of the methods was 25% of the land in the area was unidentified because it was covered by cloud. It is expected that future researchers involve cloud removal processing to minimize unidentified area.

## 1. Introduction

Land cover refers to description of vegetation and man-made construction that covers the surface of the land. The construction is visible directly from the remote sensing image. The objective of land cover observation is to predict human activities and land use. Some issues on land cover observation are preparation of vertical use, and minimum size of mapping areas. Furthermore, land use and land cover mapping becomes the bases for establishing new policies and designing output maps that generate some generalized information according to the scale and purpose of the application.

Townshend and Justice state that land cover is a physical (visual) embodiment of vegetation, natural objects, and cultural elements present on the earth's surface regardless of human activities on those objects [1]. In addition, Barret and Curtis explain that the earth's surface is partly composed of natural features (land cover) such as vegetation and snow as well as results of human activities (land use) [2].

Land cover data are obtained from aerial photographs and changes towards the photographs are known from multitemporal airborne images. Aerial photo interpretation technique is one of the aspects of the remote sensing systems. Remote sensing is the science and art of obtaining information about objects, regions or symptoms by analyzing data obtained by particular set of equipment without direct contact with the objects, areas, or symptoms being observed [3].

Aerial photography has been widely used as a source of information in many applications. In order to use aerial photographs, an individual should have ability to observe the entire sign associated



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with the object or phenomenon being observed [4]. These signs are called recognition keys or commonly referred to as interpretive elements. These elements include: hue/ color, texture, shape, size, pattern, site, association, and convergence of evidence. To be able to make clear and user-friendly land cover interpretation, a working guide for land cover classification using satellite data is required. Satellite sensor system technology and digital signal processing algorithms facilitate faster, detailed and accurate retrieval of information related to the Earth surface.

Remote sensing application provides information about vegetation, reflection of the greenish level as drought predictor. In addition to vegetation, remote sensing can also convey other information such as growth of population and development that result in environmental degradation, environmental damage, decrease of natural resources and change in land use. These information can be obtained through unsupervised classification techniques as preliminary information for designing geographic information system of a region.

## **2. Methodology**

The setting of the study was the Municipality of Malang. The data were the Administrative Boundary Map of the Municipality of Malang (Peta Tata Batas Administrasi Pemerintahan Kabupaten Malang) and Landsat 8 image taken on July 4, 2016 from the official website of NASA, <http://glovis.usgs.gov/>. These data were then used for land cover analysis. The research procedures were as follow:

### *2.1. Data Input*

It referred to input of the satellite images and administrative boundary shapefile. The data were used for the reference towards which areas to observe, geometric correction as well as panning during image processing.

### *2.2. Image Processing*

The steps in Landsat 8 image processing were as follow:

- Image restoration

The purpose of image restoration was to eliminate radiometric and geometric error. The following step was panning the satellite image so that the researcher was able to classify them accurately.

- Subset Image

Subset image referred to the process of classifying areas that became the objects of the study. The areas were called Area of Interest (AOI).

- Image Classification

Prior to classification, the researcher should make spectral classes and characteristics of the spectral classes. The basis for classification was the actual land cover condition in the field and limited to the purpose of classification. The study used unsupervised classification.

There were 6 types of land cover classification in the study, namely:

- a. Lake or reservoir,
- b. Ricefield,
- c. Dry land Farming (Plantation),
- d. Residential Area,
- e. Bushes,
- f. No data (cloud and cloud shadow).

### *2.3. Land Cover Analysis*

The result of the land cover overlay was map describing change in land cover and a table. The following procedure was to provide description or interpretation towards the data. The steps were data reduction, data display (in the form of chart and text) and drawing conclusion.

## **3. Results And Discussion**

### *3.1. Image Conversion*

The Landsat 8 satellite images downloaded were satellite images consisting of several bands resulting from satellite censor recording. The images had \*.tiff extension and could not be analyzed yet. In order to analyze the images, image conversion of which objective was combining several bands of images to a file with \*.ers extension was conducted.

The study used Landsat satellite image with RGB 654 composite in which the three composites belonged to visible spectrum range and near-infrared and had wavelength that matched band 4, band 5 and band 3 pada citra satelit landsat 7 ETM+ landsat satellite image.



**Figure 1.** Band 654 and Band 8 Combination



**Figure 2.** Layout from the Image Subset

### 3.2. Landsat 8 Satellite Image Pan-Sharpening

Landsat 8 image was enhanced by combining band 8 (panchromatic) into RGB composite image. Band 8 had significance role in image processing due to its high spatial resolution. Out of 11 bands Landsat 8 had, band 8 had the highest spatial resolution, 15 m per pixel. Band 1 to band 6 only had 30 m spatial resolution. Combining band 8 (panchromatic) into RGB image composite was one method for sharpening image known as pan-sharpening. The result of the pan-sharpening was road network in villages located in the Municipality of Malang. Vegetation was grown on both sides of the road.

### 3.3. Image Cropping

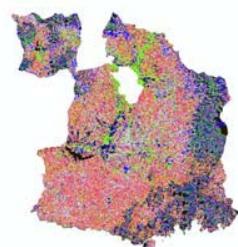
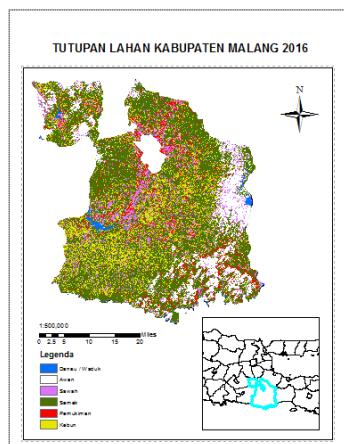
The stage referred to cropping the image based on the Area of Interest (AOI). The goal was to simplify the analysis by focusing on certain areas that became object of the study and eliminating those that did not.

The study combined the satellite images and the vector data, the administrative boundaries of the Municipality of Malang where the study was conducted.

### 3.4. Image Classification

The process began by clarifying classes or areas researcher wished to observe or clarifying number of classes. Unsupervised classification would categorize all pixels into classes by displaying the same spectral or spectral characteristics. Results of the classification were influenced by the parameters the researcher had specified in unsupervised classification dialog box. Unsupervised classification would make statistical calculation to divide dataset into classes the researcher had determined earlier.

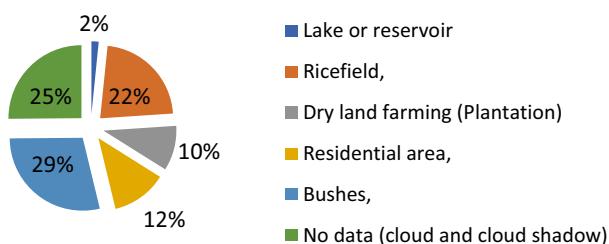
Result of the unsupervised classification was interpreted using the actual data in the field to determine the classes describing the actual area or region. Based on the information, the researchers may decide to combine or remove the classes. The following stage was to color and name each of the classes.

**Figure 3.** Result of Classification**Figure 4.** Validation Reclassification Map**Figure 5.** Image Classification Legend

Based on the classified images, it was concluded that the land management in the Municipality of Malang was pretty good. Based on the satellite image, most of the area was covered by plantation area and only certain part of the area became residential area. The following table showed the result of the Landsat 8 satellite image towards the land cover in the Municipality of Malang.

**Table 1.** Total Area as the Result of Landsat 8 Satellite Image

No	Classification	Total Area
1	Lake or reservoir	0.0162
2	Ricefield,	0.2233
3	Dry land farming (Plantation)	0.0999
4	Residential area,	0.1228
5	Bushes,	0.2865
6	No data (cloud and cloud shadow)	0.2514

**Figure 6.** Land Cover Percentage in the Municipality of Malang

#### 4. Conclusion

Distortion is inseparable part of remote sensing imagery data management. Therefore, the conclusions of the study are Satellite image requires geometric and radiometric correction in order to provide valid data or at least an image similar to the actual object. Objective of classification is to enable users to see an image in homogenous method. That way they can extract the information more quickly and easily;

Remote sensing imagery is closely related to how much data are available and how much distortion the data has. Therefore, taking primary data is vital to guarantee validity of the data (image). Cloud removal method should be conducted before classification to eliminate the no data that are covered by cloud. Most productive areas in the Municipality of Malang are used for plantation.

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## Revenue Risk Modelling and Assessment on BOT Highway Project

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# Revenue Risk Modelling and Assessment on BOT Highway Project

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**Abstract.** The infrastructure project which is considered as a public-private partnership approach under BOT (Build-Operate-Transfer) arrangement, such as a highway, is risky. Therefore, assessment on risk factors is essential as the project have a concession period and is influenced by macroeconomic factors and consensus period. In this study, pre-construction risks of a highway were examined by using a Delphi method to create a space for offline expert discussions; a fault tree analysis to map intuition of experts and to create a model from the underlying risk events; a fuzzy logic to interpret the linguistic data of risk models. The loss of revenue for risk tariff, traffic volume, force majeure, and income were then measured. The results showed that the loss of revenue caused by the risk tariff was 10.5% of the normal total revenue. The loss of revenue caused by the risk of traffic volume was 21.0% of total revenue. The loss of revenue caused by the force majeure was 12.2% of the normal income. The loss of income caused by the non-revenue events was 6.9% of the normal revenue. It was also found that the volume of traffic was the major risk of a highway project because it related to customer preferences.

## 1. Introduction

The Indonesia government has a limited reserve for infrastructure development. One of the approaches to overcome this issue is through a Public Private Partnership (PPP). Suseno [1] stated this partnership uses a concession period, a period where the private partner can collect the benefit from the infrastructure projects - through tariff. Once the concession time expired, the projects are returned to the government and the community can freely use them. Askari [2] stated the viability of an infrastructure project is important due to the mega project characteristics include high capital outlays, long-term investment, and the volatility of macro economics. Especially for PPP project, feasibility study of a project is essential to ensure the equal sharing of benefits, costs, and risks. Also, each infrastructure project is unique as it developed at particular environmental condition and time. Thus, the risks of these projects are high and are greatly affected by government intervention and macroeconomics factors.

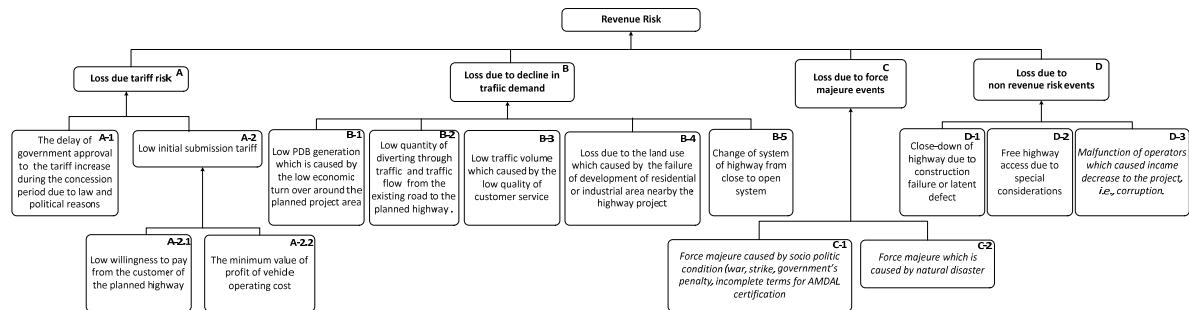
Risk can be defined as a factor, event, or an occurring effect which has to be handled carefully to finish a project which is limited by time, cost and quality. Burkhanov [3] stated a fundamental principle of PPP is that risks have to be processed by the competent parties. This research discusses



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highway infrastructure projects which focused on risk analysis for revenue containing the causes of risk variables which identified by a risk analysis for revenue model of highway projects.

Auriol [4] stated development of infrastructure projects with PPP and BOT scheme are limited by concession period, in which management of costs and risks are essential to maximize revenue. Risks as a factor in the feasibility study and risk management were investigated as pre-negotiation data. Risk analysis methods include Delphi, fault tree analysis, fuzzy logic and scenario analysis were used to obtain risk value from probability value and predicted risks. Kang [5] stated it should initial outlook consensus does not meet the minimum variance. This minimum variance should be applied in Delphi method. The conceptual model of Fault Tree Analysis which validated through Delphi is as follow:



**Figure 1.** Conceptual risk assessment model using Fault Tree Analysis

## 2. Experimental Method

### 2.1. Risk identification

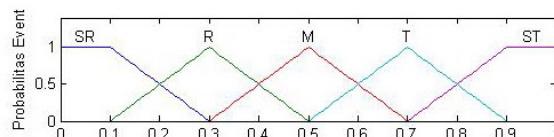
The risk of revenue was the identified and analyzed risk, which was started by mapping of variables of revenue risk. The mapping of this variable was done using fault tree analysis tool which is validated by respondent. Respondents in the present research were infrastructure experts with the qualification of a 10-years experience in highway projects and 15-20-year experience in road and bridge infrastructures projects.

### 2.2. Risks Assesment

After the variables that cause risk of revenue were identified and the proposed model was verified, calculation of probability and risk effects of those variables was done referring to expert judgment using Delphi to find consensus. Calculation of risk value for revenue was done using the fuzzy algorithm in Matlab. Li [6] stated the fuzzy logic programming, consisting of fuzzification, fuzzy rule evaluation, aggregation, defuzzification

## 3. Result and Discussion

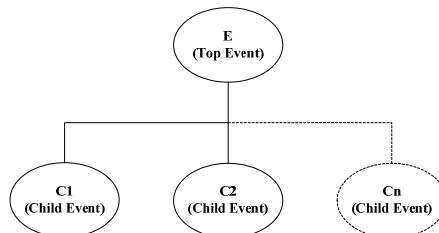
As previously discussed, the PPP projects are timed projects. Therefore, the initial tariff is crucial. If the original tariff was too low, it could not be raised instantly, but gradually in two years based on regional inflation. If the tariff was too high, it was difficult to win the project bidding and is limited by the public ability to pay and willingness to pay in the area of the projects. The probability of membership function is as shown in Figure 1.



**Figure 2.** Membership function of probability of event

Development of fuzzy reasoning, as follow

Figure 2. Shows the schematic diagram of calculation of probability fault tree analysis using fuzzy logic:



**Figure 3.** Schematic variables of Fault Tree Analysis using Fuzzy Logic

Calculation Probability of risk is as follow:

$$\begin{aligned} \text{Probability (E)} &= P(\text{route C1-E OR route C2-E}) \\ &= P(\text{route C1-E}) + P(\text{route C2-E}) - \{P(\text{route C1-E}) * P(\text{route C2-E})\} \end{aligned} \quad (1)$$

**Table 1.** The variance of risks in the development of three scenarios

Event	Risk Assessment (%)			Variance of 3 Scenarios (%)	Variance of 3 Scenarios
	Optimistic	Most Likely	Pessimistic		
A	20,1831	38,03662	50	24,70	0,25
B	40	44,29918	47,1831	1,43	0,01
C	30	46,01728	60,0864	25,14	0,25
D	20,1831	26,08512	30,0297	2,69	0,03

The variance of the three scenarios showed that the variance was adequate  $\leq 0.25$ .

**Table 2.** Risk value for revenue

Event	Probability	Risk value for revenue (D) (%)			Expected Value of risk	Risk value (%) $\{G\} = \{B\} * \{F\}$
		O	ML	P		
{A}	{B}	{C}	{D}	{E}	{F}	{G}
A	0,28582	20,1831	38,03662	50	37,0549	10,5910
B	0,47768	40	44,29918	47,1831	44,0633	21,0482
C	0,26748	30	46,01728	60,0864	45,6926	12,2219
D	0,27112	20,1831	26,08512	30,0297	25,7589	6,9837

Based on the calculation above, the risk value for revenue is as follow:

**Table 3.** Risk value for revenue of each event

<b>Code</b>	<b>Event</b> <b>Name</b>	<b>Risk assessment</b> <b>(defined as % of normal revenue per total income)</b>
<b>A</b>	Loss of revenue caused by tariff risks	10,5910
<b>B</b>	Loss of revenue caused by low traffic volume	21,0482
<b>C</b>	Loss of revenue caused by force majeure	12,2219
<b>D</b>	Loss of revenue caused by incidental events	6,9837

### 3.1 Loss of revenue caused by tariff risks

Table 3 shows that the ranking of this risk is placed third. This is because there have been legal improvements to protect the investor, especially the legal certainty about periodical tariff increase every two years (according to the inflation of the location of the construction of the toll road). Consideration of uncertainty in investment decisions becomes very important with the complexity of a project, especially infrastructure projects. The shareholders manage the costs, profits, and the risks of a project. Siemiatycki [7] and Huang [8] stated the feasibility study at the beginning of the project is essential in determining the toll tariff, that is, to generate an adequate return, Internal Rate of Return (IRR) exceeds MARR and Net Present Value (NPV) more than zero. Tariffs can not be raised because of the low volume of the traffic and can not be lowered when it increases. Indonesia embraces a price cap system where tariff increases are adjusted to the inflation rate, which states that the evaluation and adjustment of toll tariffs are conducted every two years by BPJT based on the old tariff adjusted for the effect of inflation. The investor can not freely determine initial toll rates. This is related to the Willingness to Pay (WTP) of the targeted community. Ability to Pay (ATP) can be used as a benchmark of WTP. ATP is the ability of a person to pay for the services he or she receives based on the income that is considered ideal. In other words, ATP is the ability of the community to pay for the cost of travel, while the WTP is the willingness of users to issue rewards for services obtained.

ATP is the maximum rate that can be collected by investors. If the tariff was above ATP, the government must subsidize the tariff charged to the user. The zone between the ATP and the WTP is the tariff zone but the investor must either improve the service level or must comply with the applicable quality service standards. Under the WTP zone, investors do not have to improve the level of service, because the tariff setting charged to the user is at a very cheap level and the user will use the service without taking into account the quality of service.

### 3.2 Loss of revenue caused by low traffic volume

Babatunde [9] stated this traffic volume risk is the main risk that must be considered by an investor as it related to the revenue. Revenue is obtained from tariffs collected from road users. This is related to the number of road users which is predicted from the beginning of the project. The more road users using toll road services, the higher the revenue. Lu [10] stated the decreasing or increasing the number of road users is influenced by many factors and the determination of toll road tariffs that are mainly influenced by government policies.

The risk of traffic volume is caused by the low Gross Regional Domestic Product (GDP). The growth of traffic volume is based on GDP growth. The high GDP in a region is one of the indicators of the economy of a region. The higher the GDP, the higher the economic turnover and the economic level of the community in the area, resulting in the potential number of toll users and future business development.

### 3.3 Loss of revenue caused by Force Majeure

The risks of force majeure are risks arising from specific events that are unpredictable and can not be controlled by the project manager and have a major impact on toll road projects. Force majeure can occur due to sociopolitical conditions, for example, there are wars, public demonstrations, government penalty, lack of AMDAL requirements, etc.

### 3.4 Loss of revenue caused by incident Non-revenue

This event may occur because the toll road is closed due to certain events, for example, due to construction failure or latent defect. Toll road users are exempted from the cost of using toll roads for a period due to certain considerations, resulting in loss of income. Malfunction from the toll road operator administration is resulting in a decrease in toll road project revenues, for example, loss of revenue due to the corruption of certain parties related to toll road management.

## Conclusions

The results obtained through calculations through a fuzzy logic based on the variables that exist in the model Fault Tree Analysis are as follow: Loss of revenue caused by tariff risk has a risk value of 10,5910%. Income losses due to the potential for low traffic volume has a risk value of 21,0482%. Income losses caused by force majeure have a risk value of 12,2219%. Income loss resulting from non-revenue events has a risk value of 6,9837%. Fuzzy logic or ALARP (As Low As Reasonably Practicable) predicted the upper bound value. The highest risk is the risk of traffic volume, as it involves the prediction of the planned toll road users which possibly over/under predict. Regulations related to toll roads have been improved, especially regarding the increases of toll tariff. The increase of toll road tariff is aimed to return the investment financed by investors in the construction of the toll roads through tariff paid by toll road users.

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## Prototype Design of Smart System as A Vines Medium of Javanese Long Pepper (*Piper Retrofractum Vahl*)

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# Prototype Design of Smart System as A Vines Medium of Javanese Long Pepper (*Piper Retrofractum Vahl*)

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**Abstract.** Javanese long pepper is one of the Indonesia's native medicinal plants which is included in the family Piperaceae. This plant has a characteristic thrives on plains which high rainfall between 1,200 – 3,000 mm per year and the level of soil moisture ranges from 80-100%. In the area of Bluto, Madura, these plants are generally grown on farmland by using a moringa tree as a vines medium. However, in line with technological developments, the vines media plants of Javanese long pepper begin to be replaced by technology that utilizes a concrete cylindrical as the vines media. In this research, the vines media are made from hollow concrete cylindrical with a height of 180 cm which is controlled automatically by the device of Arduino Uno as a microcontroller and its connected with ultrasonic sensors, light dependent resistor sensors, soil moisture sensors, and solar cell as an alternative energy source which called smart system. It has several main functions such as medium vines of Javanese long pepper plants, keep the moisture of plants, store the water as well as being able to do the watering automatically. This prototype design is expected to be an alternative solution to improve the quality of plant growth, especially in the dry season.

## 1. Introduction

The event of *El Nino* is often accompanied with a prolonged dry season due to the decreased amount of rain falling in certain areas. Data reveal that there have been some cases of drought hitting 16 provinces covering 102 regencies/cities and 721 districts in Indonesia [1]. The majority of the community, especially the farmers of *Piper Retrofractum Vahl* (Cabai Jamu / Cabai Jawa – Medicinal Pepper / Javanese Long Pepper), feels the direct impact of the drought in the Bluto area, Sumenep regency. Javanese Long Pepper (*Piper Retrofractum Vahl*) plants can not grow well due to the decreased rainfall. Based on the background, the role of technology is considered necessary as an effort to overcome the agricultural problem of the non-optimal growth of Javanese long pepper plants in the dry season [2]. This study was aimed to install a prototype of the propagation media of Javanese long pepper (*Piper Retrofractum Vahl*) by combining several electronic and mechanical instruments including hollow concrete cylinders as the propagation medium of Javanese long pepper, and also sensors, Arduino UNO microcontroller and solar cell as the supply of energy sources that convert solar energy into electrical energy [3].

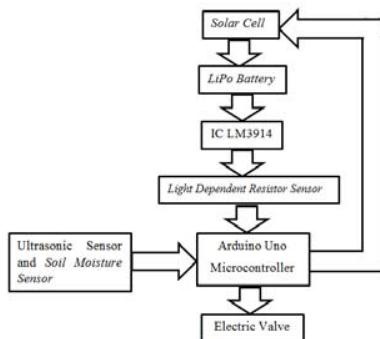
## 2. System Design

The *smart system* in this study used several electronic instruments such as LDR sensor (Light Dependent Resistor), ultrasonic sensor, soil moisture sensor, automatic valve, Arduino UNO, LiPo



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12V DC battery, solar cell, and IC LM3914. The electronic instruments would later be mounted on a hollow concrete cylinder with a high dimension of 180 cm serving as a propagation medium of Javanese long pepper plants. Here is a block diagram of the smart system design:



**Figure 1.** Block Diagram of Smart System

The ultrasonic sensor and soil moisture sensor served as input parameters on the Arduino Uno microcontroller. The ultrasonic sensor worked as the detector of water level in the concrete and gave information on the microcontroller to activate electric valve functioned as the outer wall sprayer of the concrete [4]. The soil was automatically functioned as the planting media while the soil moisture sensor was used to measure the moisture of soil as the planting medium of Javanese long pepper plants. The working principle of soil moisture sensors is to provide an output value in the form of electrical quantities as a result of water lying between the capacitor plates on the sensors. This sensor was used as the detector of soil moisture on the medium planted with Javanese long pepper so that the electric valve condition would be active (on) when the soil moisture was less than the predetermined parameter.

### 3. Results and Discussion

#### 3.1 Concrete Cylinder Manufacturing

The use of a hollow concrete cylinder on the smart system has a function as a substitute for Moringa trees as the propagation medium (vine) of Javanese long pepper plants. The selection of concrete base material as the propagation medium is grounded by the fact that concrete has strong characteristic and relatively long durability (working life) without replacing the concrete. In general, the process of manufacturing concrete cylinder has several stages such as making concrete molds and concrete dough, pouring the concrete dough on the concrete molds, finishing the process, and drying the concrete. In this study, the dimension of the used concrete cylinder had a high specification of 180 cm, an inner-concrete diameter of 10 cm, and outer-concrete diameter of 14 cm.

#### 3.2 Sensor Calibration

In this study, a calibration was needed to determine the level or range of sensor readings to be used in the system design. The calibration was aimed to produce values from the readings of the ultrasonic sensor, soil moisture sensor, and control system in the solar cell.

##### 3.2.1. Ultrasonic Sensor

Ultrasonic sensor, in this study, was used to perform distance readings by reflecting ultrasonic waves [3]. Before it was applied to the smart system, firstly, a calibration stage must be performed to determine the reading range that would be used as a reference for the program to be created. The results obtained after the calibration were that the ultrasonic sensor readings reached 20-25 cm and 5-7 cm. The farthest reading distance of 25 was used as a reference when the system would perform water filling in the concrete cylinder by activating the electric valve, while the nearest distance of 5-7 cm was used to stop the water filling in the concrete cylinder.

### 3.2.2. Soil Moisture Sensor

In this study, soil moisture sensor was functioned to read the moisture level of soil used as the planting medium of Javanese long pepper plants. The purpose of the use of this sensor was to optimize the level of water use at the time of watering. When the soil moisture value was still in accordance with the parameters that had been determined, the system would not perform watering until the soil was in dry condition. In general, the way to get a calibration range of soil moisture level uses some soil samples with different humidity level, that is dry soil, moist soil, and wet soil. Based on the results of the study, there were several data ranges of the readings of soil moisture sensor as follows:

- a. If ( $\text{Sensor Readings} \geq 1000$ ), the sensors could not read the level of soil moisture or in unwell-implanted condition;
- b. If ( $600 < \text{Sensor Readings} \leq 1000$ ), the level of soil moisture was in dry condition;
- c. If ( $300 < \text{Sensor Readings} \leq 600$ ), the level of soil moisture was in moist condition; and
- d. If ( $\text{Sensor Readings} \leq 300$ ), the soil was in wet condition.

### 3.2.3. LDR (Light Dependent Resistor) Sensor

The smart system uses sunlight as a source of renewable energy to generate electrical energy. The working principle of solar cells is to make the absorption of electrons generated by sunlight and convert it into electrical energy which is then stored on batteries in power units. The type of battery used in this study was *Lithium Polymer* (LiPo) battery of 12 V DC. The factor of over load or low battery can be avoided by applying a battery monitoring system on the smart system so that the condition of the battery is expected to be steady. In this study, the battery monitoring was done analogously by IC LM3914 with the output of ten active (on) LEDs that were serialized according to the battery voltage. The output of IC would be read by the LDR (Light Dependent Resistor) sensor to make a current connection or termination. The results of battery indicator using the output of ten active (on) LEDs when the battery has 80% power or about 11.70 V.

## 3.3 Soil Moisture Level Control and Plant Watering Intensity Setting

This stage was done using the instrument of soil moisture sensor as the medium to monitor the soil moisture level for Javanese long pepper by performing automatic watering intensity. The program in this stage was done in line with the desired soil moisture level by using conditions (*if*) as the barrier between the upper and lower thresholds. The use of this condition worked until the system could distinguish the structure of dry, soil and wet soils. When the sensor readings were in the dry soil condition range, the system would automatically do watering using electric valve by activating the relay until the soil moisture sensor as wet soil condition recognized the soil condition. Figure 2 shows the condition when the system detected the dry soil condition and activated the electric valve to do the watering automatically.

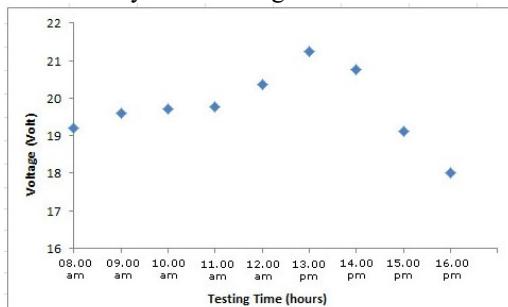


**Figure 2.** Automatic Watering Performed by the System in Dry-Detected Soil

The data results of this study showed that the smaller value of the ADC (Analog to Digital Converter) readings by the sensors would result in higher soil moisture level. The depth of laying sensors on the ground also greatly affected the results of sensor readings. The data of this study indicated that the ideal depth during the test process using soil moisture sensors was 4.5 cm.

## 3.4 Battery Monitoring System on Power Absorption Using Solar Panels

The output voltage of the solar panel system is given in Figure 3 which shows the relation between voltage to the intensity of the sunlight.



**Figure 3.** Voltage output of the solar panel system

Based on the testing results reveals that the output voltage of the solar panels depends on the intensity of the sunlight. The Output voltage of solar cells system is increasing along with the increase in the intensity of the sunlight all day long. When the testing was done at 08.00 am, the output voltage that produced by the solar cells system reached 19.80 Volts. The largest voltage was produced at 13.00 pm which reached 21 Volts because it was the peak time of the sunlight intensity. When the testing was performed at 16.00 pm, the output voltage was the lowest condition because its indicated that the sunlight intensity was reduced significantly.

Based on the results of the study, it was obtained that the smart system could make a performance according to what was desired. The system could terminate the current when the battery was full and conducted a current connection when the battery condition was critical. This proved that the monitoring of voltage capacity worked well. IC LM3914 displayed a level indicator of battery voltage with the output of ten active (on) LEDs serially according to the state of the 12 Volt DC battery voltage. In the charging process carried out from the state of the 11.70-volt battery to the full state of 12.60-volt battery took time for about 3 hours depending on the high intensity of irradiation of sunlight. The charging from the solar panel had a relatively long span of time because the flowed currents had a small amperage of 500-800 mAh.

### 3.5 Overall System Design

The assembly of electronic and mechanical instruments on the smart system is shown in Figure 4.



**Figure 4.** Assembly on Smart System

In general, the working principle of this system is to drain the water that has been stored in a reservoir into the concrete cylinder as well as to automatically water the bottom and middle parts of the concrete cylinder by setting the electric valve instrument. When the water level in the concrete cylinder was reduced in a certain height, the water inside the reservoir would automatically fill the concrete cylinder. The water inside the cylinder would seep out and moisten the outer surface/wall of the concrete cylinder. This moist concrete cylinder medium would be used as the propagation medium

of Javanese long pepper. The main energy used as the power source of the smart system was obtained from solar energy converted by solar cell devices to become DC electrical energy.

#### 4. Conclusion

*Smart system* is a multi-functional and environmentally friendly technology that aims to store and conserve water usage, control water level, maintain soil moisture, perform watering automatically and utilize renewable energy from sunlight as the main power supply. This system consists of several electronic and mechanical devices such as a concrete cylinder used as the propagation medium of Javanese long pepper, LDR (Light Dependent Resistor) sensor, ultrasonic sensor, soil moisture sensor, automatic valve, Arduino UNO, 12V DC LiPo battery, solar cells, and IC LM3914.

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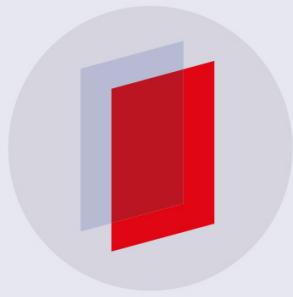
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## On-line Tool Wear Detection on DCMT070204 Carbide Tool Tip Based on Noise Cutting Audio Signal using Artificial Neural Network

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# On-line Tool Wear Detection on DCMT070204 Carbide Tool Tip Based on Noise Cutting Audio Signal using Artificial Neural Network

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**Abstract.** This study develops an on-line detection system to predict the wear of DCMT070204 tool tip during the cutting process of the workpiece. The machine used in this research is CNC ProTurn 9000 to cut ST42 steel cylinder. The audio signal has been captured using the microphone placed in the tool post and recorded in Matlab. The signal is recorded at the sampling rate of 44.1 kHz, and the sampling size of 1024. The recorded signal is 110 data derived from the audio signal while cutting using a normal chisel and a worn chisel. And then perform signal feature extraction in the frequency domain using Fast Fourier Transform. Feature selection is done based on correlation analysis. And tool wear classification was performed using artificial neural networks with 33 input features selected. This artificial neural network is trained with back propagation method. Classification performance testing yields an accuracy of 74%.

## 1. Introduction

The cnc machine is capable of operating without operator supervision during machining. But in machining in cnc machine there is a risk of failure. Among the risk of failure is the damage tool and tool wear[1][2][3]. Tool breakage can occur suddenly, while the tool wear occurs gradually[4][5][6]. As a result of the wear tool is the decline in the quality of CNC machine work [7][8]. In order to maintain the quality of CNC machining, we need a system capable to monitor tool wear when machining progresses. This study aims to build on-line system detection tool wear.

## 2. Related work

Research on the detection of wear and tool breakage has been done by many researchers. general research on tool wear is done using a tool that wear out naturally[5][9] as well as a tool that wear out artificially [10]. Research on tool wear using the tool that wear out naturally generally done in two ways: to observe the gradual wear [11][10] and observed the classification tool wear with normal tool [12][13][14]. And the machine that is often researched is the lathe [5][15][16] or the milling machine [17][18]. This study observes and classifies normal and worn-out tools on CNC lathes.

Generally speaking, the process of wear and tear detection tool through the stages of capturing the observed physical signals, signal feature extraction that characterizes the tool's wear, selection and reduction of signal features for the classification process, and the latter is the classification of tool



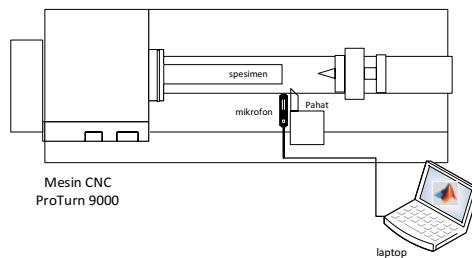
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conditions based on the selected signal feature [19]. Various methods using various sensors are done to capture the physical signal from the CNC machine. To capture the vibration phenomena generated from machining, one uses an accelerometer [2][5] to capture the vibration of a machine or to use a microphone to capture audio noise. Methods performed by other studies capture acoustic emission signals using acoustic emission sensors[20][21]. There is also a tool wear detection study based on the measurement of energy consumption in spindle motor and motor feeder[1]. The study by Jacob[22] detects the wear of the tool based on the cutting force measured by the dynamometer. The study in this paper detects the tool wear on the lathe machine based on the noise of the cutting sound.

Feature extraction in this study was performed on frequency domain with fast fourier transformation. Other studies perform feature extraction in various ways, including wavelet decomposition, domain order transformation, energy spectrum, chirp detection. Selection of features in related research is done by two approaches, namely filter approach or wraping approach. Selection of features is done by method of regression analysis, linear discriminant analysis, principal component analysis, KNN, decision tree, genetic algorithm. And many classification systems use statistical pattern recognition, genetic algorithms, artificial neural networks.

### 3. Overview of system and experimental setup

The on-line tool wear detection system consists of hardware and software. The hardware of the experimental detection and setup system presented in Figure 1 consists of a microphone mounted in the CNC ProTurn 9000 machine tool post and a computer with a wear detection system application running on matlab software. The data stream of the signal from sound recording to the noise wear classification process is shown in figure. 2.

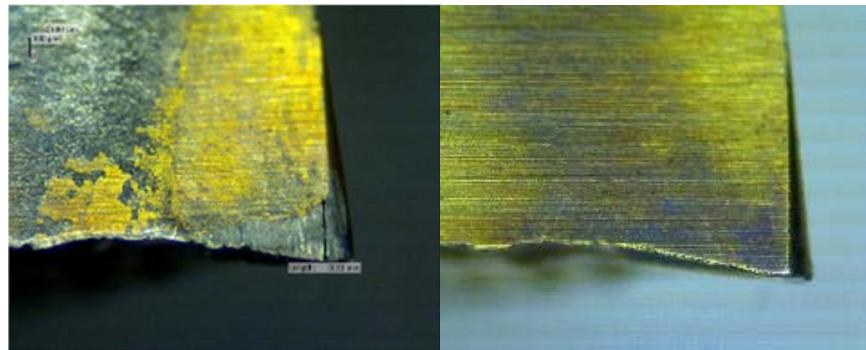


**Figure 1.** experimental setup of on-line tool wear detection.



**Figure 2.** Data flow and data processing in on-line tool wear detection

The tool used in this research is carbide tool with type DCMT070204. Wear of tool is measured using Nikon Measurescope. The observation tool used in this research is shown in Figure 3. The picture shows the normal tool and worn tool according to ISO3685 criteria used in this research. the tool is used for ST42 cylindrical steel machining.

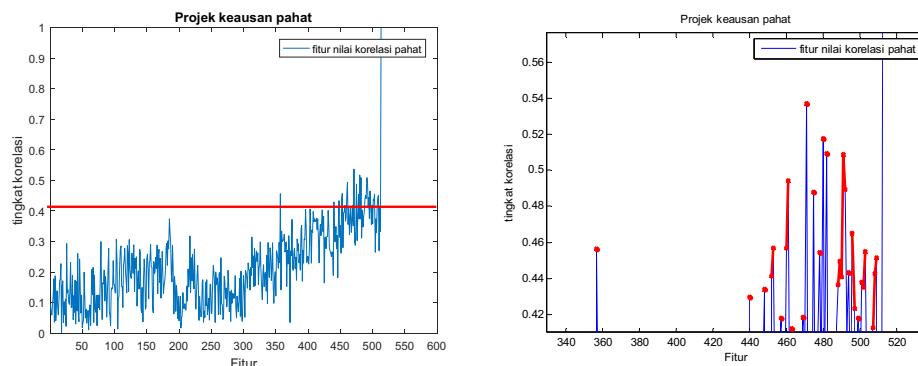


**Figure 3.** Microscopic photos of normal tools and wear tools according to the ISO3685 tool wear criteria used in the study

Sound signal recording using omni-directional Andoer microphone with frequency response between 20Hz to 16 kHz. Sound recording is done in matlab software as well as signal conditioning in the form of normalization of sound amplitude. The next step is a fast fourier transform to get the frequency spectrum of the sound signal. Based on the frequency spectrum data is selected frequency feature that characterizes the wear of tool. Selection of features using correlation analysis to look for features of a strongly correlated frequency against tool wear grade. The next stage is to train artificial neural networks in order to distinguish signals derived from normal tool or from worn tool.

#### 4. Results and discussion

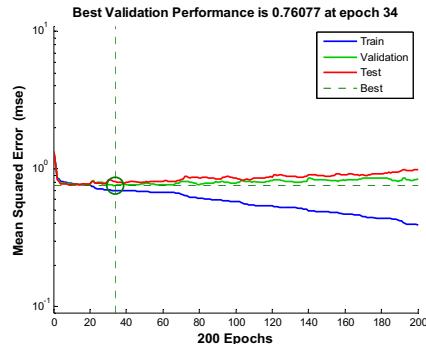
Results of correlation analysis of the frequency spectrum against the wear grade of the tool are shown in Figure 4. (a). visible from the picture there is no frequency spectrum feature that is very strongly correlated with the wear grade. It is also seen that the high frequency spectrum is stronger in correlation than the low frequency spectrum. With strong correlation coefficient criteria above 0.4, 33 features were selected for artificial neural network input, figure 4. (b).



**Figure 4.** (a). The result of the frequency spectrum correlation analysis of the tool wear class, and (b) the selected frequency features based on strong correlation coefficient criteria.

The selected feature of 33 out of 110 recording data is entered in a multi layer perceptron neural network with 33,16,1 neuron architecture. A total of 110 data is divided into training data, test data, and validation data, with a proportion of 8: 1: 1. Multi layer perceptron trained with back propagation method. Training parameters used are default matlab with stopping criteria of training process if reach MSE 0.001 and 10 times validation check. The best training results are shown in Figure 5. The best

results are achieved on the 34th epoch with the stopping criteria of 10 validation checks. Accuracy achieved by classifier is equal to 76%



**Figure 5.** The best training results.

## 5. Conclusion

The DCMT070204 tool wear detection system has been developed successfully. This detection system records machining sounds and then the sound signals are transformed in the frequency domain to select the frequency feature that characterizes the wear of the tool. The selected frequency feature is used to train artificial neural networks. The results of artificial neural training to distinguish worn tool and normal tool can achieve accuracy of 76%.

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## Is the State of Indonesia In Charge to Provide Law Protection to the Indonesian Migrant Workers ?

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# IS THE STATE OF INDONESIA IN CHARGE TO PROVIDE LAW PROTECTION TO THE INDONESIAN MIGRANT WORKERS ?

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**Abstract.** Right to work is assured in the regulation of 1945 Constitution (amendment) Article 28 D Clause (2) mandating that every person deserves to work and in return they get wages, fair and proper treatment in the relation of employment. Working as migrant worker is accessible job opportunity, especially to people who have low education and skill with promising income. Many case faced to the migrant worker. It is necessary to analyze how the state's position in providing protection to its citizens experiencing problems overseas. Country has the right to protect its citizens overseas and to intervene diplomatically. It cannot provide direct protection because if there is a criminal act committed by Migrant Worker of Indonesia, then the applicable law is the law of country where the Migrant Worker works. The actual protection is to make bilateral agreements with the destination country. Law No 39 Year 2004. Article 77 regulates the right to obtain protection from pre-placement, placement period to post-placement. Employment or the right to work is one of human rights that is the right to social freedom, namely the right to meet the basic needs. Regarding the legal protection for women migrant workers, the relevant human rights theory used is the natural rights theory because the right to work in this case is the right that every human being possesses

## 1. Introduction

In order to fulfill their needs and purpose, human is gifted by certain ability through interaction, one of them are related to employment. Employment to human being is related to the nature God gives; by working human in their position as employee gets wages that are used to meet the needs of their life. Moreover, working is a part of human rights. This right is regulated in the United Nation Universal Declaration of Human Right, Year 1948 Article No 23 that generally states that "every person deserves to get a job [1]. While the basic right for every human to migrate is recorded in the Article 13 Chapter 1 stating that "Everyone has the right to freedom of movement and residence within the borders of each state.

In the regulation of national law of Indonesia, right to work is assured in the regulation of 1945 Constitution (amendment) Article 28 D Clause (2) mandating that every person deserves to work and in return they get wages, fair and proper treatment in the relation of employment. Employment rights assurance in 1945 Constitution carries certain consequences for the state to provide law protection to every citizen to obtain their rights. Furthermore, the regulation of Article 28 Clause (4) states that protection, progress, enforcement, and fulfillment of human rights are the responsibility of the state especially the government.



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Working as Migrant Worker of Indonesia who works overseas is accessible job opportunity, especially to people who have low education and skill with promising income. Even though the Migrant Worker gives foreign exchange to state and regional government as well as gives solution to the problem of employment opportunity within the country, Migrant Worker still obtains limited law protection [2]. This condition is proved by the existence of so many cases of violation especially for the right of Women Migrant Worker every year.

The birth of Regulation No 39 Year 2004 is meant to create effective placement mechanism based on the Human Rights Regulation especially to Migrant Worker of Indonesia, aiming to prevent or at least minimize the problems faced by the Migrant Worker of Indonesia. Even though the existence of cases faced by the Migrant Worker, many people are still willing to work in this field, since the number are increasing every year despite of the problem. The Ministry of Labor and Transmigration identifies 110,171 cases in regard with the placement of Migrant Worker of Indonesia [3].

Related to the problem of employment, the protection of Migrant Worker rights have been regulated in the conventions and recommendations of International Labor of Organization /ILO [4]. The existence of ILO convention can legalize the same standard of protection. ILO convention is binding where every member of ILO is bound to implement the convention since its position as a member of ILO is not based on the ratification [5]. This obligation at Declaration of Fundamental Rights and Principles at Work has been adopted in the ILO Convention No 86 in June 1998 [6].

In this context the question of whether the state is responsible for protecting labor migrants is subject for debate. It is necessary to analyze how the state's position in providing protection to its citizens experiencing problems overseas because the reality of the migrant workers of Indonesia problem occurs overseas in the context of universal provisions and the provisions of state of Indonesia.

## **2.The State Responsibility**

To explain about the concept of state responsibility and legal protection to Migrant Worker as a whole needs to be done at national and international level. This is because procedural process of placement of Migrant Worker consists of pre-placement, in-work and post-placement. At the national level, the instruments of protection are directed to the phase before the migrant workers go abroad and after returning to the state of origin. While instruments protection at the international level starts when workers leave Indonesia and are at work until the time he or she returns to Indonesia.

Related to the concept of protection at the time Migrant Worker in overseas, it is related to the jurisdiction of the destination country. Jurisdiction is an attribute of state sovereignty in which the jurisdiction of a certain state refers to the competence of the state to govern people and property with its domestic law (criminal and civil) [7]. This principle is generally granted by international law to all countries that want to enforce it. This principle relates to a state which is not obliged to surrender its citizens who have committed crime overseas [8].

A country can ask responsibility for losses to other countries for reasons such as breach of treaties, breach of contractual obligations, and the existence losses, related to the citizens of other countries and so on [7]. Such breach of obligation can be an act and omission. The state's responsibility to its citizens cannot be separated from the issue of claims, since a country has the right to protect its citizens overseas and to intervene diplomatically or to claim for a satisfactory settlement. The analogy of this cases that the claimant states is deemed to have been harmed through its people or claimed its right according to international law. In the case of labor law in particular, it cannot provide direct protection because if there is a criminal act committed by Migrant Worker of Indonesia, then the applicable law is the law of country where the Migrant Worker works.

## **3.The State's responsibility toward legal protection for Migrant Worker**

A further understanding is the protection of the law which implies giving protection of human rights that are harmed by others and that protection is given to the community so that they can enjoy all the rights granted by law. Law is an inseparable part of human life whereas legal protection is a

form of consequence of a state of law, in which ‘the state of Indonesia is based on law (*rechtstaat*) not based on mere power (*machtstaat*).’ The government based on the constitution is not absolute [9]. The law is living within society and on the contrary, in society there is always a legal system, therefore there is a famous term “*ubi societas, ibi ius*” [10].

Related to the case of legal protection for workers, Suliati Rahmat argues that the Republic of Indonesia is obliged to protect the entire nation of Indonesia [11]. The phrase “the entire nation of Indonesia” also includes workers which mean Migrant Workers. Furthermore, it is said that the protection of labor law, whether with or without the assistance of workers’ organizations, through regulations, actions aimed at protecting the weak, places the workers in a proper position as human beings.

The protection of the law is the protection of the pride and dignity as well as the recognition of human rights owned by legal subjects within a country based on the legal protection of arbitrariness. There are two kinds of legal protection for people, namely: preventive law protection and repressive legal protection. M Hadjon’s opinion facilitates an analysis of legal protection [12]. In the concept of legal protection for people, at least there are two relating parties, where the protection of the law is focused on one party, with its actions, dealing with the people who are subjected to such acts of government. The concept of legal protection for the people is very relevant to use in assessing the legal protection for Migrant Worker because the worker, in this case Migrant Worker, is in a weaker position than the company. Furthermore, the actual protection is to make bilateral agreements with the destination country, the protection that is given to all Indonesian citizens, whether the workers are sent legally or illegally due to cheating of brokers and they must be protected in the making of the agreement.

The protection scope of the law is wider, by raising the issue of protection of all Indonesian citizens overseas from the side of the penal code. Therefore, another scope of law protection, the state needs to enter into extradition treaties as well as mutual assistance in criminal matters (Mutual Assistance in Criminal Matters) and the diplomatic lobbies. If the provisions of the ILO cannot be a mediator between the national provisions of each country, it can be minimized through the creation of bilateral agreements or contracts that can accommodate the interests of each party [5].

Basically, the contract law has a very important principle to be described, especially to analyze the contracts made by Indonesian workers working overseas with their employers. In signing this standard contract, there is the impression as if there are parties who do not participate in making or formulating the articles. In the arrangement and theory, there are basically two groups of opinions: the first is a group that says for the side who did not participate in making; signing a standard contract, when they are violated their freedom, guaranteed by the principles of freedom of contract. Nevertheless, the other groups argue that the parties who do not participate formulate the articles in the contract still have the freedoms to sign or not sign. Only when he signs, then he or she is no longer free to determine his or her will that should be listed in the contract.

With the principle of freedom of contract, the parties have the right to decide what they want and are also allowed to determine what they do not want to put into their agreement, and what the agreement will be binding on the parties signing the agreement (Article 1338 the Book of Civil Code). In the principle of the existing opinion of the standard contract, it can be traced also by examining the legal relationship between the parties making the agreement in terms of its position, form and nature.

To formulate clauses that contain legal protection requires discussion of the legal principles related to the issue of the legal relationship between the workforce with the employer and the company provider of workforce. The principle is the logical ratio of the regulation that indicates the existence of ethical demands. The legal principles of the legal relationship between the workforce, employers and company provider of workforce are the principles of national law and there are also the principles of international law. Since there are parties who make agreements has different citizenship from the Indonesian workers; namely the company that mediates in the receiving country, as well as the employers who employ them.

The concept of protection of Migrant Workers of Indonesia is contained in Article 1, clause 4 of Law No 39 Year 2004. It states that the Protection of Migrant Worker of Indonesia is all efforts to protect the interests of candidate of Migrant Worker of Indonesia or Migrant Worker of Indonesia in realizing the guarantee of the fulfillment of their rights, in accordance with the rules and regulations in term of before, during, and after working.

Article 77 regulates the right to obtain protection from pre-placement, placement period to post-placement. During the placement, article 78 is stipulated that overseas Representatives of the Republic of Indonesia given the duty to protect migrant workers. This protection is certainly in accordance with the laws and regulations as well as international customs. The protection in this context includes the provision of legal assistance, in accordance with the laws and regulations in the destination country as well as applicable international laws and customs. In addition, the representative of the Republic of Indonesia in the destination country is also obliged the duty of defending the fulfillment of rights in accordance with the employment agreement and or the laws and regulations exist in the destination country.

In article 20 of the Foreign Relations Act, Representatives of the Republic of Indonesia "must" settle disputes among fellow citizens by deliberation or in accordance with applicable law. Consequently, if the Representative of the Republic of Indonesia does not carry out its duties and obligations, then they have violated those articles, or in other words, the forms of violation are not obeying the law. Meanwhile the offender is the Representative of the Republic of Indonesia and Company Provider of Migrant Worker.

In relation to article 79, it can be seen that the obligations of the Embassy of the Republic of Indonesia or the Consulate General of the Republic of Indonesia not only protecting the Migrant Worker of Indonesia, but also including the guidance and supervision of private Company Provider of Migrant Worker of Indonesia representatives in the destination country; namely in this regulation referred to as Business Partners.

While article 25 and article 24 state that in the framework of the protection of migrant workers, the Embassy of the Republic of Indonesia or Consulate General of the Republic of Indonesia may conduct supervision on Business Partners by making a list of troubled Business Partners and further provisions shall be stipulated in a Government Regulation. In this case, the Consulate does not have the authority to revoke the business license of the troubled Partners because it relates to the principle of territorial jurisdiction, as it is well known that the Business Partner is established under the laws and regulations of the country concerned. Then the protection given by the Embassy of the Republic of Indonesia or Consulate General of the Republic of Indonesia against the Migrant Worker of Indonesia in the framework of the control of the Business Partners is to appeal and foster the troubled Business Partners to provide protection. Although the Overseas Company Provider of Migrant Worker of Indonesia Act states that, the Representative of the Republic of Indonesia, in this case the Embassy or Consulate can 'make' a list of problematic agents.

This indicates that the Government of Indonesia determines the role of Business Partners in the placement of Overseas Workers, so that the establishment of Business Partners is based on the laws of the destination country, but the Indonesian government may determine the working agreement clause between Private Company Provider of Migrant Worker of Indonesia and Business Partners.

#### **4. Construction of Human Rights in Protecting Labor Migrants**

One form of legal protections is the existence of human rights assurances. According to Abdullah Rozali, human rights are [13] the basic rights that human beings have since birth is the grace of God Almighty. It is necessary to understand that human rights are not sourced from the state and the law, but merely derived from God as the creator of the universe and its contents, so that human rights cannot be minimalized (non-derogable right). Therefore, what is required of the state and the law is an acknowledgment and assurance of the protection of the human rights.

According to Miriam Budiardjo [14], the rights formulated in the seventeenth and eighteenth centuries were strongly influenced by the notion of natural law as defined by John Locke (1632-1714)

and Jacques Rousseau (1712-1778) and are limited to political rights only, such as equal rights, the right to liberty, and the right to vote. In the twentieth century, however, these political rights were perceived as less than perfect, and began to add several other rights which were broader in scope. Conversion of human rights concerning the nature of human being to legal rights and socioeconomic rights is the main characteristic of human rights nowadays. The classical theory of human rights based on the theories of natural law, the thoughts relating to human rights include [15]: human rights are owned by everyone naturally in accordance with the assumption that a person is born as a free person, valid universally to everyone regardless of geographical location, do not require actions or programs from others whether they are individuals, groups or governments.

From the understanding of human rights, it can be stated that employment or the right to work is one of human rights that is the right to social freedom, namely the right to meet the basic needs. Regarding the legal protection for women migrant workers, the relevant human rights theory used is the natural rights theory because the right to work in this case is the right that every human being possesses. Furthermore, the right to work or to meet their needs must be contained in the real law, namely as a right assured in the state constitution.

Indonesia as part of the world community and a member of the ILO has a moral obligation to implement international provisions in industrial relations practice in Indonesia [16]. In the Convention which has been ratified into Regulation No 6 Year 2012 concerning the Ratification of the International Convention on the Protection of the Rights of All Migrants Workers and Members of Their Families, may be found in article 10 of the Migrant Convention that "No migrant worker or member of his or her family shall be subjected to torture or inhuman or degrading treatment or punishment"(International Convention on the Protection of the Rights Of All Migrant Workers and Members Of Their Families).

From this article, it can be seen that Indonesia fully supports what has become an agreement on the Migrant Workers Convention. Therefore, it has been ratified and made a law. The content is concerning of the Migrant Workers Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment. As mentioned earlier, the legal protection of migrant workers is closely linked to the fulfillment of human rights, including in the protection of employment, protection of equality before the law with fellow citizens of the destination country of work, protection in remuneration, and so on.

## **5. Conclusion**

Related to the concept of protection at the time Migrant Worker in overseas, it is related to the jurisdiction of the destination country. The state's responsibility to its citizens cannot be separated from the issue of claims, since a country has the right to protect its citizens overseas and to intervene diplomatically or to claim for a satisfactory settlement. In the case of labor law in particular, it cannot provide direct protection because if there is a criminal act committed by Migrant Worker of Indonesia, then the applicable law is the law of country where the Migrant Worker works. Government is obliged to protect the entire nation of Indonesia. The phrase "the entire nation of Indonesia" also includes workers which mean Migrant Workers. The concept of legal protection for the people is very relevant to use in assessing the legal protection for Migrant Worker because the worker, in this case Migrant Worker, is in a weaker position than the company. The actual protection is to make bilateral agreements with the destination country, the protection that is given to all Indonesian citizens, whether the workers are sent legally or illegally due to cheating of brokers and they must be protected in the making of the agreement.

The concept of protection of Migrant Workers of Indonesia is contained in Law No 39 Year 2004. Article 77 regulates the right to obtain protection from pre-placement, placement period to post-placement. In relation to article 79, it can be seen that the obligations of the Embassy of the Republic of Indonesia or the Consulate General of the Republic of Indonesia not only protecting the Migrant Worker of Indonesia, but also including the guidance and supervision of private Company Provider.

Employment or the right to work is one of human rights that is the right to social freedom, namely the right to meet the basic needs. Regarding the legal protection for women migrant workers, the relevant human rights theory used is the natural rights theory because the right to work in this case is the right that every human being possesses. Furthermore, the right to work or to meet their needs must be contained in the real law, namely as a right assured in the state constitution.

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## System Security And Monitoring On Smart Home Using Android

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# System Security And Monitoring On Smart Home Using Android

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**Abstract.** Home security system is needed for homeowners who have a lot of activities, as a result, they often leave the house without locking the door and even leave the house in a state of lights that are not lit. In order to overcome this case, a system that can control and can monitor the state of the various devices contained in the house or smart home system is urgently required. The working principle of this smart home using android is when the homeowner sends a certain command using android, the command will be forwarded to the microcontroller and then it will be executed based on the parameters that have been determined. For example, it can turn off and on the light using android app. In this study, testing was conducted to a smart home prototype which is equipped with light bulbs, odour sensors, heat sensors, ultrasonic sensors, LDR, buzzer and camera. The test results indicate that the application has been able to control all the sensors of home appliances well.

## 1. Introduction

Due to tremendous growth in the present day emerging technology, humans are adapted to these technologies in many ways. Communication is the process of transferring information from one point to other point [1,2]. It can be done by wireless communication to control smart home.

A smart home is a house which is integrated with communication network using electrical equipment that can be controlled and monitored or accessed remotely. The main purpose of creating a smarthome isto provide comfort to the homeowner in terms of controlling and monitoring the state of his home when they are away [4]. The simplest example is the house lights, turning them on and off are easily done by using a wall-mounted switch. However, it also grants us a slight drawback that when we are away we cannot control the lights in our homes as we cannot touch the switch at home[6].

If Android is used as the remote control of the smart home, homeowners can turn on and off lights regularly eventhough they are not at home, as if we were at home. Another advantage of implementing smart homes is that it can help the elderly and also the disabled as they can switch off and on electronic equipment and home doors more easily without the need to walk first[5,8].

This study aims to build smart home that has capabilities as what follows: detecting gas leakage, turning on the fan when the room temperature is hot, opening and closing the gate if there is a car in front of the fence and turningon the lights on the fence and garden automatically at night. This smart home system can also open and close the door of the house, turn on the lights and monitor the state of the house surroundings and environment using android [10].



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## 2. Methodology

### Mechanical System Design

The mechanical system is designed as the system protector, electronical component supporter and as a initiate prototype of smart homes. In designing this mechanical system, multiplex and acrylic are used as the basic material so that the prototype of this Smart Home can run well as if it were a real house. Smart home prototype as shown in Figure 1.



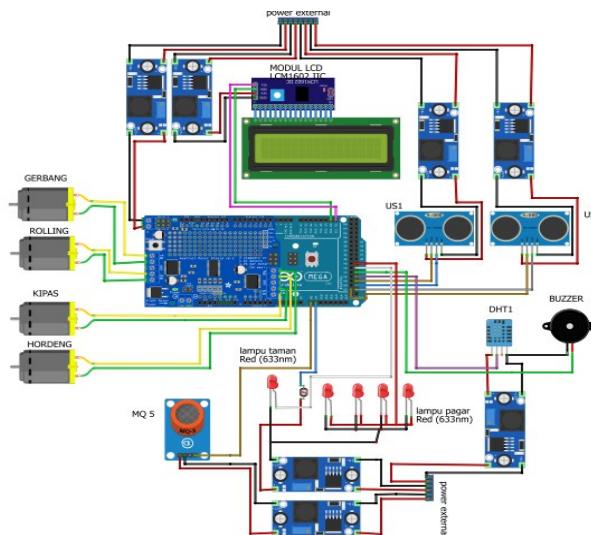
**Figure 1.** Prototype of Smart Home

### Electronic System Design

The electronic component of this Smart Home uses an arduino as a circuit regulator and is equipped with several sensors that can work automatically, for instance [3]:

1. LDR sensor, this sensor will work if the LDR sensor receives a little amount of light or no light at all (dark conditions / night), so it can activate the lights on the fence.
2. Ultrasonic sensor 1, this sensor will work if the sensor detects objects or cars located in front of the fence.
3. Ultrasonic sensor 2, this sensor will work if the sensor detects the object located in front of the car garage.
4. DHT11 sensor, this sensor will activate the fan if the indoor temperature is hot enough or around 30 C
5. Sensor MQ2, this sensor will activate the buzzer if the sensor detects the smell of gas.

All the electronic components in this Smart Home, connected with the arduino, so that the sensors can work properly, as shown in Figure 2.

**Figure 2.** Electronic components in smart homes

This system is also equipped with nodeMCU and laptop connected to the internet so that the system can be controlled by using android. Some equipments that can be controlled with android include:

1. Garage Lamp
2. Lower Floor Lamp
3. Upper Floor Lamp
4. Up Front Lamp
5. Upstairs balcony light
6. Lower Balcony Lamp
7. Decorative Lamp
8. The Upper Door
9. Bottom Door
10. Camera

### 3. Results and Discussion

The objective of this study is to produce a smart home prototype system that can be controlled through android. The trials results of some equipments that can be controlled by android as shown in Table 1:

**Table 1.** Testing with Android

No	Equipment	Condition	
		on	off
1	Garage Lamp	Success	Success
2	Floor Bottom	Success	Success
3	Top Floor	Success	Success
4	Top Lights	Success	Success
5	The Top Balcony Lamp	Success	Success
6	The Lower Balcony Lamp	Success	Success
7	Decorative Lamps	Success	Success
8	The Top Door	Success	Success
9	The Bottom Door	Success	Success

10	Camera	Success	Success
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In order to figure out whether or not the system is running well, then several tests were conducted such as testing the gas sensor, ultrasonic and heat dal LDR. An example of the test is shown in Figure 3. Overall, the results of the sensor testing can be seen in Table 2



**Figure 3.** Sensors testing

**Table 2.** Sensory testing on smart home

No	Name Censors	Condition	Action	Success / No
1	Gas Sensor	If any Gas	Buzzer sounds	Success
2	Ultrasonic Sensor 1	If there are cars	Open Door	Success
3	Ultrasonic Sensor 2	If there are cars	Open Garage Door	Success
4	Temperature Sensor	If temperature > 30° C	Fan Active	Success
5	LDR	If the Night	Lights and Living Garden	Success

#### 4. Conclusions

From the results of tests, the conclusions are as follows:

1. In this study, the Smart Home system can control the home appliances such as lights and doors using android.
2. In this study, the Smart Home system can monitor the state and condition of the house by using the camera through android.
3. In this study, the Smart Home system can alarm a warning sign when there is a gas leak by turning on the buzzer.

Suggestions for future development is a security system that is built required additional security such as motion detection as well, add notifications to the user in the form of sms or email to the home owner

## 5. Acknowledgment

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## Expert System Diagnosis of Cataract Eyes Using Fuzzy Mamdani Method

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# Expert System Diagnosis of Cataract Eyes Using Fuzzy Mamdani Method

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**Abstract.** Cataracts are eye diseases characterized by cloudy or opacity of the lens of the eye by changing the colour of black into grey-white which slowly continues to grow and develop without feeling pain and pain that can cause blindness in human vision. Therefore, researchers make an expert system of cataract eye disease diagnosis by using Fuzzy Mamdani and how to care. The fuzzy method can convert the crisp value to linguistic value by fuzzification and includes in the rule. So this system produces an application program that can help the public in knowing cataract eye disease and how to care based on the symptoms suffered. From the results of the design implementation and testing of expert system applications to diagnose eye disease cataracts, it can be concluded that from a trial of 50 cases of data, obtained test results accuracy between system predictions with expert predictions obtained a value of 78% truth.

## 1. Introduction

The eye is one of the organs of the body that serves as a means of the five senses that are very important to humans so as to see all the beauty in life. If the eyes are disturbed will cause difficult for humans in vision and can experience blindness so must be careful in maintaining the health of organs every day from various diseases that attack one of them is eye disease cataracts[1].

Cataract is an eye disease that can cause blindness in humans. In this disease can be marked by the cloudy and opacity of the lens of the eye that affects the decrease of human vision, will appear like a white stain that will constantly cover the lens of the eye so that the black will be a white color. These eyes will result in normal aging that becomes blurred and murky on the human senses that are almost reaching above 40 years are usually called senile cataracts[2].

Cataract eye disease usually grows slowly so it will continue to add and grow without causing pain and pain. There are several factors that cause humans suffering from cataracts that continue to increase every year is the lack of public knowledge. Cataracts often attack both eyes in different conditions at once and will continue to develop for years without feeling pain. Therefore, there is a system that is used as a tool for diagnosis in cataract eye disease in order to avoid error handling in a case that is Expert System.

Expert System is a computer program that has the ability like an experienced human and knowledge in experts in a particular field. Basically there are some components contained in it, namely Knowledge Base (KB), Inference Machine (IE), Control Strategy (CS)[3]. Knowledge is a practical understanding of a particular object or domain. The knowledge used in this expert system is a series of symptoms-diagnosis, cause-effect, action-reaction, on the object. An expert system in the

health world is an application used to take a diagnostic decision or predict medical or health problems[4].

Several previous studies Ivana Herliana W. Jayawardanu and Seng Hansun made Design of Expert System for Early Cataract Detection Using C4.5 Algorithm [5]. This application is used to detect cataract early disease to calculate accuracy value. Based on the results of experiments conducted using 10-fold cross so that the accuracy of output system type is 80%, and the accuracy value of result output system is 93.2%. Yudi and Yessi Nofrima make the Design of Expert System Diagnosis of Cataract Eye Disease in Human-Based Web [2]. This application uses Inference Forward Chaining method is able to identify by requiring a lot of data for more accurate test results. Galih Hendro Martono, M.Eng and Siti Agrippina Alodia Yusuf perform Diagnosis of Senile Cataract Disease Using a Web Based Case Based Reasoning (CBR) Method [6]. This app is used to solve problems that look for the similarities of previous cases with new cases that yield 70% value. Dwi Marta Sukandi, Agung Triongko Basuki and Shinta Puspasari made the Application of Fuzzy Mamdani Method To Predict Total Palm Oil Production Based on Inventory Data and Demand Amount [7]. The application of this system using Fuzzy Mamdani method to meet the demand with the percentage value of 86.67% and the average difference between production and prediction is 16.23333. Fariz Aziz Khaerulah and Aripin made the Diagnosis Expert System for Dental Caries Disease Using Fuzzy Mamdani Method [8]. This application uses Fuzzy Mamdani Method knowing with the accuracy rate of 90% and has a fairly small error of about 10%.

Characteristics this system is a processing that does not require answers to what has been inputted from each question, for example there are how many symptoms of each type in cataract eye disease. Because the system will diagnose the new one next. In this system research that handles cataract eye disease by applying a Fuzzy Mamdani Logic method. Where fuzzy logic was first discovered by Lotfi A. Zahed, a professor of the University of California in 1965. Fuzzy Logic is a method that has a value between true or false and has a membership weight. Fuzzy logic is used to translate a scale by using language (linguistic) and can cultivate uncertainty so that it quickly decides a human reason [9]. Fuzzy logic techniques include several methods, namely: Tsukamoto method, mamdani method and Sugeno method. In this system will use Mamdani method. Where, Fuzzy Mamdani method is also called Max - Min method and can know a fuzzy rule condition with "If ... Then". In this fuzzy mamdani method has advantages and disadvantages that is: intuitive, easy to understand, flexible, and can work together. To get an output (output) it requires several stages, namely: Fuzzyifikasi, Fuzzy knowledge base formation, Fuzzy Set, Defuzzyifikasi using Centroid method[7].

This system will facilitate a doctor's job in examining the patient to find out the results of the diagnosis of the illness suffered by the patient based on the symptoms experienced by the patient using the Fuzzy Mamdani method. Because of this in recent years, the methodology in a computer vision has been widely applied to systems in health informatics and telemedicine to diagnose illness, in which there is a diagnostic error in physicians with new knowledge[10]. Application in solving such expert system can be generated through input and output. In this system inputanya form of symptoms of cataract eye disease, and its output is the result of the type of cataract eye disease.

## 2. Methodology

The set of variables on fuzzy mamdani contained in expert system of cataract eye disease diagnosis are as follows:

1. Variable 1, This variable 1 is the value taken from the consultation at the time of the interview with the physician. This variable has 3 set criteria. Low criteria range between 0 to 40, Medium between 20 to 80, and Height between 60 to 100.
2. Variable 2, This variable 2 is the value taken from the consultation at the time of the interview with the physician. This variable has 3 set criteria. Low criteria range between 0 to 40, Medium between 20 to 80, and Height between 60 to 100.

3. Variable 3, This variable 3 is the value taken from the consultation at the interview with the physician. This variable has 3 set criteria. Criteria Seemed to range between 0 to 60, Medium between 40 to 90, and Height between 80 to 100.
4. Variable 4, This variable 4 is the value taken from the consultation at the time of the interview with the physician. This variable has 3 set criteria. Low criteria range between 0 to 40, Medium between 20 to 80, and Height between 60 to 100.
5. Limiting Variables, This limiting variable is the value taken from the consultation at the time of the interview with the physician. This variable has 3 set criteria. Immature criteria range from 0 to 40, Matur between 20 to 80, and Hypermatur between 60 to 100.

In building a system requires a design to analyze and results so as to achieve maximum results. There are several design systems that will be built namely interface design, flowchart, use case diagram and other design models. Flowchart is a section with certain symbols that describe the process sequence in detail and the relationship between a process (instruction) with other processes in a program. In the expert system of cataract eye disease diagnosis with fuzzy mamdani method there is a system flowchart and flowchart method that will build the system. Below is a system flowchart where, this flowchart describes the flow of the system as a whole.

Flowchart method Fuzzy Mamdani describes the steps or sequence of problem solving process with Fuzzy Mamdani method in Expert System Diagnosis Cataract eye disease. The process begins with the input of symptoms of cataract eye disease, arrange the symptoms in the form of questions, the calculation process with the method Fuzzy Mamdani, and the last is the percentage of suffering from cataract eye disease.

Diagnosis process will be done by using fuzzy mamdani method that there are several stages to know the diagnosis result of patient's disease that is First Stage of Rule Formation. Formation of rules on diagnostic questions there are 3 criteria rules, namely: Low, Medium, and High. With a total of 81 rules.

Second Phase Application Function Implications. If the rule has been established, then the next to calculate predicate rules by entering the variables or set fuzzy into rules that have been made. There is a patient case with the following data:

Consultation as follows:

Question 1: opacities begin to affect the lens (25)

Question 2: Normal lens stadium (50)

Question 3: The forerunner and the eyepiece become narrower (70)

Question 4: Deeply discharges the lens fluid (80)

Application function implicasinya as below:

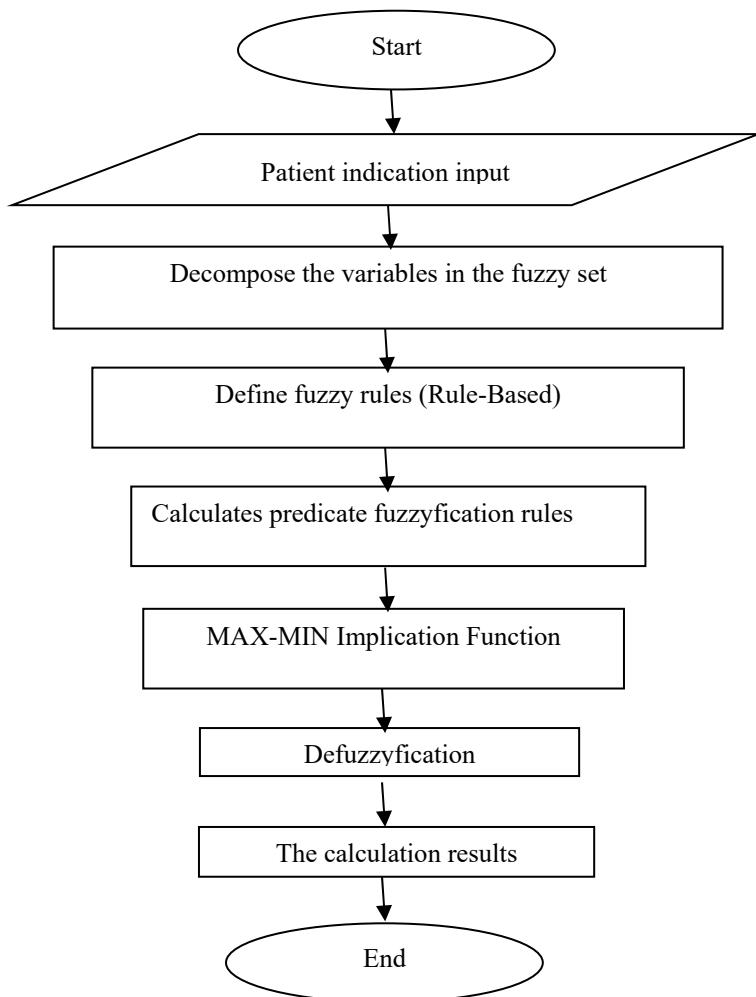
[R67] If Question 1 is Low AND Question 2 is Medium AND Question 3 is Appear AND Question 4 is High THEN Matur. Referring to the membership function of each group then obtained the data as follows:

$$\begin{aligned} \text{-predicate 1} &= \mu \text{ question1 Low} \wedge \mu \text{ question2 Medium} \wedge \mu \text{ question3 Looks} \wedge \mu \text{ question4 Height} \\ &= \min (\mu \text{ question1 Low [25]}, \mu \text{ question2 Medium [50]}, \mu \text{ question3 Looks [70]}, \mu \text{ question4 Height [80]}) \end{aligned}$$

Based on the calculation of rule-rule above, then mengronasilkan decision Is Matur. The next stage is the third stage of the rule composition. The result of the rule predicate calculation on each rule / rule is used MAX method to do the composition between all rules. From the implication of the rules on diagnostic questions then obtained the value of MAX and MIN and Boundaries Area 1 and 2 as follows:

$$a1 = (ba - bb) * max + bb \quad (1)$$

$$a2 = (ba - bb) * min + bb \quad (2)$$



**Figure 1.** Flowchart Fuzzy Mamdani Method

Fourth Stage is Affirmation / Defuzzyfication. The Confirmation Method (Defuzzyfication) used is the centroid method. With the formula to find the value of  $z^*$  (center point) based on the equation found on the theoretical basis. After the defuzzy process is complete it will result in the calculation of the value or diagnosis score of the patient's illness. The first thing to do in the defuzzy stage is to look for moments 1, 2 and 3.

$$M1 = \min / 2 * a12 \quad (3)$$

$$M2 = (1 / (ba-bb) / 2 * a23) - (bb / (ba-bb) / 2 * a22) ((1 / (bb) / 3 * a13) - (bb / (ba-bb) / 2 * a12)) \quad (4)$$

$$M3 = (\text{Max} * ba2 / 2) - (\text{Max} * (ba-bb) / 2 * (ba-bb)) \quad (5)$$

Next look for Area Area A1, A2 and A3.

$$A1 = a1 * \text{Min} \quad (6)$$

$$A2 = (\text{Min} + \text{Max}) * (a2-a1) / 2 \quad (7)$$

$$A3 = (ba - (ba-bb)) * \text{Max} \quad (8)$$

Searching for the Center.

$$\text{Central point} = (M1 + M2 + M3) / (A1 + A2 + A3) \quad (9)$$

**Table 1.** The Decision Level

Decision Level	Decision
1	Imatur
2	Matur
3	Hypermatur

### 3. Results and Discussion

Analysis of the accuracy of this system is to know the purpose of the system in providing the results of the correct output and in accordance with the medical record data obtained from experts. To test the accuracy of this application is to compare between system prediction with experts. In the trial accuracy using 50 patient data with symptoms input experienced by the patient.

From the table 1 of data accuracy test, obtained a comparison between the prediction of the system with expert predictions derived from the calculation of fuzzy logic method mamdani with expert predictions from medical record data. Of the 50 patient data, the results obtained 39 correct data checks and 11 incorrect data. To calculate the percentage of data corresponding to an expert or accuracy, calculated using the formula:

$$\% \text{ Accuracy} = \frac{\text{True Data}}{\text{Amount of test data}} \times 100\% \quad (10)$$

From the test results all data can be obtained as follows:

$$\% \text{ Accuracy} = \frac{39}{50} \times 100\% = 78\% \quad (11)$$

**Table 2.** Data Test Accuracy

No	Name	System Test	Expert Data	Result
1	Ny.Hatijah	Kat.Imatur	Kat.Imatur	True
2	Tn.Aris	Kat.Imatur	Kat.Imatur	True
3	Ny.Misnaya	Kat.Imatur	Kat.Imatur	True
4	Tn.Sumarwi	Kat.Matur	Kat.Matur	True
5	Tn.Sunaryo	Kat.Imatur	Kat.Imatur	True
6	Ny.Pusahya	Kat.Imatur	Kat.Imatur	True
7	Ny.Latifatun	Kat.Matur	Kat.Imatur	True
8	Tn.Taha	Kat.Imatur	Kat.Imatur	True
...	...	...	...	...
46	Tn.Rasyid	Kat.Imatur	Kat.Imatur	True
47	Tn.Saliye	Kat.Imatur	Kat.Imatur	True
48	Ny.Ruhani	Kat.Imatur	Kat.Imatur	True
49	Ny.andriyani	Kat.Imatur	Kat.Imatur	True
50	Tn.maskut	Kat.Imatur	Kat.Imatur	True

From the above calculation, expert system for diagnosis of cataract eye disease with fuzzy mamdani Logic method has the value of accuracy test percentage of 78%.

#### 4. Conclusion

From the results of the design of the implementation and testing of expert system applications to diagnose eye disease cataracts, it can be concluded that from a trial of 50 cases of data, obtained test results accuracy between system predictions with expert predictions obtained value of 78% correctness. From the test results of this expert system application, it is expected that the improvement by conducting the development of expert system application further by using other methods so that the bias compared from the results obtained. then by testing on another case to find a high degree of accuracy.

#### 5. Acknowledgment

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## Method Extreme Learning Machine for Forecasting Number of Patients' Visits in Dental Poli (A Case Study: Community Health Centers Kamal Madura Indonesia)

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# Method Extreme Learning Machine for Forecasting Number of Patients' Visits in Dental Poli (A Case Study: Community Health Centers Kamal Madura Indonesia)

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**Abstract.** Community Health Centers (Puskesmas) are health service institutions that provide individual health services for outpatient, inpatient and emergency care services. In the outpatient service, there are several polyclinics, including the polyclinic of Ear, Nose, and Throat (ENT), Eyes, Dentistry, Children, and internal disease. Dental Poli is a form of dental and oral health services which is directed to the community. At this moment, the management team in dental poli often has difficulties when they do the preparation and planning to serve a number of patients. It is because the dental poli does not have the appropriate workers with the right qualification. The purpose of this study is to make the system of forecasting the patient's visit to predict how many patients will come; so that the resources that have been provided will be in accordance with the needs of the Puskesmas. In the ELM method, input and bias weights are initially determined randomly to obtain final weights using Generalized Invers. The matrix used in the final weights is a matrix whose outputs are from each input to a hidden layer. So ELM has a fast learning speed. The result of the experiment of ELM method in this research is able to generate a prediction of a number of patient visit with the RMSE value which is equal to 0.0426.

## 1. Introduction

The Center for Public Health is a functional organization with health efforts that are comprehensive, integrated, equitable, acceptable and affordable by the community. Health services provided by puskesmas is a comprehensive service that includes curative services (treatment), preventive (prevention), promotive (health improvement) and rehabilitative (health restoration). The service is addressed to all residents with no distinction between sex and age group. Puskesmas have working areas covering one sub-district or part of the kecamatan. Population density factors, area size, geography condition and other infrastructure conditions are considered in determining the working area of puskesmas. Health development efforts are selected from the list of primary health care efforts of existing puskesmas that are school health efforts, health efforts by the body, public health care efforts, work health efforts, dental and oral health efforts, mental health efforts, eye health efforts, and efforts to foster traditional medicine

Puskesmas Kamal is a government-owned health service that provides health services for the Kamal sub-district. In the outpatient service there are several poly clinics, including Nose and Throat Ear Pole (ENT), Eye Poly, Dental Poly, Child Poly, and Poly Disease. Dentistry is a form of dental and oral health services directed to the community. Actions in dentistry are removal, patching, non-specialist neurological treatment and cleansing of tartar. In addition, it also provides counseling to



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patients about the importance of maintaining oral health as part of Maintain personal health, and improve knowledge and public awareness in the field of oral health.

Important factor to be considered is the availability of resources, because with the lack of resources will reduce the awareness and quality of service to patients. The existing resources, especially the material must be prepared in order to maintain the quality of services Puskesmas. Currently, the management of dental clinic of Kamal Puskesmas often experience difficulties in preparing and planning. The number of fluctuating patient visits makes it difficult for the planning party to predict how many patients will be coming so that the resources that have been provided are not in accordance with the requirements.

Forecasting technique is a technique to estimate a value in the future by taking into account past and current information. This forecasting technique has been studied in the last period which has many applications used to support in modeling forecasts such as stock forecasting, weather forecasting and so forth[1]. Standardized quantitative frameworks or techniques and mathematically explained rules are the definitions of a forecast. Forecasting is a vital part of any business organization and for any significant management decision-making because forecasting can be the basis for long-term planning. Each forecasting method has its limits and shortcomings. For example, traditional statistical methods are heavily dependent on time series data features that greatly affect the accuracy of forecasting [2].

Artificial Neural Network (ANN) is able to perform the introduction of data-based activities of the past. The past data which is studied by ANN has the ability to make decisions on data that has not been studied. ANN does not require a mathematical model but the problem is solved based on existing data.

ANN has a learning method which is called as Extreme Learning Machine (ELM), Single Hidden Layer Feedforward Neural Networks (SLFNs)[2]. ELM has attracted much attention from many researchers because it has advantages in terms of learning speed and good accuracy [3]. In addition to having universal capabilities ELM also has the ability to classify. So with this method, the output produced can approach the optimal settlement and computation time is relatively short. ELM performance can produce good generalizations in many cases and can do training faster than the current popular conventional learning algorithm [4]. ELM can be implemented with ease and the smallest weights so as to produce the smallest error value in the training process. While on the conventional network, all the parameters for the learning process then local minimum is set iteratively.

In the ELM method, input and bias weights are initially determined randomly. After that, Generalized Invers can be used to look for final weights. The matrix used in the final weights is a matrix whose outputs are from each input to a hidden layer [3]. Based on this, the study will predict how much the number of patient visits dentist in Kamal Community Health Center using ELM learning method. So by knowing how much the number of patient visits in the next period, it will help the puskesmas in providing resources needed by patients so that the optimal service.

## **2. Methodology**

### Data collection

The source of data in this study was obtained from Puskesmas Kamal. The data used is daily dental patient visit data for the last year that is year 2016 from January to December with total counted 248 data. Several studies divided the traning and testing process with the composition of 80% of training data and 20% of the total data testing [5]. Therefore in this study, the data is divided into two data training and testing. January-October data is data training as much as 198 daily data, while November-December is used as data testing with the amount of 50 data daily.

### **Extreme Learning Machine (ELM)**

ANN is one of the many applied methods in forecasting. Like the human brain, ANN consists of several neurons. Neurons will transform information received through the outgoing connection to other neurons. In neural networks, this relationship is known by the name of weight. The information is stored at a certain value on the weight [6].

**Table 1.** Visitors of Dental Poly in January 2016

No.	Date	Number of Patient Visits Daily
1	04/01/2016	23
2	05/01/2016	17
3	06/01/2016	12
4	07/01/2016	14
5	08/01/2016	12
6	11/01/2016	11
7	12/01/2016	8
8	13/01/2016	10
9	14/01/2016	14
10	15/01/2016	6
11	18/01/2016	2
12	19/01/2016	9
13	20/01/2016	18
14	21/01/2016	2
15	22/01/2016	15
16	25/01/2016	19
17	26/01/2016	5
18	27/01/2016	21
19	28/01/2016	16
20	29/01/2016	8

ELM is one of the models of ANN which uses Single Hidden Layer Feedforward Neural Networks (SLFNs) applications. ELM is an evolving learning technique of ANN by providing an efficient and unlimited solution to the feedforward network [7]. ELM shows how important the number of neurons in the hidden layer, but the number can be done randomly. ELM also has the ability to approach and universal classification. So ELM can produce high learning speed process. ELM has a simple level of complexity that unites popular learning algorithms and can be an appropriate solution for classification, regression, binary and multikas [2]. In the classification feature, features are randomized using a matrix so that the ELM can produce a final decision [8].

The process of normalization is the process of changing the value of a data into a value with a certain range. This process must be done first before the data is input into the input neuron in the ELM. Normalization is required because the activation function used will produce output with the data range [0,1] or [-1,1]. In this study the training data is normalized so that it has a range of values [-1,1]. The formulation of normalization is shown by equation (1),

$$X = 2 \times (xp - \min\{xp\}) / (\max\{xp\} - \min\{xp\}) - 1 \quad (1)$$

X Is the result of normalization which ranges between [-1,1], xp the actual data, min(xp) Is the minimum value, whereas max(xp) Is the maximum value in the data set. The results of normalization can be seen in table 2.

**Table 2.** Normalization of data

Pattern	Actual data						Normalization					
	X1	X2	X3	X4	X5	Target	X1	X2	X3	X4	X5	Target
1	23	17	12	14	12	11	0,9167	0,4167	0,0000	0,1667	0,0000	-0,0833
2	17	12	14	12	11	8	0,4167	0,0000	0,1667	0,0000	-0,0833	-0,3333
3	12	14	12	11	8	10	0,0000	0,1667	0,0000	-0,0833	-0,3333	-0,1667

4	14	12	11	8	10	14	0,1667	0,0000	-0,0833	-0,3333	-0,1667	0,1667
5	12	11	8	10	14	6	0,0000	-0,0833	-0,3333	-0,1667	0,1667	-0,5000

The most important thing in the forecasting process with the ELM is the process of training and testing. The training process aims to gain input weight, bias and output weight with a small error rate. While the testing process is to forecast based on the weight of input and output is , obtained from the training process. In the ELM training, it is used to develop the model, while in the testing process is used to evaluate the ability of ELM as a method of forecasting.

At the training stage, input and output are connected by the network. The input is supplied to the input neuron, the input layer processing by giving the activation function. The output generated from this layer is the input to the next neuron down to the neuron in the output layer. The connected relationship between neurons has a weight, which will always be updated to get a minimal error value. The error rate depends on the learning algorithm, the quality of the data and the type of network used [9].

Input on the network will be processed by a function that will add up the values of all weights. The result of the weighted sum will be compared with a threshold value through the activation function of each neuron [6]. The number of hidden neurons and activation functions must be determined to perform the training process. The trials in this study used the sigmoid log activation function because the function is most often used for forecasting problems. For the number of hidden neurons, ELM produces stable forecasting output with the number of neurons in the hidden layer 5-30 by evaluating every 5 neurons[10]. But if the output obtained from the ELM is less than optimal, it will be used to alternate transfer function or change the number of hidden neurons.

The input and output weights and biases of the hidden neurons with low error rates measured by MSE are the outputs of the ELM method. Input weight is determined randomly, while the output weight is the inverse of the hidden layer matrix and output. The new weight value is shown by table 3, while calculating the mathematical weight value can be seen in equation (2):

$$\beta = H^T T \quad (2)$$

returning the value of the output to its true value. while denormalization is shown by equation (3).

$$X = 0.5 \times (xp + 1) \times (\max\{xp\} - \min\{xp\}) + \min\{xp\} \quad (3)$$

**Table 3.** Weight and Bias

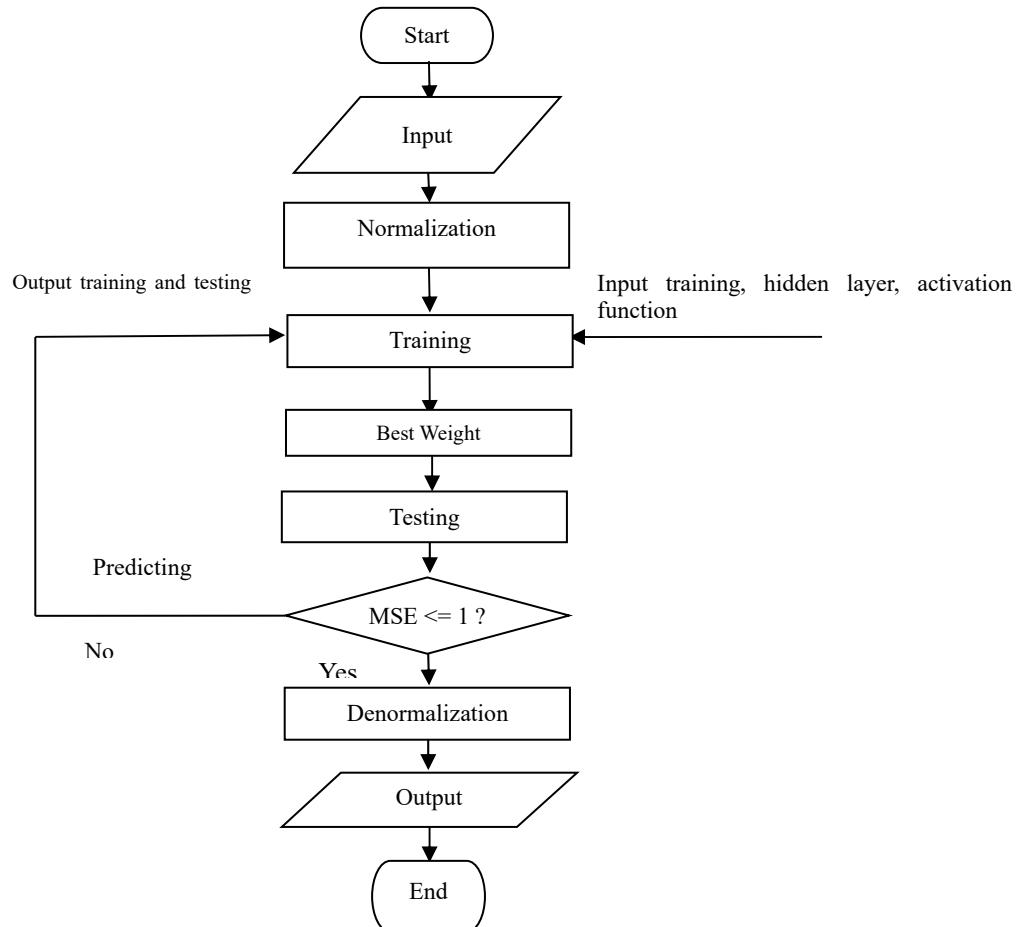
Weight					Bias
w1	w2	w3	w4	w5	
0,1996	0,2140	0,4003	0,4705	0,4305	0,1046
0,5208	0,8745	0,6328	0,5144	0,2818	0,7350
0,0931	0,1667	0,0552	0,6172	0,0540	0,6508
0,9123	0,3128	0,7046	0,7248	0,2397	0,7966
0,2380	0,7907	0,3283	0,2306	0,0452	0,2643

**Table 4.** Activation and new weight

Activation		New Weight				
		w1	w2	w3	w4	w5
		0,199858	0,218018	0,400088	0,470163	0,430179
		0,521994	0,87576	0,634027	0,515599	0,28301
0,098367	0,1817	0,094538	0,166669	0,055201	0,617198	0,053805
		0,914432	0,312758	0,704574	0,724752	0,237104
		0,238698	0,790741	0,328328	0,230555	0,044491

After doing the forecasting process, the next step is to do the process of denormalization.

Denormalization is the process of



**Figure 1.** Flowchart ELM

### Size Errors Forecasting

To evaluate the performance of the ELM method, this study used Root Mean Square Error (RMSE) [5]. To see if the method has been used is sufficient to predict a data then made an error measurement, because there is no forecasting method that can predict future data appropriately. The more precise a method of generating predictions , then the resulting error rate is smaller.

$$RMSE = \sqrt{\frac{\sum_{t=1}^n (X_t - F_t)^2}{n}} \quad (4)$$

The RMSE is obtained by subtracting the value of  $X_t$  which is the expected forecast value of period t with the  $F_t$  value which is the forecasting value of the system in the squared period t. Last is leveling as much n the amount of data.

### 3. Results and Discussion

The methods performed and the data used are described in the methodology section. This section describes accurate and effective forecasts that can assist decision makers in planning the amount of resources which needed in puskesmas especially dental poly. So that the service to patient

can be maximum. In the implementation stage, it is tested by using the sigmoid activation function with the hidden number of combining 5,10,15, and 20. In table 3, it shows the comparison of learning speed and error size using RMSE.

**Table 5** RMSE comparison uses a combination of hidden layer neuron changes

Hidden Layer	Time	RMSE
5	0.0468	0.0851
10	0.0313	0.0638
15	0.0312	0.0426
20	0.2184	0.1064

#### 4. Conclusions

The conclusions that can be drawn from this research are as follows:

1. The test results using different number of hidden neurons, then the ELM produces the optimal output with the number of hidden fifteen neurons.
2. ELM produces forecasting output with low error rate of 0.0426
3. Learning speed required by ELM is very short, that is average 0.0312 seconds.
4. The output of the ELM is determined by parameter determination such as the activation function and the number of hidden neurons.

#### 5. Acknowledgment

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## Link Power Budget and Traffict QoS Performance Analysis of Gygabit Passive Optical Network

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# Link Power Budget and Traffic QoS Performance Analysis of Gigabit Passive Optical Network

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**Abstract.** Data service of telecommunication network is needed widely in the world; therefore extra wide bandwidth must be provided. For this case, PT. Telekomunikasi Tbk. applies GPON (Gigabit Passive Optical Network) as optical fibre based on telecommunication network system. GPON is a point to a multipoint technology of FTTx (Fiber to The x) that transmits information signals to the subscriber over optical fibre. In GPON trunking system, from OLT (Optical Line Terminal), the network is split to many ONT (Optical Network Terminal) of the subscribers, so it causes path loss and attenuation. In this research, the GPON performance is measured from the link power budget system and the Quality of Service (QoS) of the traffic. And the observation result shows that the link power budget system of this GPON is in good condition. The link power budget values from the mathematical calculation and direct measurement are satisfy the ITU-T G984 Class B standard, that the power level must be between -8 dBm to -27 dBm. While from the traffic performance, the observation result shows that the network resource utility of the subscribers of the observed area is not optimum. The mean of subscriber utility rate is 27.985 bps for upstream and 79.687 bps for downstream. While maximally, It should be 60.800 bps for upstream and 486.400 bps for downstream.

## 1. Introduction

Optical fiber telecommunication network system is needed and widely applied in the whole of the world because it provides the widest bandwidth and the highest access rate [1] [4]. Optical fiber is made from purified silicon, so it is not electrical conductor and it is not influenced by electrical interference.

PT. Telkom proceeds to change the access network technology from copper based network to optical fiber based network, because they can not satisfy the need of extra large bandwidth. With optical fiber, PT. Telkom develops triple play services (telephony, internet and cable TV). Even more than triple play, it also develops the services to IP camera service. Therefore, PT. Telkom changes the access network system to the new infrastructure of optical fiber network that is called as GPON (Gigabit Passive Optical Network).

GPON becomes the main choice among several architectures that can be used in FTTx today [8]. GPON and DSL access technology are applied to improve broadband internet penetration [6]. One of the excess of GPON is the passive splitter. With it, the optical fiber cable can be split into other optical fiber branches. There are three main sections of GPON: OLT (Optical Line Terminal), ODN (Optical Distribution Network) and ONT (Optical Network Terminal). OLT services interfacing to local central, multiplexing/de-multiplexing, controller and interfacing to ODN. There are some ODNs in one OLT. ODN services data transmission and distribution from OLT to ONT. The distribution



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function of electrical power is applied by splitter to all branch of the network. While ONT services interfacing to ODN and to subscriber terminal [3].

The splitting of optical fiber network system, from OLT, ODN until ONT causes power losses. The power losses of the network system must be observed in order to provide reliable network service, and it is referred to Link Power Budget. Beside that, the performance of optical fiber network system is observed from the traffic QoS (Quality of Service).

The telecommunication network performance measurement is often made and published in many journal. For example, the simulation and evaluation of computer network performance based on data packet size difference [9], Farther more, forecasting for computer network performance with quadratic equation method [10]. In optical fiber network, there are many published papers about the performance evaluation. For example, the analysis of GPON performance that will be implemented in Kosovo [2], the enhancement of GPON performance [7], Farther more, the scheme of time division multiplexing over passive optical networks that is called TDM-PON as a solution in network broadband development [5]. In this research, GPON that is applied by PT. Telkom Regional Division V is observed if it provided a good services to subscribers or not. The comparison of the service standard that is used in this paper is Standard Recommendation of ITU-T G.984.

## **2. Gigabit Passive Optical Network**

PON (Passive Optical Network) is point-to-multipoint optical fiber based network that is developed to replace copper based network. It has optical splitter component that has function in data transmission to several terminal. The optical splitter is passive. It doesn't manipulate optical signal. PON is made by FSAN (Full Service Access Network), then it is standardized by ITU-T (A/BPON, GPON) or IEEE (EPON) [4].

GPON is technology that is developed by ITU-T G.984. it uses optical fiber as transmission medium. It uses TDMA (Time Division Multiple Access) in upstream multiple access technique with rate 1,2 Gbps, and uses broadcast technique for downstream with rate 2,5 Gbps. Some level best of GPON are:

1. It supports triple play application (data, voice and video) of FTTx service over one optical fiber core.
2. It can divide bandwidth to 32 ONT
3. It is more simple in cable installation than point-to-point architecture
4. Bandwidth allocation can be managed
5. It has flexibility in information transmission with different bit rate

While some shortage of GPON are :

1. Complexity in layering model
2. Very expensive

## **3. Methodology**

Measuring performance is one of the main elements in design, operation and management of the network. Some metrics that is usually used in measuring the network performance are delay, jitter, throughput, blocking probability. There are 3 methods in measuring the network performance [11],

1. Direct measuring (collecting data observation of the existing system). Some advantageous of direct measuring are accurate, precise, detail. But it depends on the tools and needs a lot of time.
2. Simulation (observing over the computer model of the system). Some advantageous of simulation are wider in the problem coverage, time scale management, and independency to existing system. But it has problems especially in sensitivity of the tools, so it needs validation step to the output data.
3. Analysis (making description of the system analytically). Some advantageous of pure analysis are saving the time, and the problem coverage that is wider than direct measuring and simulation. But the result is just approximation conclusion.

The performance of GPON here is observed over link power budget and QoS of the traffic. In the link power budget, the power values are obtained by 2 ways, direct measuring and calculation. The power values from both of direct measuring and calculation are compared. The next step is calculating the MSE (Mean Square Error) and Se (Standard Deviation of Error). Then, the power level quality is compared to standard recommendation of ITU-T G.984 that is enclosed in table 1 and table 2.

The power level calculation follows,

$$P_l = P_i - L_t \quad (1)$$

with,  $P_l$  = Power level

$P_i$  = Initial power

$L_t$  = Total loss

The calculation of MSE follows,

$$MSE = \left[ \frac{\sum_{i=1}^n e_i^2}{n-2} \right] \quad (2)$$

While the calculation of  $S_e$  is,

$$S_e = \sqrt{MSE} \quad (3)$$

**Table 1.** Link power budget standard system applied in PT. Telkom regional division V

No	Parameter	Unit	Attenuation Standard (dB)	volume	Total Attenuation (dB)
1	Optical fiber cable length	Km	$\leq 0,35$	17	5,96
2	splitter 1:2	unit	$\leq 3,70$		
	1:4	unit	$\leq 7,25$	1	7,25
	1:8	unit	$\leq 10,38$	1	10,38
	1:16	unit	$\leq 14,10$		
	1:32	unit	$\leq 17,45$		
3	Connector SC/UPC	unit	$\leq 0,25$	14	3,5
	SC APC/UPC	unit	$\leq 0,35$	2	
4	Adapter SC/PC single mode(blue)	unit	$\leq 0,20$	7	1,4
5	Connection in feeder cable	unit	$\leq 0,10$	5	0,5
	In distribution cable	unit	$\leq 0,10$	2	0,2
Maximum total attenuation on theory					29,19
Maximum total attenuation of link power budget of GPON class B					28

**Table 2.** OLT Transceiver and ONT receiver recommendation of ITU-T G984

OLT Recommended Operating Conditions				
Parameter	Min	Typ	Max	Unit
Storage Temperature	-40		85	°C
Operating Case	0		70	°C
Temperature	-40		85	°C
Relative Humidity	5		95	%
Power Supply Voltage	3.15	3.3	3.45	V
Power Supply Current			500	mA

OLT Transmitter Optical Specification				
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Average Output Power	1.5	5	dBm
Centre Wavelength	1480	1490	1500 nm
Spectral Width		1	nm
<b>ONT Receiver Optical Specifications</b>			
Receiver sensitivity		-27	dBm
Receiver Overload	-8		dBm
Wavelength of Operation	1260	1310	1360 nm

The second step of observing the GPON performance is calculating the traffic QoS. The parameter that is used to measure the QoS in this paper is utility rate (bps). The utility rate  $r_u$  defines a number of bits proceeded (bits utility)  $b$  during the observation time  $t_o$ .

$$r_u = \frac{b}{t_o} \quad (4)$$

The raw data of bits utility is obtained from I-Booster of PT. Telkom. It contains upstream and downstream utility bit and observation time. Furthermore, the value of utility rate is compared to the maximum bit rate recommended by ITU-T G.984 (1,2 Gbps for upstream and 2,4 Gbps for downstream). The data is obtained in Semolowaru Elok, Manyar, Surabaya.

#### 4. Results and Discussion

From the previous explanation, the GPON performance in this research is evaluated from two schemes, the link power budget and the traffic QoS. The results of link power budget observation are shown in table 3.

The error standard deviation of power level on ODC  $S_{e,pl.ODC}$  is low (0,665 dBm). It means that the power level value of the calculation  $P_{l,ODC}$  and power level value of measurement  $P'_{l,ODC}$  have almost same value. So do the error standard deviation of the attenuation loss on ODC  $S_{e,l.ODC}$  (1,555 dBm). It means that the attenuation loss value of the calculation  $L_{ODC}$  and the attenuation loss value of measurement  $L'_{ODC}$  have almost same value too.

**Table 3.** The link power budget

<b>Link power budget on OLT</b>		
Initial power of OLT	$P_i$	5 dBm
Power level of OLT	$P_{l,OLT}$	5 dBm
<b>Link power budget on ODC</b>		
Power level of the calculation	$P_{l,ODC}$	-5,235 dBm
Power level of the measurement	$P'_{l,ODC}$	-4,767 dBm
MSE of the power level	$MSE_{pl.ODC}$	0,442 dBm
$S_e$ of the power level	$S_{e,pl.ODC}$	0,665 dBm
Attenuation loss of the calculation	$L_{ODC}$	9,135 dBm
Attenuation loss of the measurement	$L'_{ODC}$	8,038 dBm
MSE of the Attenuation	$MSE_{l.ODC}$	2,418 dBm
$S_e$ of the Attenuation Loss	$S_{e,l.ODC}$	1,555 dBm
<b>Link power budget on ODP</b>		
Power level of the calculation	$P_{l,ODP}$	-16,188 dBm

Power level of the measurement	$P'_{L,ODP}$	-5,238 dBm
MSE of the power level	$MSE_{pl,ODP}$	42,798 dBm
$S_e$ of the power level	$S_{e,pl,ODP}$	6,547 dBm
Attenuation loss of the calculation	$L_{ODP}$	11,358 dBm
Attenuation loss of the measurement	$L'_{ODP}$	8,929 dBm
MSE of the	$MSE_{l,ODP}$	6,167 dBm
Attenuation loss		
$S_e$ of the	$S_{e,l,ODP}$	2,483 dBm
Attenuation loss		
Power level on ODP output recommended by ITU-T G.984		$\leq -28$ dBm

The error standard deviation of power level on ODP  $S_{e,pl,ODP}$  (6,547 dBm) is higher than  $S_{e,pl,ODC}$ . The power level value of the calculation  $P_{L,ODP}$  and power level value of measurement  $P'_{L,ODP}$  have different value relatively. It means that the accuracy level of the power level of the calculation value and the measurement value are worse than the value in ODC. So do the error standard deviation of the attenuation loss on ODP  $S_{e,l,ODP}$  (2,483 dBm). It is higher than the value in ODC. It means that the accuracy level of the attenuation loss of the calculation value and the measurement value are worse than the value in ODC. This condition can be analyzed,

1. The values of calculation involves maximum values. So, it causes the error standard deviation value is higher than the measurement value.
2. The quantity of splitting points from OLT to ODP is greater than from OLT to ODC. So, it causes the error standard deviations of ODP ( $S_{e,l,ODP}$  and  $S_{e,pl,ODP}$ ) are greater than the error standard deviations of ODC ( $S_{e,l,ODC}$  and  $S_{e,pl,ODC}$ ).

The GPON performance from link power budget is good, because the ODP power level value of calculation ( $P_{L,ODP} = -16,188$  dBm) and measurement ( $P'_{L,ODP} = -5,238$  dBm) are better than the value of ITU-T G.984 standard recommendation ( $\leq -28$  dBm).

The second evaluation of GPON performance in this paper is about traffic QoS. The result of measurement and calculation of that can be analyzed as follow,

1. The mean of upstream utility rate of each subscriber is 27.985 bps. Whereas the maximum mean of upstream utility rate of that should be 60.800 bps. It means that the upstream network utilization of each subscriber is only 46%.
2. The mean of downstream utility rate of each subscriber is 79,687 bps. Whereas the maximum mean of downstream utility rate of that should be 486.400 bps. It means that the downstream network utilization of each subscriber is only 16%.
3. The mean total of upstream utility rate of all subscriber in one line ONT is 1.119.405 bps. It means that the mean total of upstream utility rate of all subscriber in one line OLT is for about 5 Mbps. Whereas the maximum upstream utility rate of one OLT according to ITU-T G.984 standard recommendation should be 1,2 Gbps. This data shows that the utility of the network resource is too low and it should be developed.
4. While, the mean total of downstream utility rate of all subscriber in one line ONT is 3.185.462 bps. It means that the mean total of downstream utility rate of all subscriber in one line OLT is for about 13 Mbps. Whereas the maximum downstream utility rate of it according to ITU-T G.984 standard recommendation should be 2,4 Gbps. It means lack of subscriber and utilization.

## 5. Conclusion

Some conclusions of the research are :

1. The error or the difference between calculation value and measurement value of the power level and the attenuation loss in ODP is greater than in ODC, because of the number of splitting points in ODP is also greater than in ODC, beside the effect of the maximum values that is used in calculation.
2. The GPON performance from link power budget is good, because the ODP power level value of calculation ( $P_{L,ODP} = -16,188$  dBm) and measurement ( $P'_{L,ODP} = -5,238$  dBm) are better than the value of ITU-T G.984 standard recommendation ( $\leq -28$  dBm).
3. The number of subscriber in OLT for the case of this research is too small, and the network utilization is also too low. So the recommendation for PT. Telkom Regional Division V is to increase the subscriber quantity especially in Semolowaru Elok, Manyar of Surabaya.

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## Water Quality Control for Shrimp Pond Using Adaptive Neuro Fuzzy Inference System : The First Project

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# Water Quality Control for Shrimp Pond Using Adaptive Neuro Fuzzy Inference System : The First Project

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**Abstract.** Shrimp farming becomes the main commodity of society in Madura Island East Java Indonesia. Because of Madura island has a very extreme weather, farmers have difficulty in keeping the balance of pond water. As a consequence of this condition, there are some farmers experienced losses. In this study an adaptive control system was developed using ANFIS method to control pH balance (7.5-8.5), Temperature (25-31°C), water level (70-120 cm) and Dissolved Oxygen (4-7.5 ppm). Each parameter (pH, temperature, level and DO) is controlled separately but can work together. The output of the control system is in the form of pump activation which provides the antidote to the imbalance that occurs in pond water. The system is built with two modes at once, which are automatic mode and manual mode. The manual control interface based on android which is easy to use.

## 1. Introduction

Shrimp is a water commodity that has a good potency. In addition it has delicious taste, shrimp are also highly valued and give a positive contribution in the addition of foreign exchange a country. In Indonesia, shrimp farming is done by utilizing pond land. There are several things to consider in maintaining the water balance of ponds for shrimp farming to succeed properly, for example pH should range from 7.5 to 8.5, temperatures ranging from 25 to 31 ° C, water level 70 cm - 120 cm, and DO (Dissolved Oxygen) 4 - 7.5 ppm [1].

Pond water quality control that focuses on pH and alkalinity equilibrium has been done using ozonation method [2]. Unfortunately in this study the control is still done manually and not yet using computerized system. In 2012, the hydrobiological monitoring system began to be developed online. In the study ponds / ponds are made in a modern way. The research focuses only on pH, DO and other pH monitoring systems performed online and realtime, while the control system for maintaining water balance has not been done [3] [4].

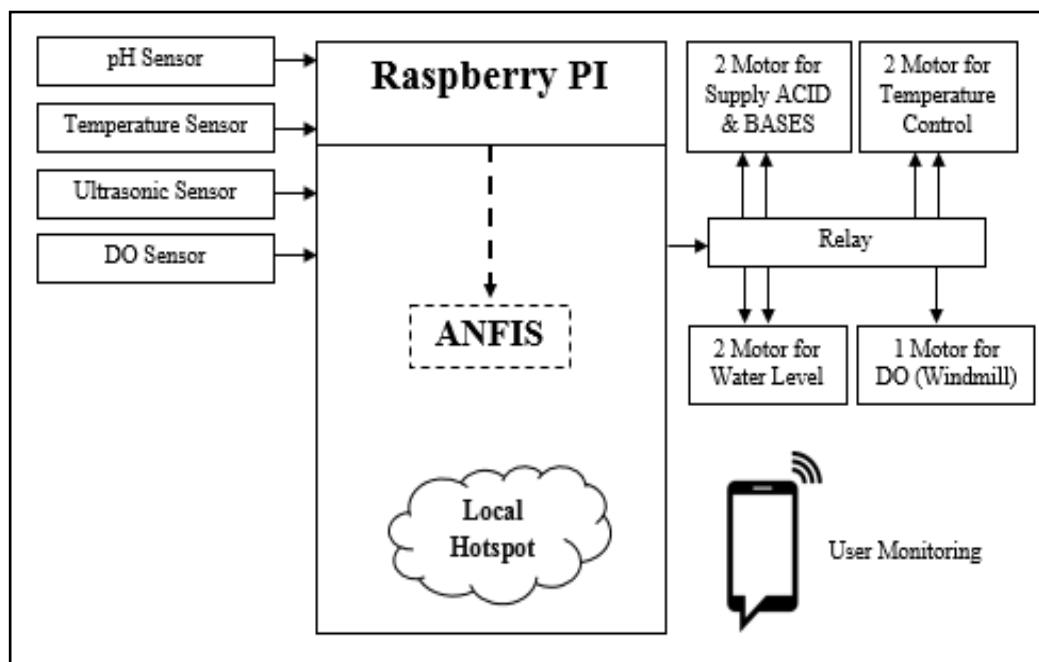
Research on hydrobiological balance monitoring was further developed by Daudi Simbeye et al. in 2014. The study also focuses only on monitoring systems [5]. Research on water quality monitoring and control is also done by focusing on 4 aspects at once: sensing and instrumentation, communication and networking, computational techniques, and control systems [6]. This research is very general and has not focused on pond water equilibrium system. The monitoring system of pH, DO and pond water temperature is also done by utilizing the network and done online. The final monitoring data can also be sent via SMS service [7]. In addition to monitoring systems, research on shrimp farming also leads to land searching that suits shrimp ponds. The decision-making process uses AHP to determine which land is good for brackish shrimp ponds [8].

Research on Automatic controls to adjust pH, DO, and water levels using Raspberries are already done online. Settings for maintaining pH, DO and water level are set online using an interface built using html [9]. The use of artificial intelligence methods to control pH development began. Fuzzy logic is embedded in the PLC to maintain pH balance. But in this study control only focuses on maintaining pH balance only [10]. Research on potatoes maintaining micro hydrobiologic balance is very much done [11] [12] [13]. Unfortunately, the existing research focuses only on monitoring systems, while control systems to maintain microhydrobiology have not been performed.

Therefore, in this study created a control system that works automatically to maintain the balance of pH, temperature, water level, and Dissolved Oxygen. The control system created can work adaptively in maintaining the pH balance, temperature, water level, and Dissolved Oxygen. The system is made using Raspberry PI equipped with various sensors and artificial intelligence for the system to work autonomously. Artificial intelligence is built using ANFIS method that works based on pH value, temperature, water level, and Dissolved Oxygen. This tool will be applied in a special area that the climate is very extreme, such as in Madura area of East Java Indonesia.

## 2. Research Object

The research object developed in the form of a tool made using Raspberries equipped with pH sensor to measure pH balance, temperature sensor to measure pond water temperature, ultrasonic sensor to measure water level and DO sensor to measure dissolved water oxygen content of pond. As in Figure 1, the four sensors are connected directly to the raspberry PI as the main controller. The measurement value of the sensor is then inputted and processed using ANFIS to determine decision making.



**Figure 1.** Block Diagram

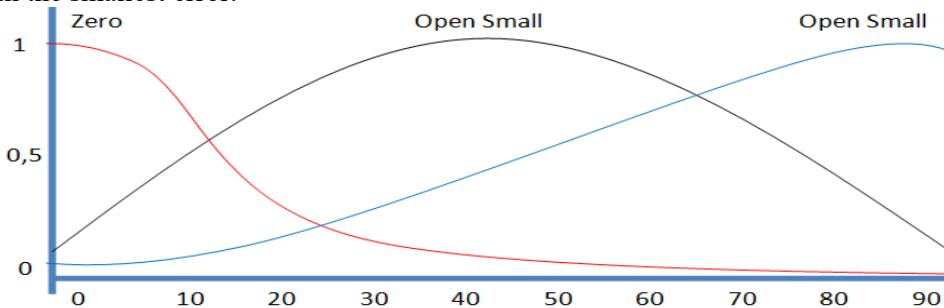
## 3. Sensors Module

- pH Probe Sensor to measure pH balance, power module 5V, pH Range 0-14, precision level  $\pm$  0.1 pH, response time  $\leq$  1 min
- LM35 Temperature Sensor for temperature measuring, 0.5 °C accuracy, operates from 4V - 30V, range -55 °C - 150 °C
- Ultrasonic Sensor for measuring water level, HC-SR04 Module, Voltage 5V DC, Current 15mA, max range 4m, min range 2 cm, Frequency 40Hz

- d. Dissolved Oxygen Probe to measure water oxygen level, Range 0 - 35 mg / L, Response Time ~ 0.3 mg / L / sec, Max Pressure 100 PSI

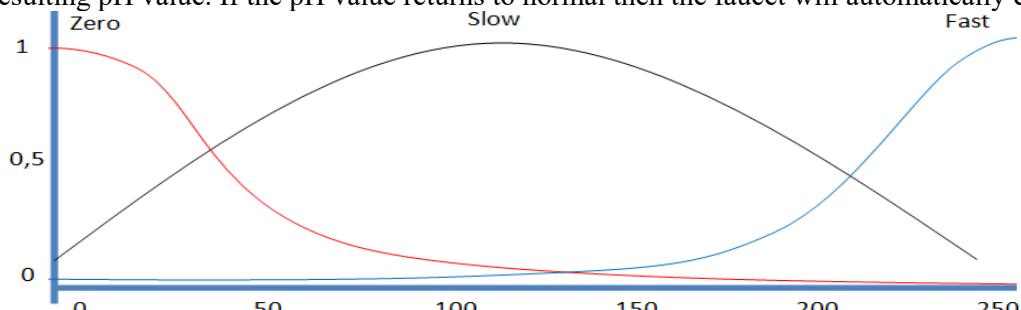
#### 4. ANFIS (Adaptive Neuro Fuzzy Inference System)

In this study, the calculation of pH balance value, temperature, water level and Dissolved oxygen are divided into 4 parts: pH with  $\Delta\text{pH}$  produces pH, Temperature with  $\Delta\text{Temp}$  produces Temperature, Level with  $\Delta\text{Lev}$  yields Level, and DO with  $\Delta\text{DO}$ . Each case was calculated separately using the ANFIS method. Eight data will be in training offline using matlab to find the ideal Fuzzy Inference System with the smallest error.



**Figure 2.** Output Fuzzy Inference System for pH

The basic essence of data training is that FIS is generated based on data mapping and trained by varying the premise and consequent parameters, so that the resulting FIS can follow the predetermined output. The four parameters are trained for 5000 epoch each, whereas the smallest error in the pH data processing process is 0.082. Figure 2 is the output of offline training data on the pH controller. Output is the action of opening acid or base faucet in 3 membership function, ie zero (closed closed faucet), Open\_Small (open faucet), and Open\_Big (open faucet very wide). The farthing of the output depends on the resulting pH value. If the pH value returns to normal then the faucet will automatically close.

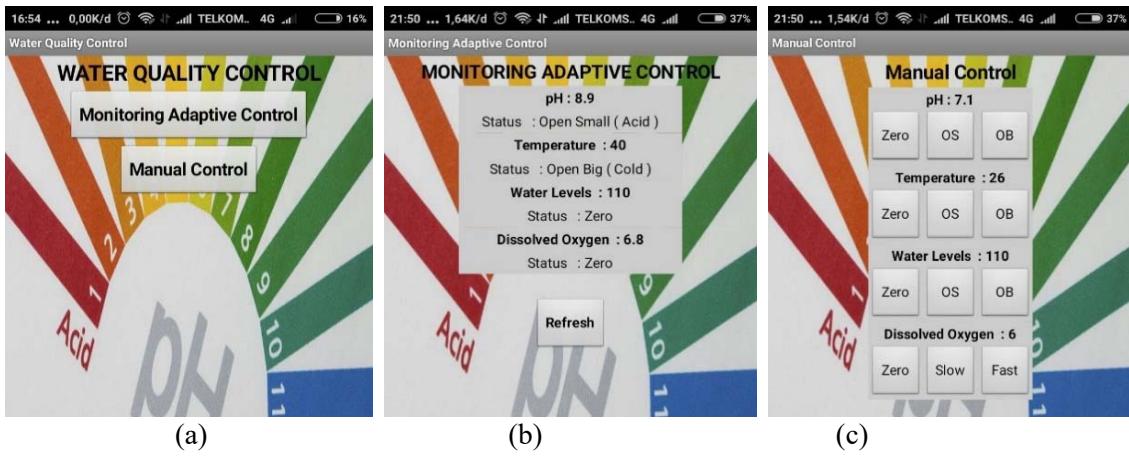


**Figure 3.** Output Fuzzy Inference System for DO

Figure 3 is the output of offline training data on the DO controller. Output is the action of turning the windmill in 3 membership functions: zero (silver windmill), Slow (medium spinning windmill), and Fast (windmill spin fast). Fixed output also depends on the value of DO produced. If the value of DO returns to normal then the windmill rotation will be stopped.

#### 5. Results and Discussion

The system is made using python programming language. Raspberry PI as the main controller receives data from the sensor and processes the data to produce a certain action in maintaining the quality of water. To produce a stable control, each parameter is controlled separately but can work simultaneously. In addition, in this study also made two control modes namely automatic mode and manual mode. Automatic mode is the control mode where the whole system works autonomously by relying on artificial intelligence that has been planted. While the manual mode is a mode where the control is done by the user with an android based interface that can be accessed via smartphone.

**Figure 4.** User Interface Monitoring Control

In Figure 4 (a) display the system's initial view. There are two menu options namely "Monitoring Adaptive Control" and "Manual Control". The Adaptive Controls Monitor menu will display the current state and system state such as Figure 4 (b). Users will only be informed of the pH, Temperature, Water Level and DO values and the control actions that the system is performing, because in this position, the system works autonomously using artificial intelligence already provided. Manual control As in Figure 4 (c) is a page that displays pH, Temperature, Water Level and DO values and gives the user the freedom to manually control by pressing Zero, OS (Open Small) and OB (Open Big) . If the user selects the manual control menu, the automatic adaptive control stops.

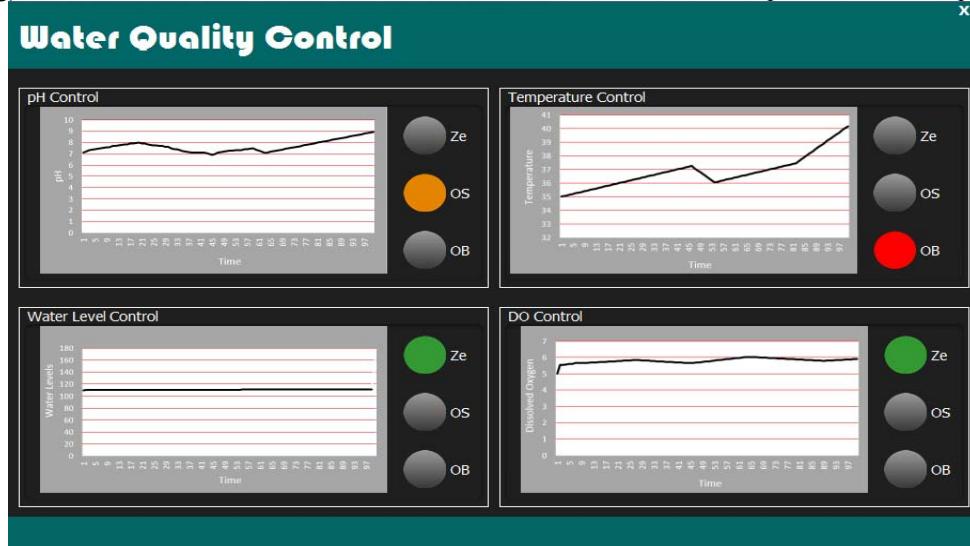
**Figure 5.** User Interface Main Control

Figure. 5 is a user interface for adaptive control system. Based on the measurement results, the pH is in the range of 7 to 9. In theory, this indicates that there is an imbalance of pH value. Therefore the control system will automatically open the Acid faucet with Open OS level until the pH level returns to normal. If the pH level returns to normal, the Acid faucet will automatically close. Likewise with the temperature sensor readings, based on the measurement results, the water temperature ranges between 35-40 °C. In theory, the temperature of 40 °C is in the position of less good category for shrimp development. Therefore the system will automatically open the faucet with the OB (Open Big) level of drainage and replace it with new water until the normal temperature point is reached. Water level measurements using ultrasonic sensors still show at safe levels, ranging from 110-111 cm and this is a good category for shrimp farming. In this case the system will not react (Zero) because the

water level is still in a safe position. Results Measurements of DO sensors show still within safe limits ranging from 5-6 ppm.

## 6. Conclusion

Overall the system works very well. The measurement of the sensor is very precise and the adaptive control works well. In addition, to facilitate the fishpond management, the system can also be controlled manually using a smartphone with a very simple user interface and easy to operate even by the layman though. Based on the test results, ponds on the island of Madura, East Java Indonesia with extreme weather yag, water temperature is quite high, ranging between 35-40 °C, of course, this also affects the pH. But with the existence of this control system, the problem has been resolved well.

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## Thumb Reach of Indonesian Young Adult When Interacting with Touchscreen of Single-Handed Device: A Preliminary Study

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# Thumb Reach of Indonesian Young Adult When Interacting with Touchscreen of Single-Handed Device: A Preliminary Study

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**Abstract.** This study is a preliminary survey on thumb reach of Indonesian population when interacting with single-handed device. This study was aimed to know the thumb reach envelope on the screen of mobile phone. The correlation between the thumb reach vs. the hand length and thumb length was also identified. Thirty young adults participated in the study. All participants had normal body stature and were right-handed person. In the observational phase, the participant was asked to colour the canvas area on the screen of the mobile phone by using his/her thumb. The participant had to complete the task by applying the single hand interaction. The participant should grab the mobile phone as he/she use it normally in his/ her daily activities. The thumb reach envelope of participants was identified from the coloured area of the canvas. The results of this study found that participants with a large hand length and thumb length tend to have a large thumb reach. The results of this study also show the thumb reach area of the participants is forming an elliptical shape that runs from the northeast to southwest on the device screen.

## 1. Introduction

Nowadays we can find people use mobile device everywhere. It is easy to find people interact with their mobile device on the bus, train, and other public transportation. They use the mobile device while sitting, standing, and walking. Few studies found people grasp their mobile device in many postures, such as: single hand, two hands, and in cradle mode [1, 2, 3]. Another survey found people use their mobile device in a flat or tilt position on a table, especially if they are interacting with tablets [4].

Few observations found people can easily change their ways in interacting with the mobile device from one posture to another one very often. It is easy to find individuals using one hand at an initial time, and then using their other hand, then moving to cradle posture, and then going back to the initial posture [2]. Another study observed the use of two thumbs, one thumb and one finger found that all participants used at least two methods [5]. Overall, those observations also obtained that most people use their thumbs and index fingers to interact with the screen of their devices [2, 5].

In the survey on the one-hand interaction, few researchers confirmed that people commonly use their thumb to interact with the touchscreen of mobile devices [2, 3]. It seems reasonable since the use of the thumb in one-handed interaction was considered to be more effective than the use of stylus or index finger [6]. People used their thumb in various posture to gain a more accurate touching point on the screen [7]. It is also possible to see that the thumb posture is depend on the position of touching target. Furthermore, a different thumb posture would show a different fingertip contact area size and shape [8].

Survey on the thumb reach performed by Otten et al. [9] seems to be the first effort of functional anthropometry of thumb since commonly many data collections on human body and its specific parts,



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included foot, hand, and other parts, were done in a structural state. The methodology developed by Otten et al. [9] can be used as a guideline for collecting the data of thumb reach envelope for a specific application [10]. Besides, the results of Otten et al. [9] study are useful for handheld device designers and engineers.

The current study focused on the measurement of the thumb reach for the mobile phone use since it is one of the mobile device that are largely used by people in whole world now. A recent development of mobile phone showed that its size is larger and larger than it in few years ago. Accordingly, it is easy to find people using a mobile phone that its size is larger than their hand size. A bigger size of mobile phone may be nice in visual aspect, but it is possible to be a problem since the users commonly use it in single-hand posture, especially for users with small hand size. People with a large hand size tend to have larger thumb reach than people with a small hand size [8]. Considering this phenomenon, this study was aimed to identify the thumb reach of Indonesian young adult when interacting with their mobile phone in single hand posture.

## 2. Materials and Method

Thirty individuals (15 males), aged in the range of 18 and 20 years old, participated in this study. All participants were students of Industrial Engineering Department at the University of Trunojoyo Madura. There are no specific requirements for participants in this study, except they should have a normal body stature and dominantly use their right hand to perform their daily activities.

The data acquisition was done at the Laboratory of Ergonomics and Work System Design, University of Trunojoyo Madura. The procedures were adopted from the study of Umami et al. [11] and Otten et al. [9]. The procedures have been simplified in order that the participants can easily complete the required task. Besides, few equipment was used to collect the required data such as digital scanner and mobile phone.

A Canon LiDE 210 digital scanner was used to capture the participants' hand image. The hand length and thumb length dimensions were measured from the digital hand images by using an image-based measurement software from the ImageJ (available at <http://rsbweb.nih.gov/ij/>). Some pertinent measurements on the image saved from the Drau application was also measured by using the software.

A Samsung Galaxy mobile phone was used in the observation. Dimensional specification of the mobile phone was shown in Table 1.

**Table 1.** Dimensional specification of mobile phone used in the observation.

Body dimensions	Length	: 121.5 mm
	Width	: 63.1 mm
	Thickness	: 10.5 mm
Screen size	Diagonal	: 101.6 mm (4 inch)
	Height	: 87 mm
	Width	: 52.5 mm
Distance between the screen edges and device edges	Top	: 17.75
	Bottom	: 16.75
	Right	: 5.3 mm
	Left	: 5.3 mm

A drawing application, Drau v1.3.5 which is available at Google Play Store™, was installed on the mobile phone. A canvas with 200 cells (20 cells high and 10 cells wide; each cell has 4.35 mm high and 5.25 mm wide) was set up on the display and used to identify the thumb reach (Fig. 1).

In the observational phase, the participant was asked to grab the mobile phone in one hand as he/she normally hold it in their daily use. Then the participant was asked to swipe his/her thumb on the canvas. The participant should keep the position of the mobile phone during he/she was completing the task.



**Figure 1.** Cells in canvas of Drau application (Reproduced from Umami et al. [11])

Thumb reach envelope is obtained from the area that could be reached by the participants' thumb on the screen. The line generated by the participants' thumb swipe showed the track of contact center between the thumb and screen. Each cell that was covered by the line of the closed curve drawn by the participant (based on researcher's judgment) was included in the individual participant's thumb reach. The covered area is classified as the comfortable area. The maximum thumb reach was defined as the farthest distance that could be comfortably reached by the thumb of participant. The maximum thumb reach was measured from bottom-right of the mobile phone.

The strength of correlation between the maximum thumb reach and the hand length and thumb length was determined by using Person's correlation analysis. The area that could be reached by the participants was identified by using heat map analysis. The shape of the reachable area was done by inspecting the heat map visually. The percentage of participants who could comfortably reach an individual area (cell) on mobile phone the screen was also possible to be represented by different colour on the heat map.

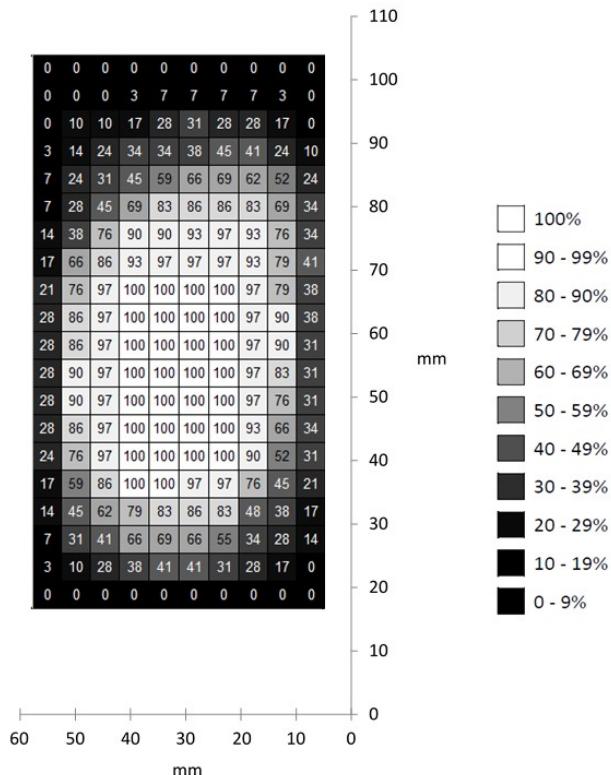
### 3. Results and Discussion

This study measured the hand length and thumb length participants. The survey found the mean and standard deviation of the hand length and thumb length of the participants are 169.76 mm ( $SD = 33.63$  mm) and 61.06 mm ( $SD = 4.24$  mm) respectively. The thumb reach measurements found the average of the participants thumb reach is 56.93 mm ( $SD = 5.50$  mm).

The Pearson's correlation analysis showed that there is no significant correlation between the maximum thumb reach vs. the hand length and thumb length. The current study found the coefficient of correlation are 0.36 and 0.25 respectively ( $p > 0.05$ ). From these findings, it is hard to say that people with a larger hand length and thumb length tend to have a larger thumb reach. The results are in accordance to the conclusions obtained by Kim and Jung's [12] study, in which they found that the hand size does not affect the thumb reach. The findings of this study are in contrary to that of Otten et al. [9] and Umami et al. [11] that clearly concluded the existence of significant, but weak, correlation between the maximum thumb reach and length of the thumb. Based on the results of the current study and the selected previous studies, it is possible to summarize that there are few factors affecting the thumb reach are of the mobile phone users. According to Otten et al. [9], the discrepancy might be caused by few factors, such as the way participants hold the mobile phone, participant's experience with touchscreen device and possibility of misunderstood the instructions during the survey.

A heat map analysis done in this study found the percentage of participants that could comfortably reach an individual cell on the canvas at the screen (Fig. 2). From Fig. 2, it is possible to see that there is no participant that could reach all areas on the screen easily. This finding is similar to the finding of Umami et al. [11] that observed the Portuguese young adults. However, this result shows more cells in the centre of the screen were easily reached by participants of the current study than those that were

reached by participants of the corresponding study by Umami et al. [11]. It is also possible to state that the result of the current study has a little difference from the study of Otten et al. [9] which found few participants could reach all areas on the screen. The differences may occur due to the differences on the size of the device used in the experiment and the way participants grasping their mobile devices in the observational phase.



**Figure 2.** Heat map analysis for the percentage of participants that comfortably reached cells on the screen

The heat map analysis showed that 80% of the participants can comfortably touch an area between 30.0 and 86.6 mm from the bottom and between 9.7 and 51.7 mm from the right (Fig. 2). From Fig. 2, it is possible to see that the thumb reach area of participants is forming an elliptical shape running from the bottom-left to the top-right of the screen. This result is similar to the finding of Karlson et al. [13], Otten et al. [9] and Umami et al. [11]. This finding is reasonable since the thumb movements along the axis running from northeast (top-right) to southwest (bottom-left) is perceived as easier for the right-handed users than those from northwest (top-left) to southeast (bottom-right) [13]. It should be noted that from the physiological perspective, such movements follow the abduction and adduction [9]. In accordance to Otten et al. [9] and Umami et al. [11], the elliptical shape of the reached area is the easiest area covered by the thumb movement toward and away from the palm.

Overall, the thumb reach of participants in the current study is farther than that of Otten et al.'s study [9] and Umami et al.'s study [11]. Besides, there are also differences in the touchable area between the both studies and the current one.

#### 4. Conclusions

This study is a preliminary survey on the thumb reach envelope of Indonesian population for interaction with single-handed device. The main objective of this study is to identify the thumb reach envelope of Indonesian young adults when using their single-handed device. It was identified that 80% of the participants could comfortably touch an area between 30.0 and 86.6 mm from the bottom and between 9.7 and 51.7 mm from the right edge of the mobile phone. The results of this study also show the thumb reach area of the participants is an elliptical shape that runs from the northeast to southwest on the device screen. The elliptical shape of the reached area indicates the easiest area that can be covered by the thumb movement toward and away from the palm for the right-handed users.

#### 5. Acknowledgement

This study was done with the support and assistance of students at the Laboratory Ergonomics and Work System Design, University of Trunojoyo Madura. Special thanks to Bayu S. Aji and Rinda F. Amalia for helping the author during the data collection. The author also thanks to all participants who have come to the Lab for the measurements and have given some feedbacks to him.

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## Simulation Modeling of Resilience Assessment in Indonesian Fertiliser Industry Supply Networks

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# Simulation Modeling of Resilience Assessment in Indonesian Fertiliser Industry Supply Networks

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**Abstract.** Supply network resilience is a significant aspect in the performance of the Indonesian fertiliser industry. Decision makers use risk assessment and port management reports to evaluate the availability of infrastructure. An opportunity was identified to incorporate both types of data into an approach for the measurement of resilience. A framework, based on a synthesis of literature and interviews with industry practitioners, covering both social and technical factors is introduced. A simulation model was then built to allow managers to explore implications for resilience and predict levels of risk in different scenarios. Result of interview with respondents from Indonesian fertiliser industry indicated that the simulation model could be valuable in the assessment. This paper provides details of the simulation model for decision makers to explore levels of risk in supply networks. For practitioners, the model could be used by government to assess the current condition of supply networks in Indonesian industries. On the other hand, for academia, the approach provides a new application of agent-based models in research on supply network resilience and presents a real example of how agent-based modeling could be used as to support the assessment approach.

## 1. Introduction

As an archipelago and developing country, Indonesia is particularly vulnerable to changes in infrastructure of transportation and distribution, which can significantly destabilise supply networks. Indonesia consists of 17,000 (seventeen thousand) islands **Error! Reference source not found.** with geographical characteristics that, especially when combined with factors such as infrastructure and facility availability, lead to supply network risks for Indonesian industry [1]. Capacity and availability of ports is a major factor in managing product lifecycles and supply network operations in Indonesia. Delivery and transportation systems influence the quality of products and problems of logistics and inventories influence the production process adversely [2], [3].

Research on supply network resilience has focused on areas such as managing lead time and demand in order to create supply networks that are inherently resilient. This paper takes a system engineering perspective to investigate relationships between supply networks and infrastructure. Most literature focuses on designing and assessing supply chain resilience in demand fluctuation and provides little consideration of infrastructure availability. A number of authors [4],[5],[6],[7],[8],[9] propose frameworks for assessing supply network resilience but the emphasis of these papers lies in theoretical aspects rather than the use of the frameworks to support management decisions in real world supply chain operations. This stimulated the research reported in this paper which explored the provision of tools to support the management of supply networks, taking account of resilience with respect to changes



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in infrastructure availability, and used data from a real world case study to illustrate the potential value of the research.

A simulation model to assess the resilience with respect to changes in the availability of infrastructure facilities is introduced. The model uses input data from risk assessment and port availability reports that are available to managers in Indonesian supply networks. An Indonesian port, a key item of infrastructure in fertilizer supply networks, is used as a case study to illustrate and evaluate the approach. In global product distribution systems such as the Indonesian fertilizer industry supply network, physical infrastructure such as ports, are important as these affect the supply network's performance. Inefficiencies in loading or unloading of material in ports have a detrimental impact through the product lifecycle, from production process to consumer satisfaction.

## 2. Methodology

The case study method was applied to investigate a real world case from the Indonesian fertiliser industry supply network in order to support the development of a resilience assessment approach. A semi-structured questionnaire [10], [11] was developed as a tool for data collection. The semi-structured questionnaire was used because it provides opportunities for researchers to explain verbally and directly the main focus of the questions to research participants and other participants. This can help improve participants' understanding of the questions and so the answers they provide. Ten participants were chosen based on their job description, experience and recommendations from managers. In addition to the primary, interview, data, secondary data from relevant risk assessment and port availability reports was used to support participants' responses. This research used the Delphi method to collect information from participants to validate the approach. The Delphi method was chosen because it is considered as an appropriate technique to gain information for a particular issue in the real world and participants involved are the key people who are considered experts in their field [12]. The number of participants is slightly difficult to determine directly, since it depends on the number of managers or staff in supply network management in the Indonesian fertiliser Industry. In this research, ten participants agreed to be involved. This amount is considered sufficient, in accordance with the requirements of the Delphi method [12].

An iterative development process was used to create the simulation model presented in this paper. Early prototypes of the simulation model were informed by findings from interviews with the participants. In addition, these early versions of the model were evaluated with participants and areas for further development identified.

## 3. Case study: the Indonesian fertiliser industry

In 2011 the Indonesian fertiliser industry reported an issue with the availability of subsidised fertiliser for farmers during planting time due to delays in the distribution of fertiliser from industry to distributors. This problem was caused by delays in the transportation system. The main infrastructure of the transport system was the port. The fertiliser industry, which used the berth occupancy ratio of the port to measure port availability, established a target berth occupancy ratio of 70%. The target was set based on the United Nations Conference on Trade and Development-UNCTAD. This target was used to determine acceptable levels of risk in the case study supply network. Berth occupancy ratio higher than 70% is a sign of congestion, while lower than 70% signifies under-utilization of the port.

The interviews highlighted that Infrastructure availability and changes increasingly affect the availability and timing of goods and services, energy and information, with failures in supply network operations affecting product quality and traceability. Access to reliable and affordable transport, communications, energy and information technology were seen as crucial for decision making. Another example of a supply network failure mode was strategic risks identified in the field of marketing and distribution such as decreasing of agricultural fertiliser absorptive capacity, busy activity of loading and unloading at the dock, congestion (long queues at the port), and overstocking in the warehouse production. The participants stated that risk assessment is an increasingly important stage to achieve targets and to improve the fertiliser industry resilience and performance.

Key performance indicators were identified based on six socio-technical system perspectives [13] as described on Table 1.

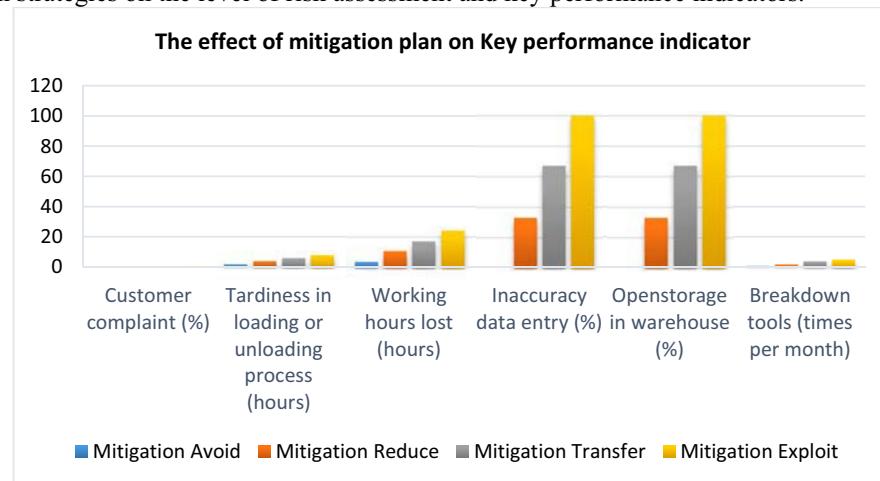
**Table 1.** The value of the key performance indicators in the level of risk

Key performance Indicators	Level of risk				
	Very low	Low	Moderate	High	Very high
Goal	0%	0.1% - 0.2%	0.2% - 0.3%	0.3% - 0.4%	>0.4%
Procedure	2 hours	2-4 hours	4-6 hours	6-8 hours	>8 hours
People	4 hours	4-8 hours	8-12 hours	12-24 hours	>24 hours
Culture	0-20%	20-40%	40-60%	60-80%	80-100%
Infrastructure	0-20%	20-40%	40-60%	60-80%	80-100%
Technology	1 per month	2 per month	3 per month	4 per month	5 per month

#### 4. Design and Implementation of simulation model

The research reported in this paper used NetLogo 5.0.4 to build a resilience assessment model to represent the effect of infrastructure changes in supply network resilience. NetLogo includes both an agent-based and dynamic systems modeller, allowing the combination of these two types of model in the simulation model. Inputs of simulation model adopt from risk assessment and port availability report from the industry. Inputs to the simulation model are: (a) The type of infrastructure facilities used; (b) The level of risk impact in each department; (c) the level of probability of occurrence in risk assessment; and (d) Mitigation strategy and facilities, Avoid, Transfer, Reduce, and Exploit. The simulation model assists the decision maker to assess resilience by analysing risk and identifying key performance indicators of resilience assessment on the supply networks. The simulation model included both agent-based and dynamic systems elements. Inputs to the model were formulated for variables code in level of risk. These variables were imported into the system dynamic modeller through an interface model.

Figure 1 presents the output of the simulation model that describes the effects of the four mitigation strategies on the level of risk assessment and key performance indicators.



**Figure 1.** Output of design experiments and the effect of the mitigation plan on key performance indicators

The simulation results identified that “Avoid” is the best the mitigation plan because it generates the lowest level of risk in all six perspectives. However, the participants in the risk management department argued that if the Indonesian fertiliser industry implements “Avoid” as the mitigation for

risk, that means there are no operational and production activities in the industry. For this reason, the Indonesian fertiliser industry never carries out "Avoid" as a mitigation plan in real activity. So for the optimum result in mitigating risk, the second scenario, Reduce, is the most ideal scenario. Analysis of resilience assessment on the fertiliser supply networks can be determined based on key performance indicators that were obtained from the output of the simulation results. For example, if the berth occupancy ratio is 90%, the interoperability dimensions: the number of customers to complain is 0.27% or level 3 and inaccurate data entry is 68% or level 4. This shows the level of collaboration within the system supply networks is still low. Next on the dimensions of Safety: loss of working hours was 18 hours or level 4 and breakdown loading or unloading machinery is 4 times per month or level 4. In addition, the dimension of reliability: tardiness in the process of loading and unloading is 6 hours or level 4. This indicates that there remains potential for improvement in the resilience of the fertiliser industry. The fourth dimension, Availability: the availability of open storage for storing excess stocks of fertiliser also reached 68% or level 4 which means there was still plenty of fertiliser stock that had not been distributed due to the level of the port utility is low.

Simulation models need to be verified and validated to ensure that they successfully represent the real system and desired objectives. This research applied a combination of face validity [14] and subjective [15] approaches to verify and validate the simulation model based on the model and simulation result with practitioners. The results of the review of the simulation model with the practitioners from the Indonesian fertiliser industry confirmed that the model could be understood by its intended audience and it represented the process of resilience assessment in the Indonesian fertiliser industry. The participants considered the possibility of applying the approach in the industry. Through the creation of simulation models, available historical data and information on the industry was implemented into a visual model that provides output in the form of quantitative data. This assists managers and other decision makers in analysing and predicting levels of risk and resilience in the supply network. The structures of the model in computer simulations were adapted with the variables taken from the case study. Thus, the port was included in the model as the infrastructure facility as well as the elements of the key performance indicators and the dimension of resilience.

## 5. Conclusions

Supply network failures in the Indonesian fertiliser industry have a serious negative impact on agricultural production especially for small and medium sized farms. This failure arises from risk particularly in the transport system. Improving supply network resilience reduces the impact of risks and so improves the situation of the small and medium sized farms in Indonesia. This research introduced a new approach to assess resilience in supply network elements by considering risk assessment and infrastructure availability changes. The research was based on the premise that the risk assessment and the port management reports that already exists in the industry can be used as an information resource for resilience assessment. This premise corroborates a theory stated by Savage and Gibson [16] that a set strategy of competitiveness, including risk management, must be defined by the organization in order to obtain supply chain resilience. By identifying the areas of highest risk in key processes of the supply network, crucial problems that influence network resilience can be identified. This is because the impact caused by the risk can be used as important information to reflect constraints in supply network activities. Moreover, mitigation plans capture the capacity of the supply network system to increase performance.

This research aids identification of key performance indicators of risk in supply networks especially for industries located in Asia in an archipelago country. The results of this study give real examples of the relationship between the risks and resilience and provide an approach containing steps using the information generated on a risk assessment to assess resilience. The simulation model considered the aspects of the managers or decision makers need, making this approach easy to adopt and applied by the managers. The use of agent-based modelling to create a simulation model also provides examples for academics on how to transform a real supply network system into the simulation model. The results of this research provide benefits for policy makers, especially the Ministry of

Agriculture and Ministry of Industry of Indonesia in analysing and assessing the supply network of subsidised fertiliser.

Simulation models such as that built in this study have the potential to be used in a wide range of industries that have characteristics and data similar to the Indonesian fertiliser industry. However, the model would need to be adjusted if it were employed in other industries that have different characteristics or supply network elements from the presented case study.

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## Automatic Lamp and Fan Control Based on Microcontroller

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# Automatic Lamp and Fan Control Based on Microcontroller

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**Abstract.** In general, automation can be described as a process following pre-determined sequential steps with a little or without any human exertion. Automation is provided with the use of various sensors suitable to observe the production processes, actuators and different techniques and devices. In this research, the automation system developed is an automatic lamp and an automatic fan on the smart home. Both of these systems will be processed using an Arduino Mega 2560 microcontroller. A microcontroller is used to obtain values of physical conditions through sensors connected to it. In the automatic lamp system required sensors to detect the light of the LDR (Light Dependent Resistor) sensor. While the automatic fan system required sensors to detect the temperature of the DHT11 sensor. In tests that have been done lamps and fans can work properly. The lamp can turn on automatically when the light begins to darken, and the lamp can also turn off automatically when the light begins to bright again. In addition, it can be concluded also that the readings of LDR sensors are placed outside the room is different from the readings of LDR sensors placed in the room. This is because the light intensity received by the existing LDR sensor in the room is blocked by the wall of the house or by other objects. Then for the fan, it can also turn on automatically when the temperature is greater than 25°C, and the fan speed can also be adjusted. The fan may also turn off automatically when the temperature is less than equal to 25°C.

## 1. Introduction

Automation systems at home today has been developed. Automation can be generally described as a process following pre-determined sequential steps with a little or without any human exertion. Automation is provided with the use of various sensors suitable to observe the production processes, actuators and different techniques and devices [1]. Smart home automations gives the owner of a home an ultimate control over his or her home by automated lighting system, dimming, and electrical appliances. This advanced technology is used to do automation of a house activities, so it is also can be called as home automation [2].

One of the home automation systems developed is an automatic lamp system. In an era like this now has a lot of people who wander out of town. So that when there is time off work or school holiday, many of these people back to hometown and will leave their home sometimes for long periods of time. To avoid the house in the dark usually some lights will keep it turned on until the person returns home. This can certainly lead to wasteful consumption of electricity and disadvantageous the government. Lighting can account for 10–38% of the total energy bill in typical cities worldwide [6]. Therefore, the researcher is interested to develop the automatic lamp system that



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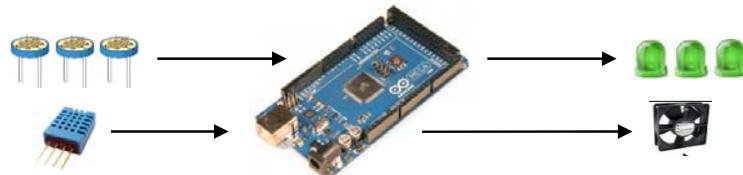
the house lamp will turn on automatically if the light intensity has dimmed and will turn off automatically if the light density is bright again. This will definitely save electricity.

Then the home automation system developed also is an automatic fan system. Country of Indonesia including tropical country which has two seasons namely dry season and rainy season. However, in recent times the dry season occurs longer so that sun exposure occurs continuously and can cause temperature rise. At this time most of the existing fan in Indonesia is still manual that is necessary for the operator. In previous research by following technological developments, mechanical switch system is no longer the only way to control speed of the fan. Speed control of a fan can be controlled by the electronic circuit system [3-5]. Therefore, researchers also want to develop an automatic fan system as a room temperature controller. In this case the fan can turn on, off and adjust its speed according to room temperature.

## 2. Methodology

### 2.1. System Description

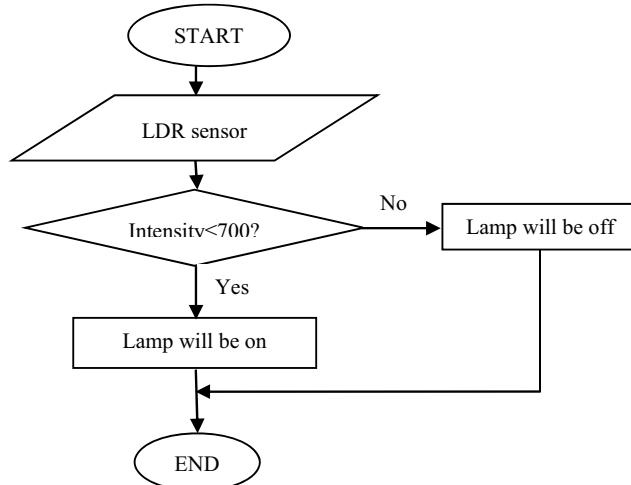
Smart home products made in the form of prototype which includes automatic lamp and automatic fan. Both systems will be processed using an Arduino Mega 2560 microcontroller. A microcontroller is used to obtain values of physical conditions through sensors connected to it [7]. In the automatic lamp system required sensors to detect the light of the LDR (Light Dependent Resistor) sensor. Some previous studies have also used LDR sensors for light detection in automatic lighting [8-11]. While the automatic fan system required sensors to detect the temperature of the DHT11 sensor. The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor [12]. The block diagram of this home automation system can be seen in Figure 1.



**Figure 1.** The block diagram of making smart home products

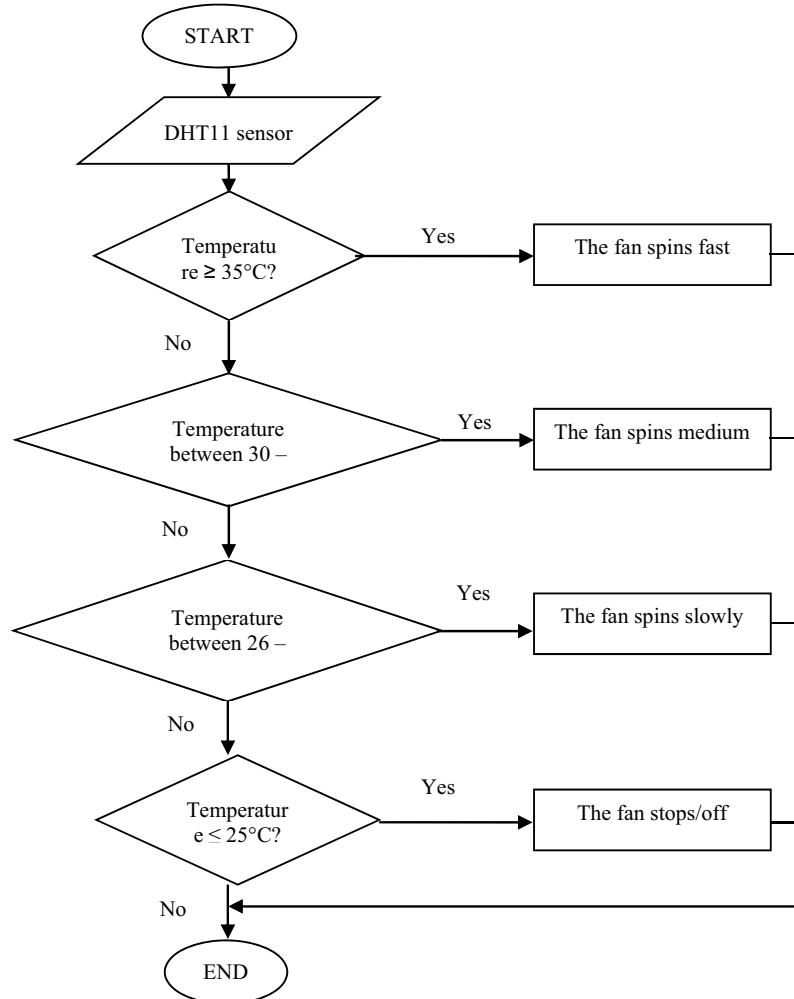
### 2.2. Automatic Lamp Design

In this automatic lamp system, the input is obtained from the LDR sensor. The LDR sensor serves to provide information about the intensity of light around. This information will be used by the microcontroller to make a decisions whether or not the light is turned on. In this process the lamp will light up when the light is dark (the light intensity is less than equal to 700) and the lamp will off again when the light is bright (the light intensity is greater than 700). For more details about this automatic lamp process can be seen in Figure 2.

**Figure 2.** Flowchart automatic lamp system

### 2.3. Automatic Fan Design

In this automatic fan system, the input is obtained from DHT11 sensor. The DHT11 is a dual temperature and humidity sensor, meaning that it can read both temperature and humidity [13]. Microcontroller will receive input data from the sensor and will process it into output on the fan. The input of this sensor is the amount of temperature in the room, then we have to set program on the desired temperature and output fan speed limits. If the sensor's read temperature is less than 25°C then the fan will off or will not rotate. If the temperature reads the sensor between 26 – 29°C then the fan will spin slowly. If the temperature reads the sensor between 30 – 34°C then the fan will spin at medium speed. Then if it exceeds 35 °C then the fan will spin rapidly. For more details about the process of this automatic fan detection can be seen in Figure 3.

**Figure 3.** Flowchart system automatic fan

### 3. Results And Discussion

#### 3.1. Automatic Lamp Testing

Automatic lamp system testing is done at different times, with the aim of knowing how different LDR sensor readings at different light intensities. In previous research the LDR sensor was able to work well which has been proven from the reading result done in the morning and evening [14]. In this research the lamp used is a 1 watt HPL lamp that is placed outside the room (home page) and placed in the room (living room). This is done to determine the difference in function of the LDR if it is outdoors or indoors, because the intensity of light received will be different. Automatic lamp testing is done in the afternoon and morning, the test results can be seen in Table 1. In table 1 it can be seen that the reading results of LDR sensors placed inside and outside the room are different. This is because the light intensity received by the LDR sensor in the room is blocked by the wall of the house or by other objects so the result is darker.

**Table 1.** The result of automatic lamp test

Test Hours	LDR Sensor Readings		Lamp Condition	
	Indoors	Outdoors	Indoors	Outdoors
17:00	473	707	On	Off
17:15	461	724	On	Off
17:30	454	694	On	On
17:45	451	689	On	On
18:00	445	688	On	On
05:30	456	671	On	On
05:45	467	689	On	On
06:00	488	693	On	On
06:15	493	713	On	Off
06:30	505	719	On	Off

### 3.2. Automatic Fan Testing

Automatic fan system testing is performed within a full day, with the aim of knowing how much temperature the DHT11 sensor reads at those times. The results of automatic fan testing can be seen in Table 2. In Table 2 the temperature read by the DHT11 sensor provides action according to the ambient temperature.

**Table 2.** The result of automatic fan test

Test Hours	DHT11 Sensor Readings	Fan Condition	Fan Speed
05:00	29	On	Slow
06:00	25	Off	-
07:00	27	On	Slow
13:00	33	On	Medium
14:00	33	On	Medium
15:00	35	On	Fast
18:00	32	On	Medium
23:00	32	Off	Medium
00:00	30	Off	Medium
01:00	30	Off	Medium

### 4. Conclusion

From the results of tests that have been done, it can be concluded that the lamps and fans can work properly. The lamps can turn on automatically when the light begins to darken and the lamp can also turn off automatically when the light begins to bright again. In addition, it can be concluded also that the readings of LDR sensors are placed outside the room is different from the readings of LDR sensors placed in the room. This is because the light intensity received by the existing LDR sensor in the room is blocked by the wall of the house or by other objects. Then for the fan it can also turn on automatically when the temperature is greater than 25°C and the fan speed can also be adjusted. Fan rotation speed is divided into three namely slow, medium, and fast. Furthermore, the fan will automatically shut off when the temperature is less than equal to 25°C.

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## Automatic Clustering Using FSDE-Forced Strategy Differential Evolution

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# Automatic Clustering Using FSDE-Forced Strategy Differential Evolution

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**Abstract.** Clustering analysis is important in datamining for unsupervised data, cause no adequate prior knowledge. One of the important tasks is defining the number of clusters without user involvement that is known as automatic clustering. This study intends on acquiring cluster number automatically utilizing forced strategy differential evolution (AC-FSDE). Two mutation parameters, namely: constant parameter and variable parameter are employed to boost differential evolution performance. Four well-known benchmark datasets were used to evaluate the algorithm. Moreover, the result is compared with other state of the art automatic clustering methods. The experiment results evidence that AC-FSDE is better or competitive with other existing automatic clustering algorithm.

## 1. Introduction

With the rapid development of technology such as the internet, every time huge amounts of data are produced and stored in the database. This data should be processed in order to get useful meaning. One of the important methods for obtaining useful information is data mining. The applications of data mining can get the relationships, data structures and hidden information within data to gain knowledge that can be used in decision making or other needed. Basically, data mining consist of two problems namely supervised learning and unsupervised learning [1]. In the supervised learning, like classification and prediction, the training data and target variables have been defined whereas unsupervised learning approaches there is no data training and target variables. Data clustering is unsupervised techniques that aim to group data or objects, whereas data in one group closely similar to each other and data in another group closely dissimilar to the data in other groups. Data clustering applications have been widely used in the real world such as web mining, market analysis, document clustering, image segmentation etc.

There are hierarchical and partitional methods in clustering algorithms. In the hierarchical algorithm, there are two modes: (1) agglomerative (start with one data point as cluster and concatenate two nearest clusters iteratively until stopping criterion meets); (2) divisive (start with all data points as one cluster, then split the cluster into smaller one until stopping criterion meets). A dendrogram is created during the processed that represent the cluster. On the other hand, Partitional algorithm works to find all clusters iteratively begin with a given non-overlapping cluster.  $k$ -means is a simple and well known partitional clustering algorithm. Begin with a specified number of clusters to partitioned  $N$  data set into  $k$  different of clusters. However, the main drawback of these algorithms is to set the final number of cluster subjectively.

There have been many clustering algorithm researched deal with the problem of final number of cluster[2, 3]. This problem is known as automatic clustering that attempt to find the final number of



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cluster automatically. Nowadays, evolutionary algorithm has been used widely to handle automatic clustering problem such as genetic algorithm [4], artificial bee colony [5], particle swarm optimization [6], differential evolution [7] etc .

Differential Evolution (DE) is an evolutionary algorithm (EA) for a global optimum solution [8]. DE algorithm is quite simple and faster than the other EA algorithm. Its performances are defined by the control parameter and the strategy of test vector in each generation. There are many proposed method to make DE more effective and efficient. One of the newest strategy is forced strategy differential evolution (FSDE) that modify mutation off original DE [9].

The objective of this paper is to study the automatic clustering algorithm. It uses forced strategy differential algorithm to make result better. The paper is organized as follows. A basic concept of clustering is explained is the first section. The second section explains some literature study followed by the proposed method in the third sections. The obtain result is present in the fourth section. Finally, the final remarks are made in fifth sections.

## 2. Literature Study

### Clustering

Clustering can also classified as hard clustering and soft clustering. In hard clustering, the data becomes a member on one particular cluster. The rules of hard clustering are as follows: (1) one cluster must have at least one data attached; (2) no data point belongs to multi different cluster and; (3) all of the point inserted into a cluster. However, in the soft clustering or fuzzy clustering, each data points can be members of multi cluster based on the degree of membership.

The  $k$ -means algorithm is one of the most popular hard clustering algorithms. Begin with initialization final number of clusters,  $k$ , and centroids is taken randomly. Iteratively, the distances from each data point to the centroids are calculated.  $k$ -means algorithm always uses Euclidean distance that shows the geometric distance in the search space. The Euclidean distance is computed as:

$$dist(x, y) = \left\{ \sum_i (x_i - y_i)^2 \right\}^{\frac{1}{2}} \quad (1)$$

Where  $x_i, y_i$  are data points to be calculated. Data points will be assigns to the corresponding cluster based on the nearest distance. After that, new centroids are produced using the means of all data point in one cluster. This process will be done until stopping criterion is met

### Quality of Cluster

To check the result of clustering algorithm, cluster validity assessment is used. The aim is to get the best partitioning fits with the underlying data. Two common criterions on evaluating and validating clustering result are: (1) compactness (each data point in one cluster should be closest as possible to another); (2) separation means that the cluster result should be widely separate to other cluster. There are many clustering validity index to measure the goodness cluster in quantitative manner that rely on the compactness and separation. One of the popular ones is  $VI$  index [10].

The  $VI$  index computes the ratio between *inter* and *intra cluster* distance. Intra is the average of minimum distance between each point to the centroid in a cluster, whereas inter is the distance between centroid in one cluster to other cluster. By using this index not only number of cluster will be gained, but also the best final partition of data. It is formulated as:

$$VI = (c \times N(0,1) + 1) \times \frac{intra}{inter}, \quad (2)$$

Let  $VI$  is the fitness function to be minimized. To avoid too small clustering result, punishment strategy,  $(c \times N(0,1) + 1)$ , is applied. The parameter  $c$  is set to 30 and  $N(0,1)$  is the Gaussian function. For

data set that have small data point,  $N(0,1)$  is adopted such as iris and wine data set. Intra cluster can be formulated as:

$$intra = \frac{1}{N_t} \sum_{k=1}^K \sum_{x \in C_k} \|x - m_x\|^2 \quad (3)$$

Calculate the Euclidian distance between all data point,  $x$ , to the centroid,  $m_x$ . Then sum up all the shortest distance of each point to the centroid of cluster, after that divided it by the number of data tuples,  $N_t$ .

Inter cluster is computed as:

$$\begin{aligned} inter &= \min \{d(\bar{m}_k, \bar{m}_{kk})\} \\ \forall k &= 1, 2, \dots, K-1 \\ kk &= k+1, \dots, K \end{aligned} \quad (4)$$

Where  $m_k, m_{kk}$  are the two cluster centroids that have to calculate its distance and  $K$  is the number of clusters.

### Differential Evolution Algorithm

Like other evolution based algorithm, DE candidate solution,  $X_{i,G}$ , is generated from number of population,  $N_P$ . Where  $i=1,2,\dots,N_P$  and  $G$  represent the generation of population. DE proses mainly fall into three phases that are mutation, selection and production. The mutation process computes different weighted vector population using scale factor,  $F$ . Begin by selecting three different individuals population randomly  $X_{j1,G}$ ,  $X_{j2,G}$  and  $X_{j3,G}$  to produce the donor vector  $V_{i,G}$  so that is formulated as:

$$V_{i,G} = X_{j1,G} + F \times (X_{j2,G} - X_{j3,G}) \quad (5)$$

Where:

$$\begin{aligned} i &= 1, 2, \dots, N_P, \\ j1, j2, j3 &\in \{1, \dots, N_P\}, \text{ randomly selected and satisfy } j1 \neq j2 \neq j3 \\ F &\text{ is the constant control parameter } [0, 1]. \end{aligned} \quad (6)$$

Crossover operation produce the trial vector,  $U_{i,G}$ , to increase the perturbed parameter vectors. It computed as shown in equation (5).

$$U_{j,i,G+1} = \begin{cases} V_{j,i,G+1} & \text{if } rand_{i,j}[0,1] \leq C_r \text{ or if } j = I_{rand} \\ X_{j,i,G+1} & \text{if } rand_{i,j}[0,1] > C_r \text{ or if } j \neq I_{rand} \end{cases} \quad (7)$$

Production in DE will select the trial vector then compared it to the target vector in current population. The lowest function value will be chosen to be the new solution for the next generation as shown as follow:

$$X_{i,G+1} = \begin{cases} U_{i,G+1} & \text{if } f(U_{i,G+1}) \leq f(X_{i,G}) \text{ where } i=1,2,\dots,N \\ X_{i,G} & \text{otherwise} \end{cases} \quad (8)$$

### FSDE-Forced Strategy Differential Evolution

The FSDE strategy implemented in mutation operator to enhanced the original DE performance [9]. It modify the mutation formula by adding the best solution,  $X_{G,best}$ , to compute the donor vector. It also attached new mutation factor,  $N$ , that takes in varying value lies between [0,1] and F parameter used constant value of 0.6. It's computed as follow:

$$V_{i,G} = X_{j1,G} + N.((X_{G,best} - X_{j2,G}) - F.(X_{G,best} - X_{j3,G})) \quad (9)$$

### 3. Proposed Method

#### Automatic Clustering based FSDE

The rest of proposed AC-FSDE clustering is as follows:

- Step 1) Initialize  $k$  (randomly generate) number of cluster centroid of chromosome and  $k$  (randomly generate) activation threshold.
- Step 2) For each chromosome,  $V_{i,k}T_k$ , find out the active chromosome using rule as shown in equation (7)
- Step 3) For  $G=1$  to  $G_{max}$  do
  - a) Assign data points to the shortest centroid distance (compute by Euclidian distance between each data point to all actives centroids)
  - b) Change the population using FSDE. Use the fitness function to compare the better candidate solution.
  - c) Apply k-means algorithm to do local search. Use the actives cluster to be the input of k-means clustering.
- Step 4) Show the final result (minimum fitness function)

The representation of chromosome is based on [7]. Every individual chromosome is a real number vector contain activation threshold and data dimensions,  $v_{i,k}T_k + (v_{i,k} \times d_n)$ . It is produced randomly generated lies number [0,1]. The activation threshold acts as control variable to inform that the cluster active or inactive. After the algorithm is completed, the activation threshold is calculated and the result will be the final number of cluster. Activation threshold has a following rule:

$$\begin{aligned} & \text{if } v_{i,k}T_k > 0.5, \text{ then } _k\text{th cluster center } v_{i,k}m_k \text{ is active} \\ & \text{else } v_{i,k}m_k \text{ is inactive} \end{aligned} \quad (10)$$

### 4. Computational Result

Four well known benchmark data set namely iris, wine, vowel and glass was validated to this proposed method. To algorithm was run 30 times to get its accuracy. VI index is applied to compute the fitness function. The initial cluster number is determined by using  $\sqrt{Np}$  formula and the result is compared with automatic clustering using differential evolution (ACDE).

**Table 1.** Benchmark data

Datasets	Data Points	Dimensions	Cluster Number	Composition for each cluster
Iris	150	4	3	50,50,50
Wine	178	13	3	59,71,48
Glass	214	9	6	70,76,17,13,9,29
Vowel	871	3	6	72,89,172,151,207,180

**Table 2.** Tuning Parameter

Parameter	Values
Size of population	10 x dimension
F (ACDE)	[0.5,1.0]
F (AC-FSDE)	[0.5,1.0]
N(AC-FSDE)	[0.0,1.0]
$k_{min}; k_{max}$	2; $\sqrt{Np}$

**Table 3.** Number of cluster

Dataset	Algorithm	Average number of cluster
Iris	ACDE	$2.8333 \pm 0.4611$
	AC-FSDE	<b><math>3 \pm 0.3713</math></b>
Wine	ACDE	$2.8677 \pm 0.4342$
	AC-FSDE	<b><math>3.0667 \pm 0.3651</math></b>
Glass	ACDE	$5.5333 \pm 0.6288$
	AC-FSDE	<b><math>6.0667 \pm 0.4498</math></b>
Vowel	ACDE	$6.2667 \pm 1.0806$
	AC-FSDE	<b><math>6.2 \pm 0.4842</math></b>

## 5. Conclusion

This study has demonstrated an automatic clustering algorithm using the variant of DE algorithm namely FSDE to obtain the final number of cluster. The result shows that automatic clustering using forced strategy of differential evolution (AC-FSDE) more competitive than automatic clustering algorithm based differential evolution (ACDE). For the next further research can be investigated on more benchmark data as well as the application of real life data set to improve the algorithm.

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