Pertanika Journal of

# SCIENCE & TECHNOLOGY

JST

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*A special issue devoted to*
**Empowering Young Researchers in the field of Science and Engineering**

Guest Editors
**Asep Bayu Dani Nandiyanto, Didi Sukyadi & Ade Gafar Abdullah**

PERTANIKA JOURNALS

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*Journal of Science & Technology*

# About the Journal

## Overview

Pertanika Journal of Science & Technology (JST) is the official journal of Universiti Putra Malaysia published by UPM Press. It is an open-access online scientific journal which is free of charge. It publishes the scientific outputs. It neither accepts nor commissions third party content.

Recognized internationally as the leading peer-reviewed interdisciplinary journal devoted to the publication of original papers, it serves as a forum for practical approaches to improving quality in issues pertaining to science and engineering and its related fields.

JST is a **quarterly** (January, April, July and October) periodical that considers for publication original articles as per its scope. The journal publishes in **English** and it is open to authors around the world regardless of the nationality.

The Journal is available world-wide.

## Aims and scope

Pertanika Journal of Science and Technology aims to provide a forum for high quality research related to science and engineering research. Areas relevant to the scope of the journal include: bioinformatics, bioscience, biotechnology and bio-molecular sciences, chemistry, computer science, ecology, engineering, engineering design, environmental control and management, mathematics and statistics, medicine and health sciences, nanotechnology, physics, safety and emergency management, and related fields of study.

## History

Pertanika was founded in 1978. A decision was made in 1992 to streamline Pertanika into three journals as Journal of Tropical Agricultural Science, Journal of Science & Technology, and Journal of Social Sciences & Humanities to meet the need for specialised journals in areas of study aligned with the interdisciplinary strengths of the university.

After almost 25 years, as an interdisciplinary Journal of Science & Technology, the revamped journal now focuses on research in science and engineering and its related fields.

## Goal of *Pertanika*

Our goal is to bring the highest quality research to the widest possible audience.

## Quality

We aim for excellence, sustained by a responsible and professional approach to journal publishing. Submissions are guaranteed to receive a decision within 14 weeks. The elapsed time from submission to publication for the articles averages 5-6 months.

## Abstracting and indexing of *Pertanika*

Pertanika is almost 40 years old; this accumulated knowledge has resulted in Pertanika JST being abstracted and indexed in SCOPUS (Elsevier), Thomson (ISI) Web of Knowledge [BIOSIS & CAB Abstracts], EBSCO & EBSCOhost, DOAJ, ERA, Cabell's Directories, Google Scholar, MyAIS, ISC & Rubriq (Journal Guide).

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We are continuously improving access to our journal archives, content, and research services. We have the drive to realise exciting new horizons that will benefit not only the academic community, but society itself.

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The Pertanika Journals and Universiti Putra Malaysia takes seriously the responsibility of all of its journal publications to reflect the highest in publication ethics. Thus all journals and journal editors are expected to abide by the Journal's codes of ethics. Refer to Pertanika's **Code of Ethics** for full details, or visit the Journal's web link at http://www.pertanika.upm.edu.my/code_of_ethics.php

## International Standard Serial Number (ISSN)

An ISSN is an 8-digit code used to identify periodicals such as journals of all kinds and on all media–print and electronic. All Pertanika journals have ISSN as well as an e-ISSN.

Journal of Science & Technology: ISSN 0128-7680 (*Print*); ISSN 2231-8526 (*Online*).

## Lag time

A decision on acceptance or rejection of a manuscript is reached in 3 to 4 months (average 14 weeks). The elapsed time from submission to publication for the articles averages 5-6 months.

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Refer to Pertanika's **INSTRUCTIONS TO AUTHORS** at the back of this journal.

Most scientific papers are prepared according to a format called IMRAD. The term represents the first letters of the words **I**ntroduction, **M**aterials and Methods, **R**esults, **A**nd, **D**iscussion. IMRAD is simply a more 'defined' version of the "IBC" [Introduction, Body, Conclusion] format used for all academic writing. IMRAD indicates a pattern or format rather than a complete list of headings or components of research papers; the missing parts of a paper are: *Title, Authors, Keywords, Abstract, Conclusions*, and *References*. Additionally, some papers include Acknowledgments and Appendices.

The *Introduction* explains the scope and objective of the study in the light of current knowledge on the subject; the *Materials and Methods* describes how the study was conducted; the *Results* section reports what was found in the study; and the *Discussion* section explains meaning and significance of the results and provides suggestions for future directions of research. The manuscript must be prepared according to the Journal's **INSTRUCTIONS TO AUTHORS**.

## Editorial process

Authors are notified with an acknowledgement containing a *Manuscript ID* on receipt of a manuscript, and upon the editorial decision regarding publication.

Journal of Science & Technology
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Pertanika follows a **double-blind peer-review** process. Manuscripts deemed suitable for publication are usually sent to reviewers. Authors are encouraged to suggest names of at least three potential reviewers at the time of submission of their manuscript to Pertanika, but the editors will make the final choice. The editors are not, however, bound by these suggestions.

Notification of the editorial decision is usually provided within ten to fourteen weeks from the receipt of manuscript. Publication of solicited manuscripts is not guaranteed. In most cases, manuscripts are accepted conditionally, pending an author's revision of the material.

As articles are double-blind reviewed, material that might identify authorship of the paper should be placed only on page 2 as described in the first-4 page format in Pertanika's **INSTRUCTIONS TO AUTHORS** given at the back of this journal.

## The Journal's peer-review

In the peer-review process, three referees independently evaluate the scientific quality of the submitted manuscripts.

Peer reviewers are experts chosen by journal editors to provide written assessment of the **strengths** and **weaknesses** of written research, with the aim of improving the reporting of research and identifying the most appropriate and highest quality material for the journal.

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What happens to a manuscript once it is submitted to *Pertanika*? Typically, there are seven steps to the editorial review process:

1. The Journal's chief executive editor and the editorial board examine the paper to determine whether it is appropriate for the journal and should be reviewed. If not appropriate, the manuscript is rejected outright and the author is informed.

2. The chief executive editor sends the article-identifying information having been removed, to three reviewers. Typically, one of these is from the Journal's editorial board. Others are specialists in the subject matter represented by the article. The chief executive editor asks them to complete the review in three weeks.

   Comments to authors are about the appropriateness and adequacy of the theoretical or conceptual framework, literature review, method, results and discussion, and conclusions. Reviewers often include suggestions for strengthening of the manuscript. Comments to the editor are in the nature of the significance of the work and its potential contribution to the literature.

3. The chief executive editor, in consultation with the editor-in-chief, examines the reviews and decides whether to reject the manuscript, invite the author(s) to revise and resubmit the manuscript, or seek additional reviews. Final acceptance or rejection rests with the Edito-in-Chief, who reserves the right to refuse any material for publication. In rare instances, the manuscript is accepted with almost no revision. Almost without exception, reviewers' comments (to the author) are forwarded to the author. If a revision is indicated, the editor provides guidelines for attending to the reviewers' suggestions and perhaps additional advice about revising the manuscript.

4. The authors decide whether and how to address the reviewers' comments and criticisms and the editor's concerns. The authors return a revised version of the paper to the chief executive editor along with specific information describing how they have answered' the concerns of the reviewers and the editor, usually in a tabular form. The author(s) may also submit a rebuttal if there is a need especially when the author disagrees with certain comments provided by reviewer(s).

5. The chief executive editor sends the revised paper out for re-review. Typically, at least one of the original reviewers will be asked to examine the article.

6. When the reviewers have completed their work, the chief executive editor in consultation with the editorial board and the editor-in-chief examine their comments and decide whether the paper is ready to be published, needs another round of revisions, or should be rejected.

7. If the decision is to accept, an acceptance letter is sent to all the author(s), the paper is sent to the Press. The article should appear in print in approximately three months.

   The Publisher ensures that the paper adheres to the correct style (in-text citations, the reference list, and tables are typical areas of concern, clarity, and grammar). The authors are asked to respond to any minor queries by the Publisher. Following these corrections, page proofs are mailed to the corresponding authors for their final approval. At this point, **only essential changes are accepted**. Finally, the article appears in the pages of the Journal and is posted on-line.

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# SCIENCE & TECHNOLOGY

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**Vol. 25 (S) Nov. 2017**
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## ABSTRACTING/INDEXING

*Pertanika* is now over 35 years old; this accumulated knowledge has resulted the journals being indexed in SCOPUS (Elsevier), Thomson (ISI) Web of Knowledge [BIOSIS & CAB Abstracts], EBSCO, DOAJ, Google Scholar, AGRICOLA, ISC, Citefactor, Rubriq and MyAIS. JST is also indexed in ERA.

# Preface

We are pleased to present this special issue on science and technology, a compilation of 16 best papers from the Annual Applied Science and Engineering Conference (AASEC) 2016 held on 18 November 2016. The theme of the conference was "Empowering Young Researchers in the Field of Science and Engineering".

The aim of this special issue is to bring together scientists, engineers, researchers and practitioners, students, and civil society organisation representatives to discuss theoretical and practical knowledge about innovation in applied science and engineering.

We would like to thank the reviewers and contributors, including Universitas Pendidikan Indonesia, for their support which led to the publication of this Pertanika Special Issue.

The editors also record their deepest appreciation to Dr. Nayan Kanwal, Chief Executive Editor, UPM Journals as well as the editorial team of Pertanika in Universiti Putra Malaysia for their assistance during the publication process.

**Guest Editors:**

Asep Bayu Dani Nandiyanto *(Dr.Eng.)*
Didi Sukyadi *(Prof. Dr.)*
Ade Gafar Abdullah *(Dr.)*

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SCIENCE & TECHNOLOGY

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# Development of Ultra-Wideband Directional Microstrip Antenna

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*Department of Electrical Engineering Education, Faculty of Technology and Vocational Education, Universitas Pendidikan Indonesia*

## ABSTRACT

The development of Ultra-wideband (UWB) directional microstrip antenna is to offer solutions for problems related to bandwidth, cost, power consumption, and size generation electronic communication equipment. The UWB allows for high-speed wireless connection through a variety of electronic devices and computer within a certain area. It can be used for Internet access and multimedia services with data up to 1 Gbps as well as for radar applications, tracking, determining an object's position. With the development of UWB, the accuracy of the position of an object can be increased either indoors or outdoors. The antenna has an important role in UWB, such as integrated circuit, getting transient characteristics (short impulse response) and the UWB antenna microstrip is design with monopole or dipole antenna. The decline in antenna performance can be prevented using UWB directional microstrip antenna. This research was based on experimental method using a Vivaldi microstrip antenna. It used software 3D electromagnetic simulator. The development of UWB directional Microstrip antenna radiation characteristics of designs that meet the specifications which have VSWR < 2 for the frequency range of 3.1 to 10.6 GHz.

*Keywords:* 3D electromagnetic simulator, directional, microstrip antenna, ultra-wideband

## INTRODUCTION

Communications technology is growing rapidly. The development of a system that works on the 2.4 GHz frequency is inseparable from device / device that are able to change energy or signals in medium guides to the free space (air). This device is called antenna which is a tool to send or receive energy. It is also used to optimise energy radiation in a particular direction (Balanis, 2016). The development of wireless technology has encouraged a new lifestyle that provides convenience to the users of mobile devices such as notebooks (Mirza, Norris, & Stockdale, 2008). Costumers also want the

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same comfort on other devices such as PC, camcorders, mp3 players, digital cameras, HDTV, PDA, mobile phones, and others in a wireless personal area network (WPAN) in their home (Dholakia, 2012). However, currently WLAN and WPAN technologies are not able to meet the needs of high bandwidth which is rapidly growing. Therefore, we need new technology to meet the needs of high-speed WPAN (Chin, Fan, & Haines, 2014).

Ultra-wideband technology (UWB) offers advantages in terms of bandwidth, cost and power consumption for electronic equipment in the next generation (Porcino, Domenico, and Walter Hirt 2003). It also allows for high-speed wireless connections through a variety of devices and PCs within a certain area (WPAN) such as house or office (Roy, Foerster, Somayazulu, & Leeper, 2004). This technology can provide the high bandwidth required to stream data quickly for huge data such as video and audio among electronic devices throughout the home (Sidhu, Singh, & Chhabra, 2007). The antenna plays an important role in UWB communication system. Generally, it must have a compact shape, efficient, easily integrated to circuit and has good transient characteristics or short impulse response (Taylor, 2012). Most antenna design for UWB currently has a radiation pattern similar to a monopole or dipole antenna. When the antenna is brought closer to the walls (Figure 1), metal objects or space body, it causes the antenna performance to decrease due to omni-directional radiation/ bi-directional radiation. If using directional UWB antenna, a decrease in antenna performance can be avoided. Therefore, the development of UWB antenna has a directional radiation needed.

Two microstrip antenna design Array / double arrays are pioneers in designing microstrip antenna (Yang & Rahmat-Samii, 2003). The third microstrip antenna parameters are two arrays bandwidth, return loss and VSWR which essentially meets the application criteria, but the substrate material used (Teflon) is expensive. This study was innovative namely because it used aluminium substrate material to produce an antenna that has a wide bandwidth with a directional radiation pattern.


*Figure 1.* The compact translucent walls radar
*Source:* Brochure XaverTM 400 www.camero- tech.com

Figure 1 shows ultra-wideband radar translucent walls that have attracted attention both in academia and the industry as they play an important role in the field of security, rescue or in the event a building collapses, and natural disasters such as earthquakes and storms. Among the various innovations on UWB radar invisibility, Xaver wall 400 is the latest product that has operates from 3 GHz to 10GHz as well as provide a high resolution image even after passing 20 mm wall in addition to having radius detection up to 30 cm (Aftanas, 2009).

## Research Purposes

Translucent wall radar is now used by the military to detect the presence of an enemy who is inside a building. In terms of civilian use, translucent wall radar can be used to search for victims trapped in buildings after an earthquake or volcanic eruption. The purpose of this research was to develop an antenna which has a wide bandwidth with a directional radiation pattern.

## The Benefits of Research

The research outcome is to produce an ultra-wideband microstrip directional antenna that can be used for applications translucent wall radar. In addition, this study is expected to contribute to the advancement of science and technology

## METHODS

The study was successful in producing UWB antenna which meant Indonesia didn't need to buy from abroad.

The microstrip antenna produced is compact in size with a very wide bandwidth with a directional radiation pattern and can also be used for UWB radar applications such as wall-penetrating radar.

As antennas are able to obtain information on what is behind the wall, they should be small and light and strong. This requirement is due to the size of the UWB device which is small and mobile.

Thus, a 3D electromagnetic simulator was used to design a microstrip antenna followed by the fabrication process. Antenna return loss, impedance, gain and radiation pattern were measured. The paper is organised as follows: The introduction is followed by literature review and ways to determine antenna specifications; antenna lay out, antenna simulation and simulation iteration to obtain the optimal results. Output of the simulator can be seen in Figure 4.

This study relied on findings of previous researches to come up with a new micros strip antenna design. Thus, this is an original research.

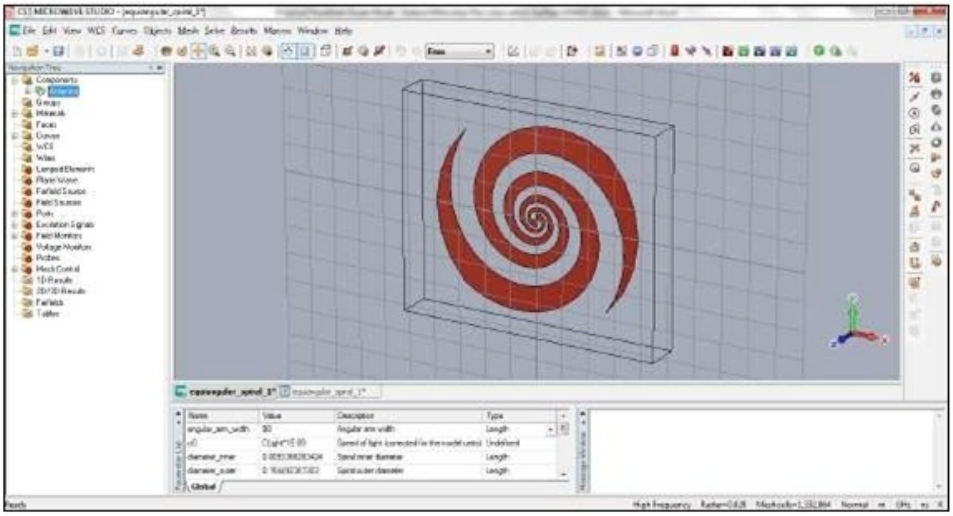


*Figure 2.* Display 3D electromagnetic simulation software

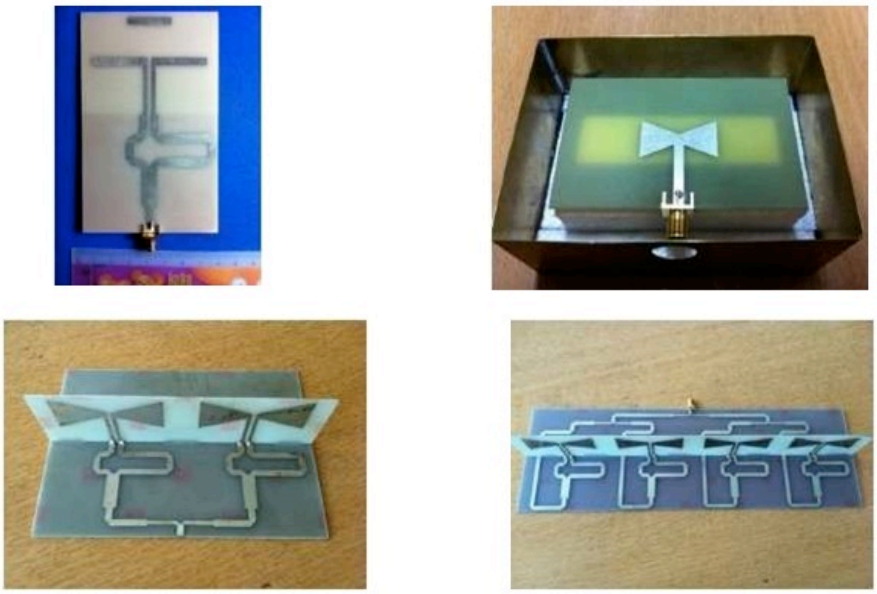


*Figure 3.* Example of antennas

The duration of this study was 8 months and was conducted in the laboratory of telecommunications electronics. Figure 4 shows some of the micros trip antenna developed by previous researchers. These antennas have different functions such as for wall-penetrating radar, rocket tracking, and WiMAX. The antenna measures return loss (S-parameter), VSWR, antenna impedance as well as radiation pattern gain. After completing the fabrication process, the UWB antenna is then measured to determine its performance. Some of the parameters measured include return loss, VSWR, antenna impedance, bandwidth, gain, and radiation

patterns. The results are compared with the results of the simulation. The antenna is expected to have better parameters of reference with 3,1 – 10,6 GHz Bandwidth; VSWR≤ 2; Unidirectional Radiation Pattern; Gain minimum ≥ 6 dB.

## RESULTS

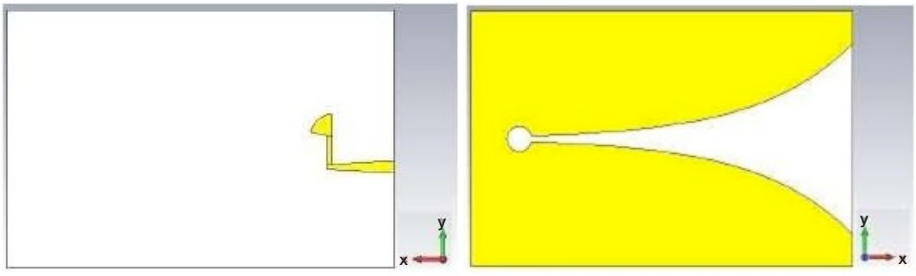
The specifications of a UWB antenna to be created are its bandwidth, the desired gain, VSWR, and radiation pattern of the antenna:

- Bandwidth antenna: 7.5 GHz
- Antenna Working frequency: 3.1 GHz - 10,6GHz
- Gain antenna: 4-8 dBi
- VSWR: 2:1
- The radiation pattern: directional

This research considered the following factors: the ability to simulate a micro trip antenna, the accuracy of the results, the speed in simulating micros trip antennas, features that can be generated from the simulation, and ease of operation. In order to meet predetermined specifications, the research used Vivaldi microstrip antenna.

### Lay Out Antenna

Figure 4 shows the image layout microstrip antenna design front and rear.




(a) (b)

*Figure 4.* Layout the antenna front view (a), Lay out the antenna back view (b)

### Simulation Results

After the simulation, 3D electromagnetic simulator software will be used to display the results of the simulation in the form of multiple antenna parameters such as impulse response in Figure 6, parameter-S in Figure 7, VSWR in Figure 8, antenna impedance in Figure 9, gain in Figure 10 and radiation patterns in Figure 11-17. The impulse response of the antenna designed is

shown in Figure 6. In this figure, it can be seen that if the antenna is given an impulse (red curve) then its impulse response is a curve in green.

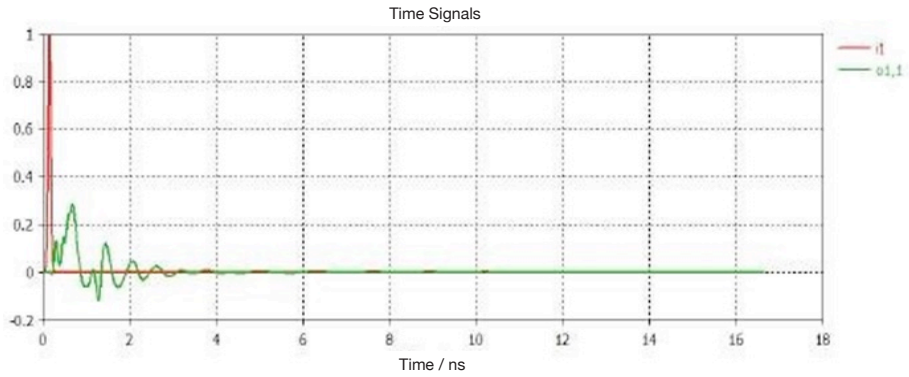



*Figure 5.* Response impulse antenna

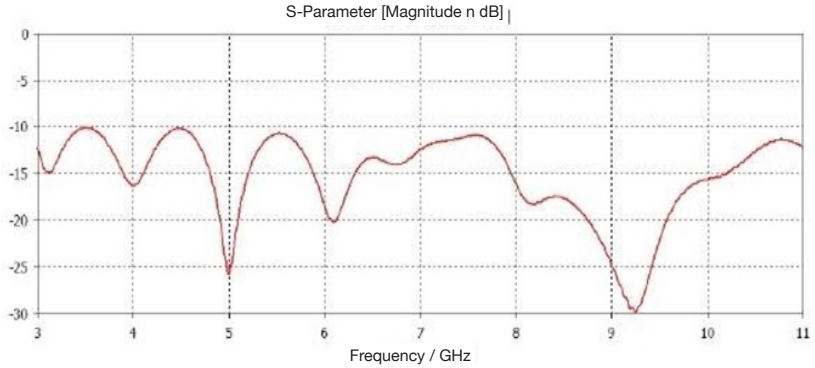



*Figure 6.* Return loss

Figure 6 shows curve measurement return loss result using a simulator.

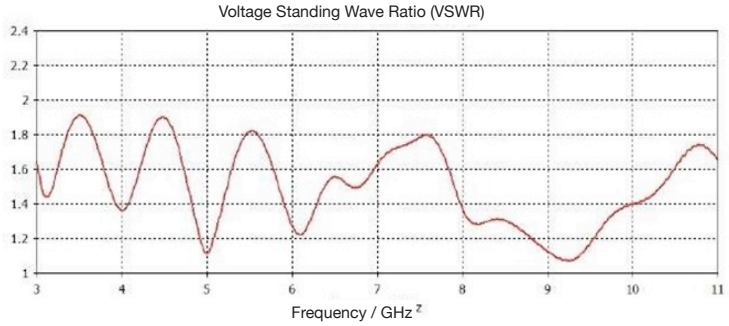
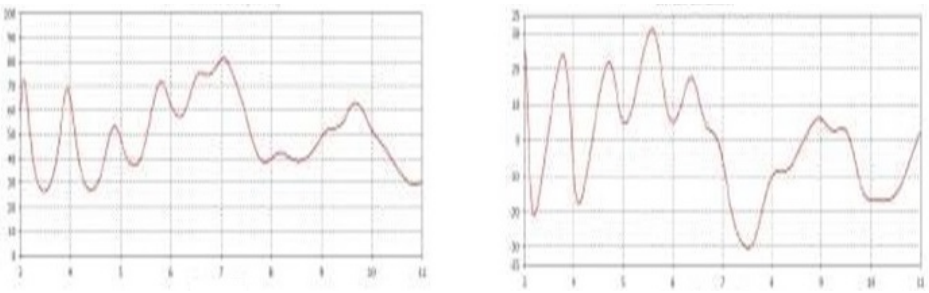



*Figure 7.* VSWR

Figure 7 shows curve measurement VSWR result using a simulator.



(a) (b)

*Figure 8.* The antenna impedance real part (a), the imaginary part (b)

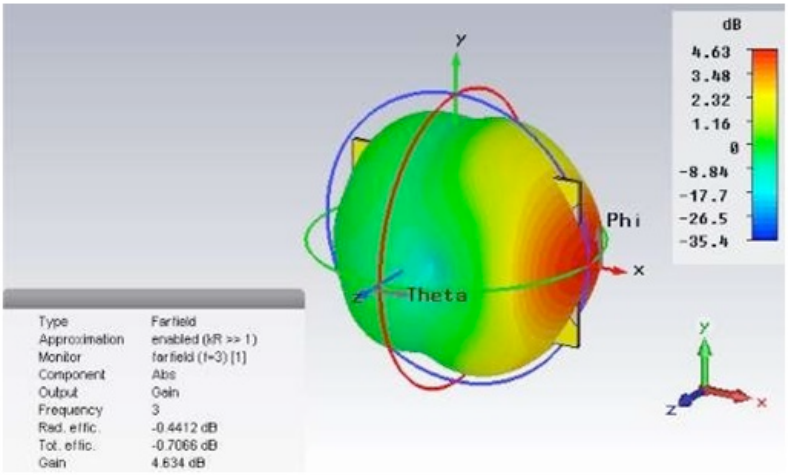



*Figure 9.* Gain and antenna radiation pattern at a frequency of 3 GHz

Figure 9 shows measurement gain and antenna radiation pattern at a frequency of 3 GHz result using a 3D electromagnetic simulator.

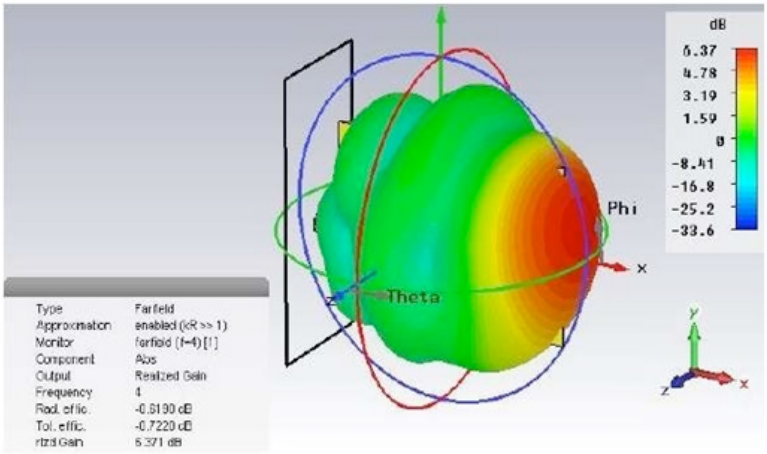



*Figure 10.* Gain and antenna radiation pattern at a frequency of 4 GHz

Figure 10 shows measurement gain and antenna radiation pattern at a frequency of 4 GHz result using 3D electromagnetic simulator.

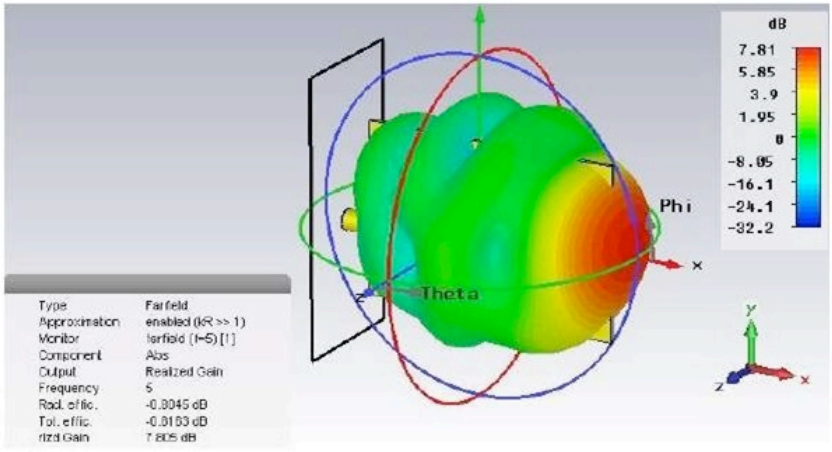



*Figure 11.* Gain and radiation pattern of the antenna at a frequency of 5 GHz

Figure 11 shows measurement gain and antenna radiation pattern at a frequency of 5 GHz using a 3D electromagnetic simulator.

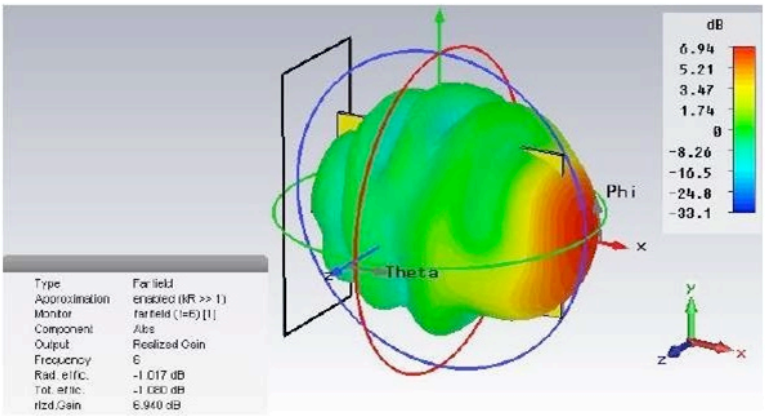



*Figure 12.* Gain and antenna radiation pattern at a frequency of 6 GHz

Figure 12 shows measurement gain and antenna radiation pattern at a frequency of 6 GHz result using 3D electromagnetic simulator.

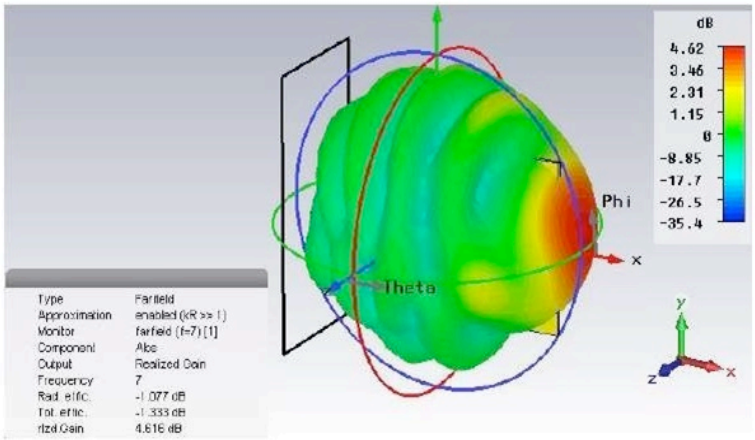



*Figure 13.* Gain and antenna radiation pattern at a frequency of 7 GHz

Figure 13 shows measurement gain and antenna radiation pattern at a frequency of 7 GHz result using 3D electromagnetic simulator.

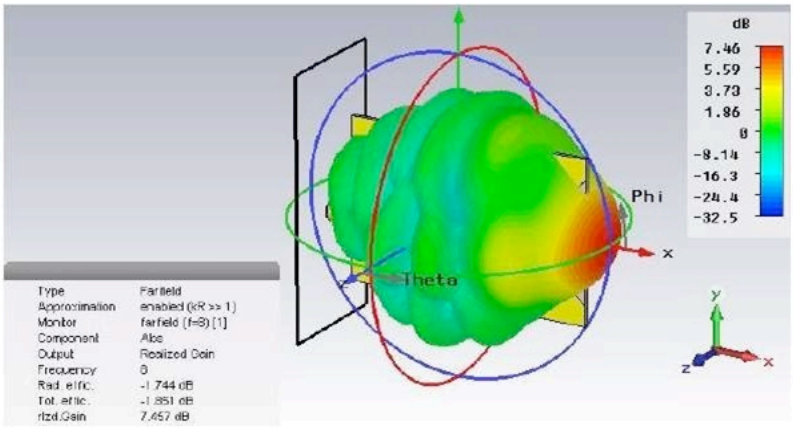



*Figure 14.* Gain and antenna radiation pattern at a frequency of 8 GHz

Figure 14 shows measurement gain and antenna radiation pattern at a frequency of 8 GHz result using a 3D electromagnetic simulator.

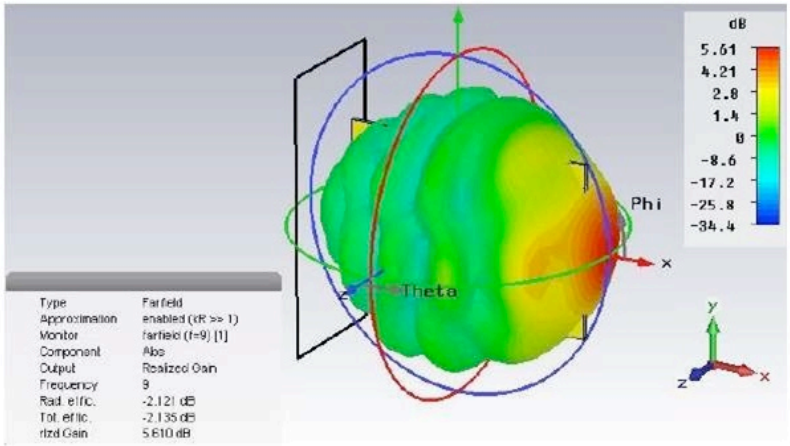



*Figure 15.* Gain and antenna radiation pattern at a frequency of 9 GHz

Figure 15 shows measurement gain and antenna radiation pattern at a frequency of 9 GHz using 3D electromagnetic simulator.

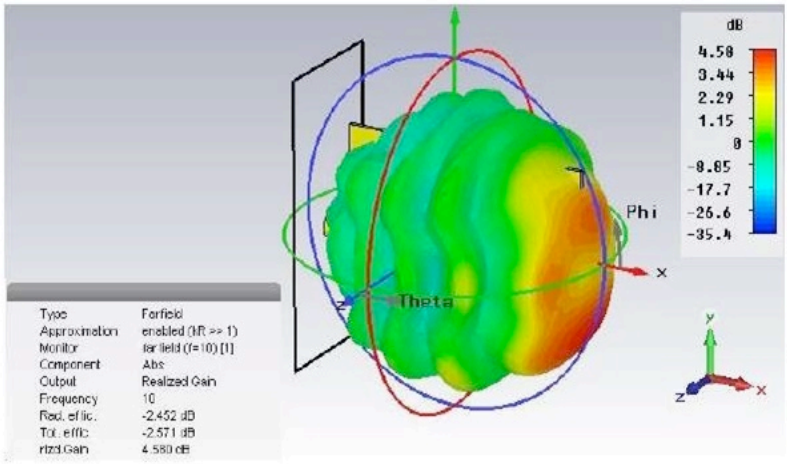



*Figure 16.* Gain and antenna radiation pattern at a frequency of 10 GHz

Figure 16 shows measurement gain and antenna radiation pattern at a frequency of 10 GHz using 3D electromagnetic simulator.

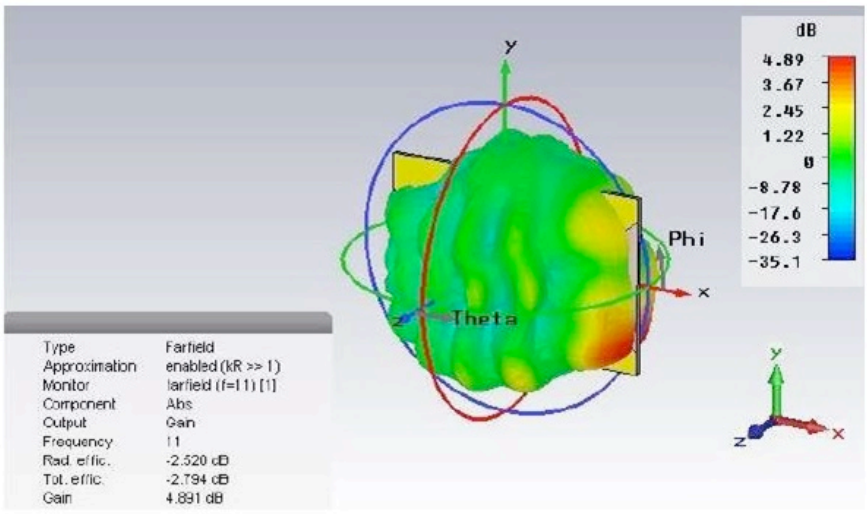



*Figure 17.* Gain and antenna radiation pattern at a frequency of 11 GHz

Figure 17 shows measurement gain and antenna radiation pattern at a frequency of 11 GHz result using 3D electromagnetic simulator. Based on images, it can be seen that the antenna has a gain of about 4.6-7.8 dBi and a directional radiation pattern of a frequency of 3-11 GHz.

## CONCLUSION

This study produced an ultra-wideband microstrip antenna design directional having fulfilled the specifications for VSWR <2 for the frequency range from 3.1 to 10.6 GHz, using microstrip Vivaldi antenna.

The antenna performance can be further enhanced by taking into consideration the following factors:

- Simulation with another substrate material for obtaining the antenna's performance using different materials
- Using other simulators to determine accuracy of each simulator
- Develop new methods to obtain directional radiation pattern in the form of a planar antenna
- Develop new methods to reduce the dimensions of the antenna size.

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# Random Amplified Polymorphism DNA Method to Authenticate Indonesian medicinal Plant Ciplukan (*Physalis angulata*; Solanaceae)

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## ABSTRACT

Ciplukan (*Physalis angulata*) is a medicinal plant in Indonesia, belonging to the family of Solanaceae. Based on molecular phylogenetic analysis, this plant is relative to Ashwaganda (*Withania somnifera*), the famed South Asia medicinal plant touted to kill cancer cells. A study was conducted on genetic variation of Ciplukan using Random Amplified Polymorphic DNA (RAPD) marker. A total of 23 plants from Northern, Southern, Central, Eastern, and Western part of Bandung were examined The RAPD analyses were performed using three selected random primers (OPA1, OPB17, and OPB10). Clustering analysis was conducted based on Unweighted Pair-Group Method with Arithmetic Average (UPGMA) using MEGA 4. Dendrogram showed that the sample plants were not grouped by their geographic localities, suggesting that a genetic interaction occurs among plants from five different locations. This result was also supported by the high level of estimated gene flow (Nm= 1.0919). It is likely due to the nature of self-incompatibility in Ciplukan which requires cross-pollination, creating a higher exchange of genes and leads to homogenization of genetic composition. Overall, these results indicated no genetic differentiation, meaning that all individuals remain taxonomically under the same species.

*Keywords:* Ashwaganda, Ciplukan, Polymorphism, RAPD fingerprinting

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## INTRODUCTION

Ciplukan (*Physalis angulata*) is a herb belonging to the family Solanaceae. It is indigenous to Indonesia and grows well in tropical and subtropical climates. In Indonesia, Ciplukan is the most popular local name for this plant, although different regions have different names for it, such as Cecenet/

Cecendet (West Java), Nyurnyuran (Madura), and Kopok-kopokan (Bali). For many years, Indonesians have used Ciplukan as food and as traditional medicine. Previous molecular phylogenetic analysis based on the DNA sequences of internal transcribed spacer (ITS) region suggest that Ciplukan is a relative of Ashwaganda (*Withania somnifera*) (Hidayat, Priyandoko, Wardiny, & Islami, 2016). This molecular data was supported by morphological characters Ciplukan and Ashwaganda resemble in term of their fruits which are covered by expanded calyx, like a balloon. As Ashwaganda is a well-known medicinal plant which has anticancer activities and indigenous to South Asia, Ciplukan could serve as an alternative for Indonesians.

Ciplukan contains saponin (in shoot), flavonoids (in leaf and shoot), phenols, physalin, tannin, cryptoxantine, ascorbic acid, sugar, Withangulatin A (in fruit), palmitate and stearat acid (in seed), alkaloid (in root), and chlorogenic acid (in stem and leaf) (Licodiedoff, Koslowski, & Ribani, 2013). These chemical components are important to treat various diseases such as schitosomiasis, trypanosomiasis, inflammation, malaria, leismania, asthma, and tuberculosis (Rengifo-Salgado & Vargas-Arana, 2013; Mahalakshmi & Nidavani, 2014).

The chemical compounds and pharmacological activities in the plant are influenced by genetic factors. Different plants of the same species may have different pharmacological activities due to their genetic variations (Hao, Gu, & Xiao, 2015). Therefore, a study on genetic variation is important.

Authentication of species is important to eliminate doubts so that the ordinary Indonesians can use the plant without being wary (Mei et al., 2014). The genetic variation analysis is also crucial before undertaking research. There are several molecular markers available to measure genetic variation among populations, of which Random Amplified Polymorphic DNA (RAPD) is the most common marker (Freeland, 2005). The advantages of RAPD among others are it (1) does not require prior knowledge of DNA sequence information; (2) requires only a small amount of DNA; and (3) is not time consuming as well as being a simple and efficient technique (Kordrostami & Rahimi, 2015).

This study was aimed at analysing genetic variation of Ciplukan in Bandung city and its surrounding area using RAPD as a marker locus, in order that the local peoples obtain valuable information before using the plant. Genetic variation refers to genetic composition of a particular area, so that if the genetic composition homogen, then the locals are able to easily use the plant, and vice versa.

## MATERIALS AND METHODS

### Plant Materials

The 23 plants studied were from Northern, Southern, Centre, Eastern, and Western parts of Bandung (Figure 1; Table 1).

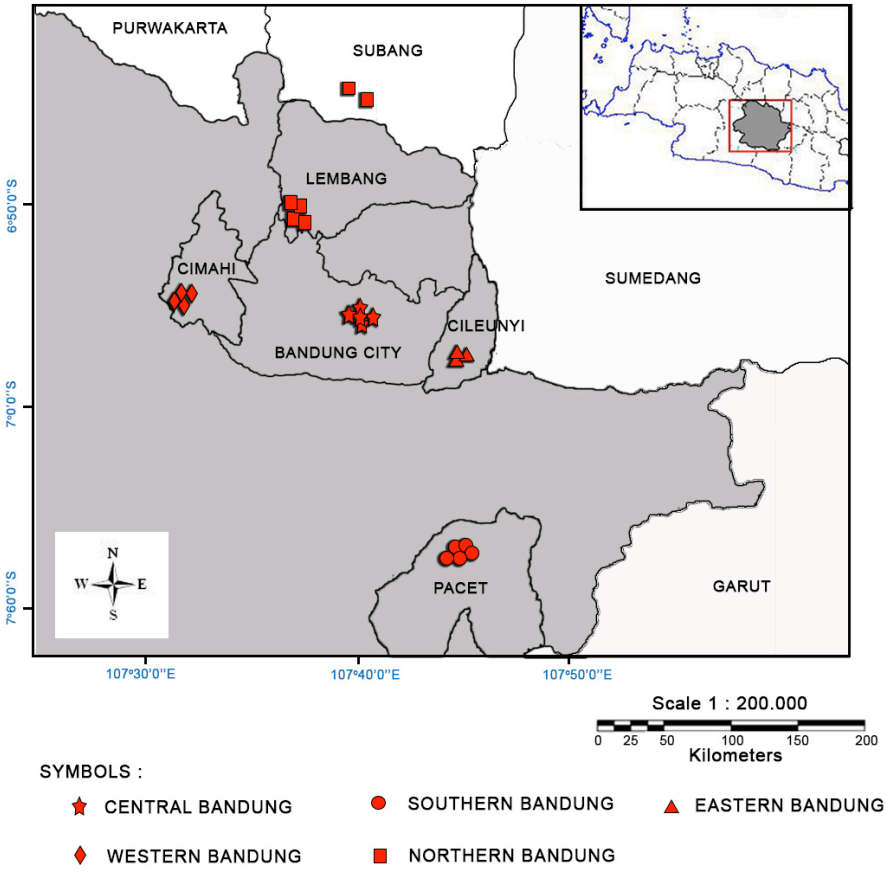


*Figure 1.* Map of sampling location of this study

Table 1
*Plant materials examined in this study*

| Area | Location | Code |
|---|---|---|
| Northern Bandung | Komplek Pondok Hijau-1 | 14 |
| | Komplek Pondok Hijau-2 | 15 |
| | Cihideung-1 | 11 |
| | Cihideung-2 | 12 |
| | Ciater-1 | 20 |
| | Ciater-2 | 21 |
| Eastern Bandung | Komplek Bumi Harapan Cibiru-1 | 10 |
| | Komplek Bumi Harapan Cibiru-2 | 19 |
| | Komplek Bumi Harapan Cibiru-3 | 13 |
| Central Bandung | Tegalega-1 | 3 |
| | Tegalega-2 | 4 |
| | Tegalega-3 | 16 |
| | Tegalega-4 | 8 |
| | Tegalega-5 | 5 |

Table 1 *(continue)*

| | | |
|---|---|---|
| Southern Bandung | Pacet-1 | 7 |
| | Pacet-2 | 17 |
| | Pacet-3 | 6 |
| | Pacet-4 | 22 |
| | Pacet-5 | 23 |
| Western Bandung | Cibaligo-1 | 18 |
| | Cibaligo-2 | 9 |
| | Cibaligo-3 | 1 |
| | Cibaligo-4 | 2 |

## DNA Extraction and Amplification

The genomic DNA was extracted from fresh materials using a GeneJET Plant Genomic DNA Purification Kit (Thermo Scientific, USA). Quantity and quality of the extracted DNA was determined using UV spectrophotometer (JASCO, Tokyo, Japan). The amplification of RAPD loci was carried out using three selected random primers (Table 2). The polymerase chain reaction (PCR) profile consisted of an initial 4-minute pre-denaturation at 94°C and 60 cycles of 1 minute at 94°C (denaturation), 1 minute at 32°C (annealing), and 2 minutes at 72°C (extension), followed by a final 10 minute extension at 72°C. The PCR products were separated on agarose gel (Sigma Co., USA) in 1x TAE buffer and the size of amplified fragments were estimated on the basis of 1 Kb DNA ladder (DNA marker) (Thermo Scientific, USA). 0.8 ul of PeqGreen (Peqlab Biotech., USA) were used for staining instead of ethidium bromide in 30 ml of 1.4% agarose gel, and was run for 80 minutes at 45 V, and subsequently documented using a camera phone (Oppo Smartphone F1, USA).

Table 2
*The random primers used in this study*

| Primers | Sequences |
|---|---|
| OPA1 | 5' CAGGCCCTTC 3' |
| OPB10 | 5' CTGCTGGGAC 3' |
| OPB17 | 5' AGGGAACGAG 3' |

## Data Analysis

Amplified products were scored qualitatively for the presence (1) or absence (0) of bands. Only informative bands (clear and unambiguous) were subjected to analysis. The effectiveness of the primers was gauged based on polymorphic information content (PIC) value (Mir, Zaman-Allah, Sreenivasulu, Trethowan, & Varshney, 2012; Noormohammadi et al., 2015). Clustering analysis was conducted based on Unweighted Pair-Group Method with Arithmetic Average (UPGMA) using MEGA 4 (Tamura, Dudley, Nei, & Kumar, 2007). Gene flow was estimated based on number of migrants per generation (Nm) using POPGEN32 (Yeh, Yang, Boyle, Ye,

& Mao, 2000). Nm value was obtained from the calculation of coefficient differentiation (GST) based on frequency of allele (Nei, 1973). All analyses were based on data from the three random primers used.

## RESULTS AND DISCUSSIONS

In total, 24 primers were screened, and only three primers produced bands (Figure 2). They provided information in terms of their percentage of polymorphism as well as PIC (Table 3). These three primers amplified 23 loci (7.66 loci per primer) and among them, 16 loci (5.33 loci per primer) were polymorphic. The average polymorphism was 71.58% with the highest from primer OPA1 (83.33 %).

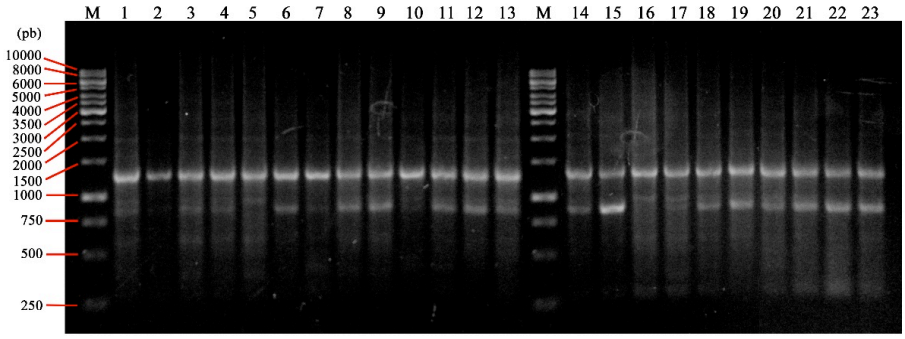


*Figure 2.* "The band pattern of RAPD product amplified by primer OPA1. Lane 1-23 correspond to code of individual as described in Table 1. M = DNA marker"

One important factor that influences the polymorphism in RAPD analysis is the quality of primers. As shown in Table 3, the primers used in this study were effective and informative indicated by good PIC value which is 0.425 in average. As for dominant markers such as RAPD, a good primer must have PIC value between 0 and 0.5 (De Riek, Calsyn, Everaert, Van Bockstaele, & De Loose, 2001).

Table 3
*Effectivity of primers used*

| Primers | Number of loci | Polymorphic loci | % Polymorphism | PIC |
|---|---|---|---|---|
| OPA1 | 6 | 5 | 83.33 | 0.462 |
| OPB10 | 7 | 5 | 71.42 | 0.395 |
| OPB17 | 10 | 6 | 60 | 0.420 |
| Average | 7.66 | 5.33 | 71.58 | 0.425 |

As mentioned earlier, dataset from individual primers was combined for further analysis. Every single primer produced a unique band pattern which is different from other primers. By combining all three primers, a comprehensive and plausible results will be achieved (Zybartaite

et al., 2011). Combining dataset can also be done among different markers, such as RAPD and microsatellite (Tripathi, Saini, Mehto, Kumar & Tiwari, 2012). Clustering analysis showed three major groups among the 23 samples used in this study (Figure 3). However, the groups did not correspond with their geographical origin. This result was supported by value of gene flow (Nm= 1.0919; see Table 4), which means 1.09 individual per generation migrate among different plants randomly.

Genetic composition of particular populations is examined as well as its relationships with other populations in the particular area, so that genetic differentiation that leads to speciation event in the populations can be identified. This situation may cause confusion of the local peoples to access the plant, and therefore, authentication is needed (Mei et al., 2014).

The dendogram reconstructed in this study (Figure 3) showed that the individuals examined were not grouped by their geographic localities, suggesting that a genetic interaction occurs

Table 4
*Gene flow estimation for Ciplukan in Bandung*

| Loci | Sample Size | Diversity of gene in total (Ht) | Diversity of gene in population (Hs) | Coefficient Differentiation (Gst) | Estimation of gene flow(Nm) |
|---|---|---|---|---|---|
| 2004 bp | 23 | 0,1629 | 0,0989 | 0,3929 | 0,7729 |
| 1862 bp | 23 | 0,4883 | 0,3872 | 0,207 | 1,9149 |
| 1634 bp | 23 | 0,4602 | 0,2222 | 0,5171 | 0,467 |
| 1478 bp | 23 | 0,4593 | 0,2747 | 0,4019 | 0,7441 |
| 1215 bp | 23 | 0,15 | 0,966 | 0,556 | 0,9059 |
| 1132 bp | 23 | 0,1454 | 0,1355 | 0,0683 | 6,8241 |
| 1119 bp | 23 | 0 | 0 | **** | **** |
| 1083 bp | 23 | 0 | 0 | **** | **** |
| 1028 bp | 23 | 0,2667 | 0,1831 | 0,3136 | 1,0943 |
| 992 bp | 23 | 0 | 0 | **** | **** |
| 947 bp | 23 | 0 | 0 | **** | **** |
| 849 bp | 23 | 0,2428 | 0,0828 | 0,6589 | 0,2589 |
| 840 bp | 23 | 0,4604 | 0,4147 | 0,0993 | 4,5373 |
| 818 bp | 23 | 0,3868 | 0,3492 | 0,097 | 4,6532 |
| 770 bp | 23 | 0,3504 | 0,193 | 0,4492 | 0,613 |
| 737 bp | 23 | 0,4728 | 0,2734 | 0,4217 | 0,6857 |
| 671 bp | 23 | 0 | 0 | **** | **** |
| 622 bp | 23 | 0,4355 | 0,2941 | 0,3246 | 1,0401 |
| 608 bp | 23 | 0 | 0 | **** | **** |
| 583 bp | 23 | 0,3509 | 0,2794 | 0,2036 | 1,9552 |
| 547 bp | 23 | 0 | 0 | **** | **** |
| 509 bp | 23 | 0,4355 | 0,2941 | 0,3246 | 1,0401 |
| 392 bp | 23 | 0,288 | 0,1907 | 0,1642 | 2,544 |
| Mean | 23 | 0,239 | 0,1639 | 0,3141 | 1,0919 |
| St. Dev | | 0,0368 | 0,0195 | | |

among the plants from five different regions. It is likely due to the nature of self-incompatibility in Ciplukan which requires cross-pollination (Sullivan, 1984). Human activities are also another factor that causes the interaction (Martinez, Freire, Arias-Perez, Mendez, & Insua, 2015). As people in Bandung use Ciplukan as a medicine, they may cultivate the plant in other locations.

This genetic interaction as depicted in Figure 3 was also supported by the high level of estimated gene flow (Table 4). The higher the gene flow, the lower the genetic differentiation among the samples (Mahjoub, Mguis, Rouaissi, Abdellaoui, & Brahim, 2012). The high level of gene flow can prevent differentiation or speciation (in the context of taxonomy) due to exchange of gene among populations through migration of individuals and pollination in order to obtain a homogeneous genetic composition (Morjan & Rieseberg, 2004).

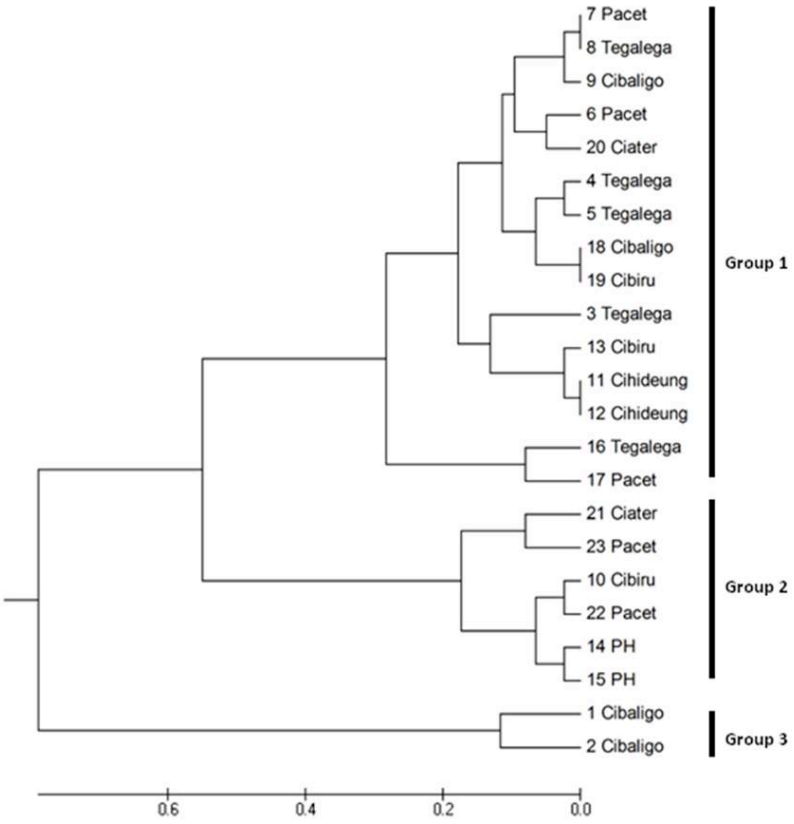


*Figure 3.* " Dendogram (UPGMA) of combined data (three primers) shows remakable genetic interaction among individuals from five different populations. Three major groups were recognised."

## CONCLUSION

This study found that the genetic composition of Ciplukan in Bandung was homogenous. All the Ciplukan plants in Bandung were authentic, and taxonomically under the same species. This means the locals in Bandung are able to easily access the plant without hesitation. Moreover, this study has proved that the RAPD analysis can be applied to authenticate Ciplukan in other regions.

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# Cililin Landslide Process Modelling Using *Lumped Mass Model*

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## ABSTRACT

This study analysed physical properties of landslides at Cililin using a *Lumped Mass Mode*l. It used analytical and numerical methods. The results show that landslide happens at a slope of about 32.74° angle. It usually occurs at the base of the slope, around 700 m in the horizontal direction relative to the initial position and the predicted landslides after landslides for 26 seconds. About 26 seconds after the landslide, the run-out is 800 m with a total travel time of about 33 second. The length of the initial landslides is 200 m experienced as fragmentation effect until the base of the incline before it shrinks after passing basic tilt and stops at the end of 500 m length. The areas affected by the landslide are determined by analysing the centre of mass velocity and the front of the landslides. Prediction run-out for the three locations around the location of landslides Cililin, showed that the magnitude of the tangent slope angle is smaller than the value of the coefficient of friction, and hence it is not prone to landslides.

*Keywords:* Landslides, Landslide parameters, *Lumped Mass Model*

## INTRODUCTION

Landslides, especially in the mountainous areas, are natural disasters that lead to loss of lives and properties. The mountainous terrains are characterised by high energy with instability and variability of the masses (Sumantra & Raghunath, 2016; Delaney & Evans, 2014). In Indonesia, most of the mountainous regions are characterised by landslides. Data from Badan Nasional Penanggulangan Bencana (BNPB) in 2013 showed as many as 124 million people in Indonesia live in areas prone to landslides. One of them is the biggest landslides that occurred in West Bandung regency in 2013 and in Nagrok, Mukapayung village, district of Cililin, West Bandung, West Java (BNPB, 2013) on March 25. Based on GPS data the

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location of landslide is 6°59′30,6780″ *SL* and 107°28′58,5756″ *EL* precisely at the base of Mount Arca. This disaster left 17 people dead and at least seven homes were lost. Based on the landslide hazard map, the village Mukapayung was included in the high landslide danger zone. Some of the landslides in the area happened in 2001, 2009, and 2012. Looking at BNPB data, this means there are 124 million people in Indonesia who live in landslide prone areas. Landslides have major impacts that include loss of lives, injury, damage to building and infrastructure, disruption of services, loss of business and loss of confidence, loss of land resources, and environmental degradation (Chowdhury & Flentje, 2014).

Landslide can be defined as the movement of rock, debris or soil due to gravity (Blasio, 2011). In general, there are two factors that cause landslides, namely: 1) natural factors, such as rainfall, ground movement, soil and rocks, seismic and slope; 2) human activity, such as land development along steep hillsides and deforestation.

As mitigation, residents of Indonesia who occupy areas prone to landslides can be relocated to safer areas. But it is difficult to do because it involves many factors. Thus, the residents should be able to anticipate and protect themselves against landslides by anticipating heavy rains or preparing to seek a safe haven from the threat of landslides. They must also have the ability to build soil and water conservation, tree planting roots in long parallel contours, terraces, channels in the direction of the slope and so on. Many models describing the dynamics of landslides. Oremus's (2006) model looks at the dynamics of landslide using a one-dimensional dense-snow landslide model (model of one-dimensional density snow landslide) by analysing the flow rate of the landslide to a safe distance prediction (run out). The modelling of landslide is very important to analyse its dynamics of landslide and hence, it is useful for prevention or mitigation of landslides. The information/ knowledge about of dynamics of landslide one effort to Landslide Risk Reduction (Winter, 2014).

De Blasio and Elverhoi (2008) proposed the model of rock landslide using a model of friction. The analysis includes the movement, speed and friction generated. Blasio (2011) used a lumped mass model (the other name for model of fixed mass) to describe cases of Elm landslide and landslide Novaya Zemlia. The analysis includes landslide velocity as a function of position, velocity and the mass centre of the front of the landslide as a function of position.

This paper describes the mechanism of Cililin landslide using Lumped Mass Model. This is a simple model to describe the dynamics of landslide and assumes the mass of landslide matter is constant. The lumped mass model successfully describes the stretching effect. It is the change of geometry (shape and size) of landslide matter.

Many studies have successfully described landslides. Generally, an analysis of motion landslides only focuses on the centre of mass motion. This research analysed the dynamics of landslide using centre of mass, front part of landslide matter, and stretching effect.

This paper also analysed speed landslide centre position, position and velocity as a function of time functions were derived using differential numerical methods. This landslide modelling can predict a safe distance (run out) if landslide occurs in other areas in the vicinity of the landslide.

## Landslide

In order to distinguish landslides with the flow / mass movement due to gravity, the former is defined as the largest part of the material that moves with a density of at least 10% greater than the density of water.

Gravity tends to drive the material to the slopes, if there is no cohesion and friction between rocks with soil. However, stable conditions may change due to the adjustment of balance or because of external interferences. In this case, landslides can be triggered by various factors. In general slope stability depends on several factors, including the type of material involved, the geometry of the material, the weight distribution along the slope, the water factor, the external impulsive force such as an earthquake, waves and volcanic eruptions, and vegetation (Blasio, 2011).

## Lumped Mass Model

As a simple toy model, we can envisage a rock avalanche as a rigid, no deformable object moving down the slope and subject to the sole Coulomb friction. This avoids the difficult calculation of the internal deformations within the granular medium. In one type of model, called the lumped mass model, the whole mass is condensed to a single point. The equation of motion is calculated for this point, representative of the whole landslide. The centre of mass or the front of the landslide is a possible choice (Blasio, 2011).

During a landslide, geometric changes, such as length, occur. The reason is that the landslide usually begins as a unit slab with very high cohesion. As it slides and strongly disintegrates, it is transformed into a deformable granular flow; the lateral pressure thus makes it to stretch, widening and flattening. While the centre of mass tends not to be affected by the fragmentation process, with the front can be widened in scope. The general condition is described in Figure 1.

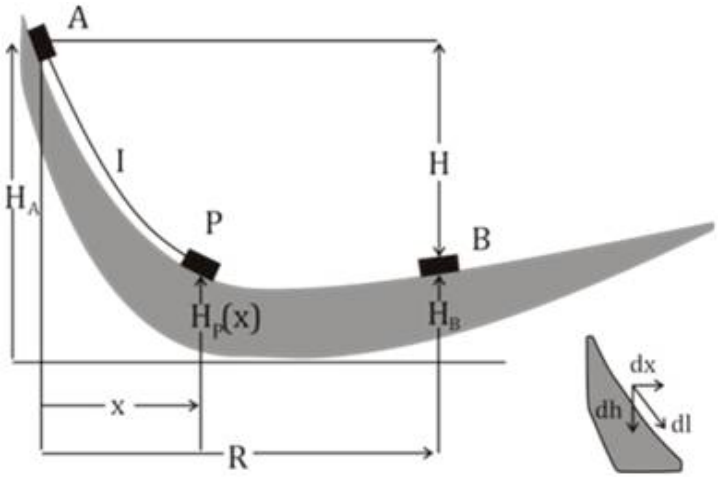


*Figure 1.* Basic geometric in *lumped mass model*

Figure 1 shows the basic geometric lumped mass model with some physics properties. If $H_p$ ($x$) the height of the material is at a distance $x$, using the law of conservation of energy can be expressed as follows:

$$MgH_A = MgH_P(x) + \int_A^B \mu gM \cos\beta(x)dl + \frac{1}{2}MU^2 \quad (1)$$

With $\beta(x)$ local states as a function of tilt angle $x$ and $\frac{1}{2}MU^2$ the kinetic energy. Integration in the above equation can be resolved as

$$\mu gM \int_A^B \cos\beta(x)dl = \mu gM(x - x_A) \quad (2)$$

So, they can get the equation for the value of speed as a function of $x$ as the following

$$U(x) = \sqrt{2g}\sqrt{[(H_A - H_P(x)) - \mu(x - x_A)]} \quad (3)$$

Using this equation will allow to calculate the speed at each point based on the height of the topography $H_p$ ($x$). For cases with a straight line can be considered as a special case of this equation, the value $H_p$ ($x$) can be determined using simple trigonometry. The coefficient of friction can also be determined using condition $U(R) = 0$, thus, providing value

$$\mu = \frac{H_0 - H(R)}{R} \quad (3)$$

With $\mu$ is coefficient of friction. In the same way, it can be analysed as a function of velocity values obtained value $z$ axis

$$U(z) = \sqrt{2g(1-\mu)}\sqrt{(Z_A - Z_P)}\sin\beta \quad (4)$$

Values for each position will be useful at this time to determine the speed each time. The position of the data rate as a function of position can be determined numerically using MATLAB.

In explaining the landslide of material deformation, material landslide is no longer seen as an object but it is a point particle system continuously or only seen as a centre of mass movement only. For this purpose, the concept of the speed of the front (front velocity) landslide is proposed. Forward speed (front velocity) landslide is defined as:

$$U_{FRONT}(x) = U(x)\left[1 + \alpha\frac{(x - x_0)}{R_{CM}}\right] \quad (5)$$

With $\alpha = (1/2)\ (\Delta x/x_1)$ a *total stretching* is defined as half of the total length change landslide $\Delta x = x_2 - x_1$ compared to the initial length $x_1$.

## METHODS

To obtain the location of a landslide area surface model, Global Positioning System (GPS) and the Global Mapper Software was used. The GPS is used to obtain the position / location

landslide and surroundings. The trail (track) obtained from GPS and then transferred to Global Mapper. Output of Global Mapper form XYZ coordinates (XYZ Grid) which was then modelled into a surface location of the landslide in the study area Cililin. After the landslide surface model is obtained, projecting the surface to a field (e.g. field XZ) will be determined using slope and landslide. Cicilin Speed as a function of the position is determined using equation (2) and (4). As for determining the positions as a function of time is done numerically using MATLAB with input in the form velocity as a function of position, boundary conditions and initial conditions.

Determination of velocity as a function of time was performed by numerical differentiation method that includes five points. The dynamics of landslide is described using lumped mass model.

## RESULTS AND DISCUSSIONS

### Geometry Location Landslide

Based on data obtained at the site of landslide, the slope of the landslide area to the surface of the landslide is described as below.

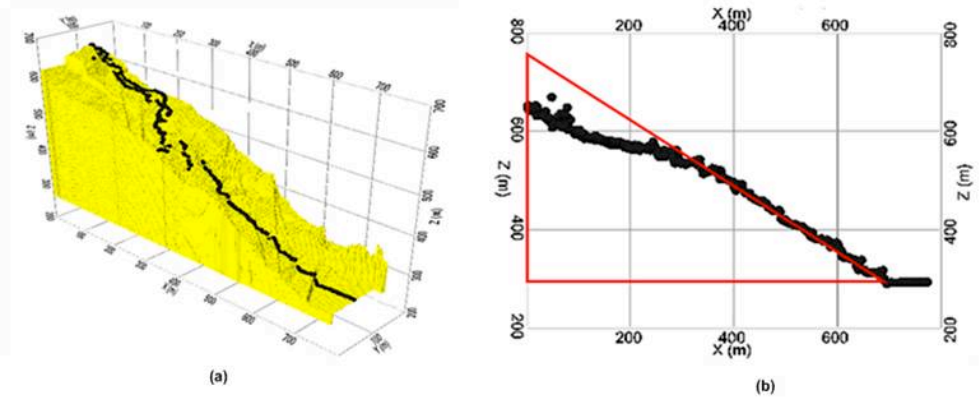


*Figure 2.* (a) The trail surface landslide (b) slope of the projection into the field XZ

Figure 2 shows the geometric and slope around the surface and plane of landslide. This is from tracking GPS and using CRSP software. The landslide is first examined by analysing parts of the centre of mass. The coefficient of friction is determined by using the ratio of height of the run out.

$$\mu = \frac{H_{CM}}{R_{CM}} = \frac{396}{716} = 0{,}553$$

In order to obtain

$$U_{CM}(x) = \sqrt{2g}\sqrt{[(x-84{,}1)(\tan\beta - \mu)]} \approx 1{,}328\sqrt{(x-84{,}1)}; \quad (84{,}1 < x < 700\ m)$$

In general, for the first part of the track, the speed of moving landslide material is accelerated due to gravity. The speed value will continue to grow until the end of the slope that is when the horizontal distance equals to the distance $x = R_1$. Speed at the end of the slope that is at a distance of maximum value $x = 700\ m$ is the maximum $U_{maks}(x) = 33\ m/s$. Velocity will be achieved at a distance $x = 700\ m$ with the speed value $U_{maks}(x) = 33\ m/s$. As for the second path $x > 700$ m, the magnitude of the speed of the centre of mass can be calculated as below:

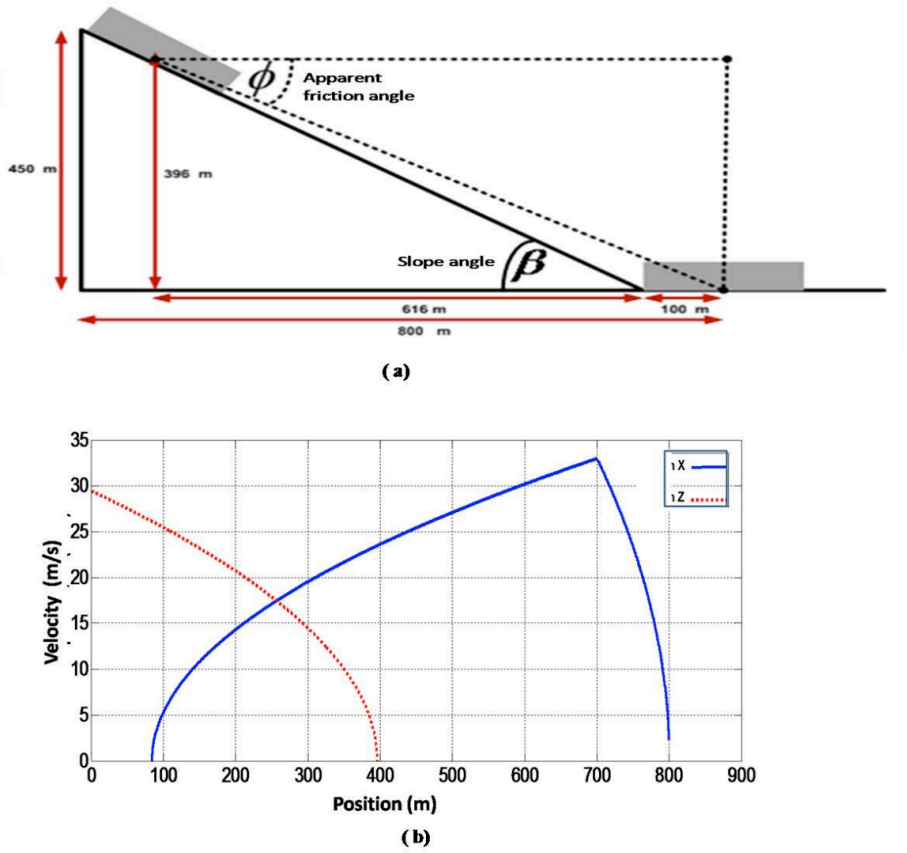


*Figure 3.* (a) The geometry of the surface of the landslide (b) The speed of the landslide as a function of position

$$U_{CM}(x) = \sqrt{U^2{}_{maks} - 2\mu g(x - R_1)} \quad = \sqrt{(33)^2 - 2(0{,}553)(9{,}8)(x - 700)}$$

Figure 3 shows the speed $U(x)$ function of the horizontal distance $x$, landslide reaches a maximum at a horizontal distance $R_1(700\ m)$ and then its speed decreases in flat track, $x > R_1(700\ m)$ because the influence of friction and it comes to a halt. The blue line describes the velocity in horizontal direction (axis x), and the red line describes the velocity in vertical direction (axis z). Changes large enough for velocity occurs when the slide reaches the bottom of the slope before the basic trajectory. From the graph, it can also be known that the derivative

of the velocity $U(x)$ is infinite good position on the starting position ($x = 0$) and the end position ($x = 800\ m$) indicates the changes of speed significantly at both positions. So, by simple analysis on the position $x = 800\ m$ of a landslide suddenly stopped.

## Position Centre of Massa Landslide Matter

Positioning centre of mass landslide matter as a function of time is determined by using analytical methods. By using MATLAB, a position can be obtained at any time as follows.

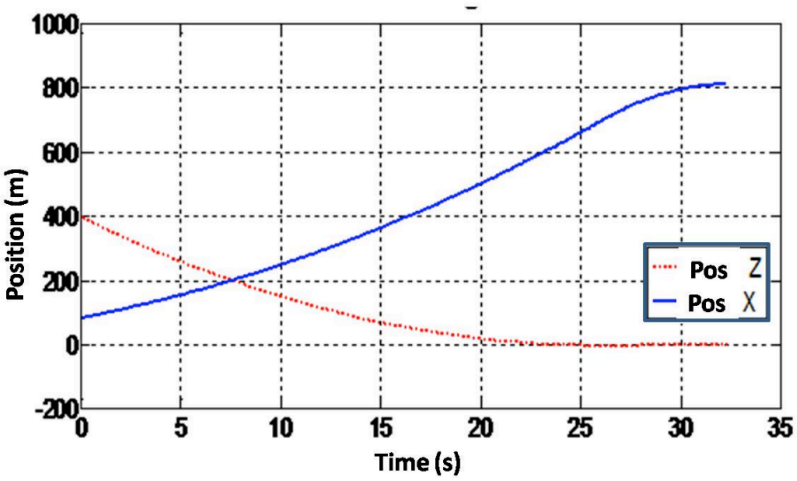


*Figure 4.* Position centre of mass a function of time

Figure 4 shows that the speed reduction occurs in about a second. It is characterised by decrease of the slope of the graph x (t) and z (t) at that time (the slope of the graph position versus time is the speed). The initial position is not zero, because the reference position of landslide matter is centre of mass. From the graph, it also appears that the speed in the x direction is zero in and marked with a zero slope. This means the analysis is in accordance with the foregoing discussion that the avalanche of material stops after distance and time.

## Long of Landslide Matter

Based on direct measurements at the site of the landslide, the length of the landslide was about 200 meters, while the thickness and width landslide, each about 11 meters and 55 meters, were determined by measuring the difference in the estimated coordinates of two point's boundary part landslide.

During its movement, landslide is deformed. The BNPB data showed hoarding at landslide areas of 500 meters long. This is the length of the entire trajectory of landslide end. This condition is based on two views, namely a review centre of mass and review of the front of landslide. In general, the condition can be described in Figure 5.

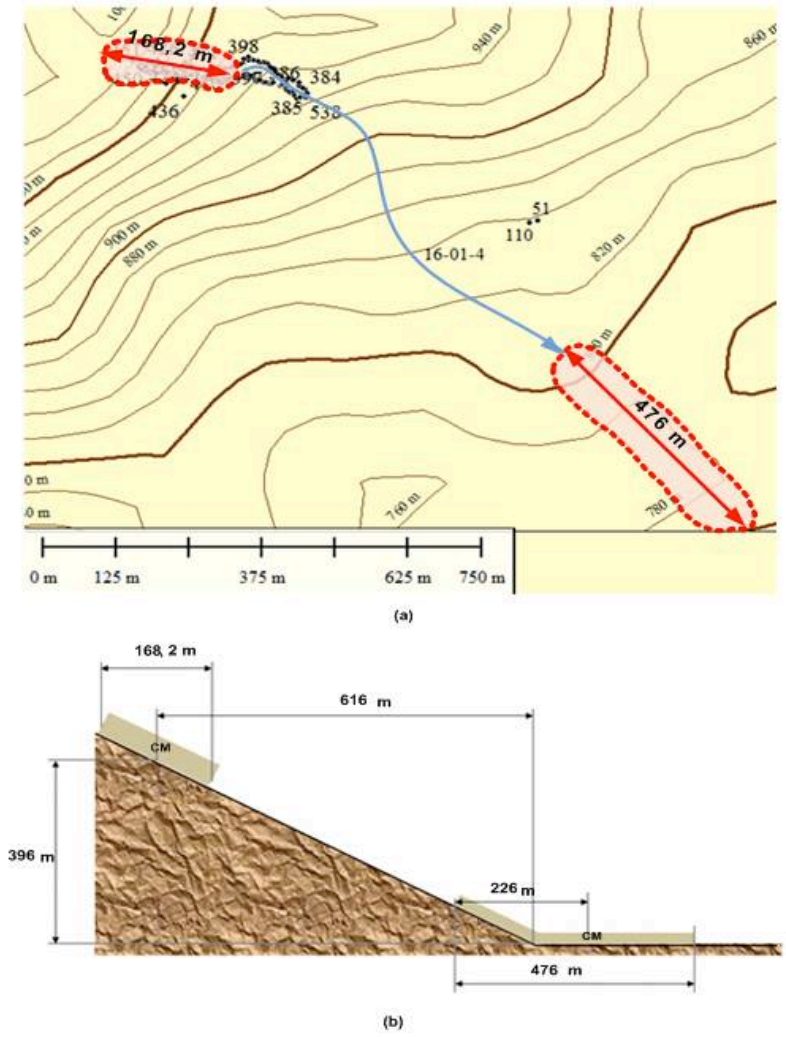


*Figure 5.* (a) A landslide Cililin review of the contour (b) simple geometry landslide Mukapayung Cililin

Figure 5 shows the contour of Cililin landslide from initial position until the final position with the stretching effect. During landslide, there will stretching (stretching Securities) due to the effects of fragmentation and redistribution of material in the landslide in the area is quite large. Landslide forward speed (front velocity) will indicate a value greater than the speed of the centre of mass.

The areal landslide conditions shown in Figure 5 can be expressed as below:

$$U_{FRONT}(x) \quad U(x)\ 1 \qquad \frac{(x \quad x_0)}{R_{CM}} \Big] = 1{,}328\sqrt{x-168{,}2}\left[1+(0{,}915)\frac{(x-84{,}1)}{716}\right];\ 168{,}2 < x < 700\ m$$

The maximum speed is achieved at $x = 700\ m$ the moment with a value around $56\ m/s$. As for the second track, ($x > 700\ m$)

$$U_{CM}(x) = \sqrt{(56)^2 - 2(0{,}553)(9{,}8)(x - 700)} \quad ; \quad x > 700\ m$$

This is shown in Figure 6.

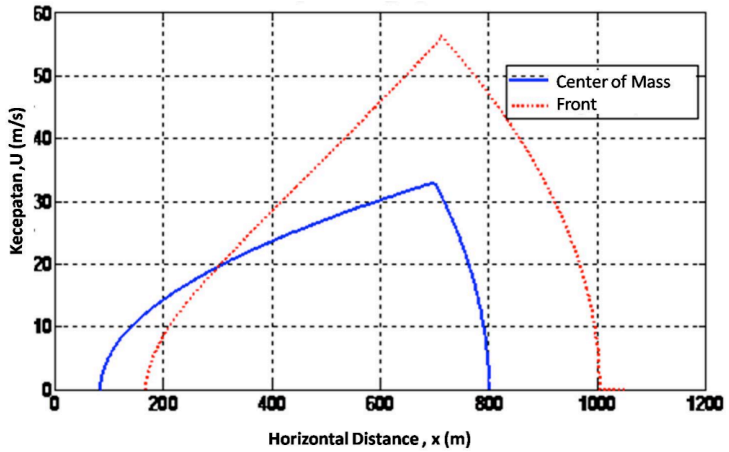


*Figure 6.* Graph of the speed of the centre of mass and the front of the landslide as a function of the horizontal distance

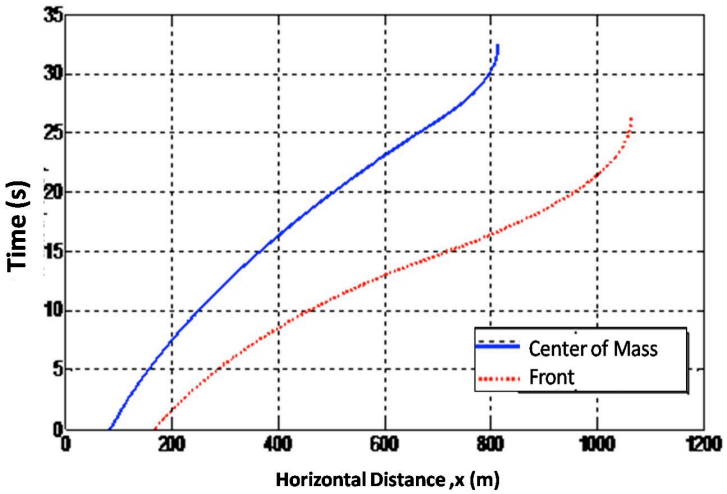


*Figure 7.* Graph of the position of the centre of mass and the Avalanche forward to every time

Figure 7 shows the front of the landslide stops faster ($t$ = 26,1 $s$) than the rest of the centre of mass ($t$ = 32,2 $s$). This is the effect of the friction material field with landslide, thus, speeding up the pace of reduction in any part of the front of the landslide. The front of the landslide seemed to stop at $x$ = 1063,7 $m$, for the centre of mass. 249.8 m difference is half of the length of the final landslide. Thus, it predicts the landslide end approximately 499.7 m. approaching the true value of 500 m. The general visualisation landslide mechanism for each time is shown in Figure 8.

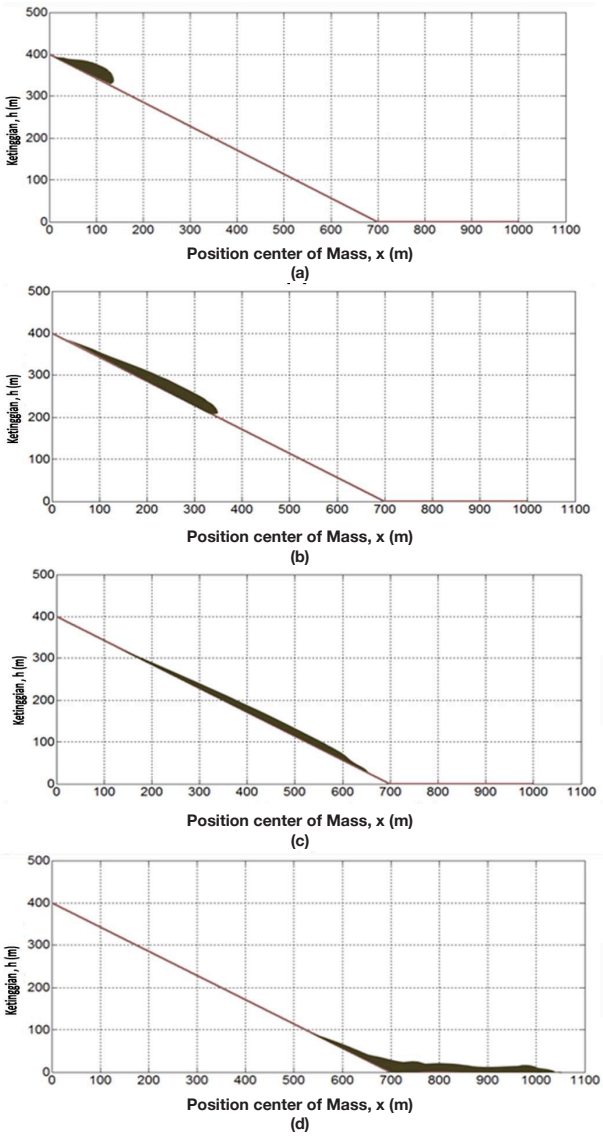


*Figure 8.* Visualisation landslide mechanism for each time (a) t = 0 s, (b) t = 7.6 s, (c) t = 14.8 and (d) t = 32.3 s

Figure 8 shows the visualisation landslide mechanism during the Cililin landslide. The geometric landslide matter changes during the flow, such as length and shape.

## CONCLUSIONS

The Cililin landslide can be describe using *Lumped Mass Model*. Based on *Lumped Mass Model* the velocity of landslide matter at initial condition is 12 m/s in horizontal direction (x-axis) and 30 m/s in vertical direction (y-axis). There are geometric landslide changes during the flow, such as length as the stretching effect. The initial length changes from 200 m (initial length) to 500 m (final length in the final condition, where the landslide matter stopped or the speed is zero).

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# Development of Cyberblog Learning Media to Improve Logical Thinking Concepts on Computer Science Students

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## ABSTRACT

The aim of this study is to improve the mastery of the concept of students' logical thinking, especially in learning algorithm, applied to a new learning model. It is named the "cyberblog" model, which is a web-based learning model that combines web and blog functions in one weblog concept in the form of text, audio, and video developed with sources from the internet and researchers themselves. Therefore, this research proposes the Cyberblog model and describes its implementation. Some experiments on the concept of logical thinking are conducted. The sample of this study is students of the Department of Computer Science in Bandung city. Data were collected by using a test mastery of the concept of logical thinking and field notes and will grow to a computer network-based media (internet) specialized in the learning algorithm that is considered difficult. The results showed a medium of learning that can improve students' logical thinking skills.

*Keywords:* Cyberblog, Logical thinking, Model, Research and development, Web based learning, Weblog

## INTRODUCTION

There is a need for quality education through improvement and refinement of the learning process in schools.

Conventional learning approaches do not demand much creativity in the learning process. Thus, ICT-based learning strategies are useful to achieve this (Leidner & Jarvenpaa, 1995). This learning strategy has many types, such as Interactive Multimedia (IM), Macromedia, Hypermedia, Hypertext, Weblog, and so forth. Weblog or blog is a kind of learning strategy that has many advantages (Wagner & Longmire, 1999). It can accommodate the needs of individual learning, connecting geographically dispersed learners, and asses the student's performance quickly. Moreover, by using weblog, it can

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improve a teacher's knowledge (Ramasamy, Valloo, & Nadan, 2010) and also improve student's reading habit (Yang, 2008). Moreover, Massive Open Online Courses (MOOCs) contain e-learning media which is a product of collaboration among several universities that are designed for large a number of students. Several studies report that MOOCs have become an important technology in universities across Europe (Jansen & Schuwer, 2015), the US (Allen & Seaman, 2015), and Australia (O'Connor, 2014).

The basic theory of all logical thinking is sequential thought (Albrecht, 1984; Dettmer, 2007; O'Brien & Shapiro, 1968). This process involves taking the important ideas, facts, and conclusions involved in a problem and arranging them in a chain-like progression that takes on a meaning in and of it. To think logically is to think in steps (Albrecht, 1984).

Previous studies suggest that learners who have the ability to think logically earn higher grades than the students who don't. The results of the previous studies showed that the ability to think logically affects the learning outcomes of students. It means that by increasing the ability to think logically the learning outcomes of students will be increased (Aminah, 2015).

Albercht (1984) stated the basis of logical thinking is sequential thought where thoughts are united like a chain sequence to arrive at a meaning. Logical thinking is thinking gradually (Milková & Hulkova, 2013). There is a relationship between logical algorithms, which use the concept of sequential thought. This indicates that the algorithm is created by mimicking the logical thinking of humans. In other words, the logical thinking ability of a person affects the development of algorithms: the better the ability to think, the better the algorithm.

Algorithm and programming is difficult to learn (Jenkins, 2002; Gomes, & Mendes, 2007), because it requires not only knowledge but also the ability of logical thinking. Algorithms and programming is an important subject for the student in computer programming because algorithm is a core competency for vocational high students at the Department of Software Engineering. Algorithm and Programming can be defined as processes to build a program. These subjects are difficult for students because most of them have never learned about programming before.

Cyberblog is Cyberblog is web-based software that unifies the functionality of web and blog in the form of video or computer simulation sourced from the Internet or from the researchers themselves (Wihardi & Agustan, 2015). As a product of e-Learning, cyberlog is a rich learning media, highly proficient, adaptable and easy program for a higher level of interaction. Interactive multimedia training materials involving the animation and video clips help learners to gain new capabilities (Breckling, 2012).Wahyudin et al. (2015) recommend learners use cyberblog as a tool for studying algorithm as it could increase understanding of the concept.

Thus, this study focused on developing a new model based cyberblog to improve the student's ability to think logically. In order to evaluate and validate the model, an experiment among a select group of computer science students were conducted. It entailed cyberblog media development for adjusting the characteristics of the sample students.

## METHODS

There are two approaches in this study: Research and Development (R&D) to implement the model, and a pre-experimental design using experimental and control groups.

In order to develop learning media based on Cyberblog, the processes used are based on Far West Laboratory (see Figure 1) (Gall, Borg, & Gall, 1996). It consists of 10 phases.

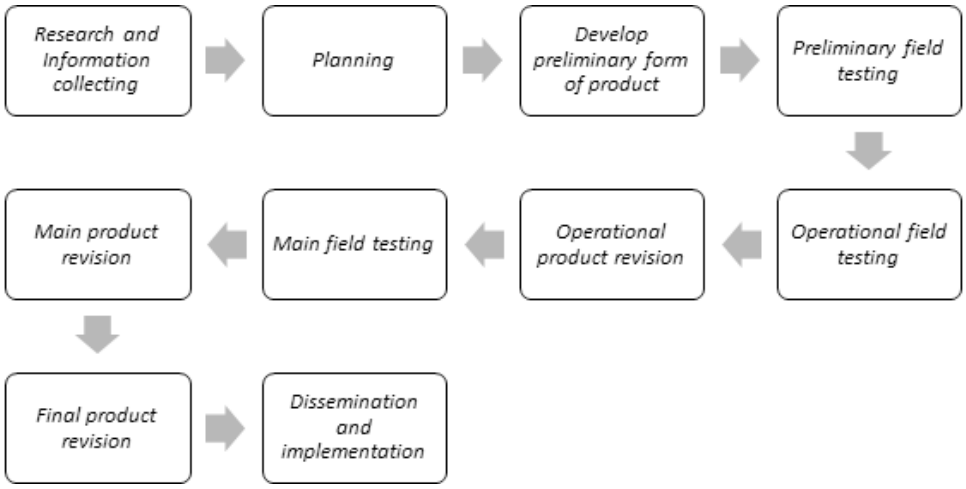


*Figure 1.* R&D Steps based on Gall et al. (1996)

Additionally, the students were assigned randomly, in the pre-experimental design, to experimental and control groups. A cluster random sampling technique was used after the two classes were tested for normality and homogeneity. The experimental group was exposed to cyber-blog learning with multimedia-based system, while the control group conventional learning.

The study population was 30 students randomly selected from Department of Computer Science Education in Universitas Pendidikan Indonesia. The study phase involved: preparation, implementation of the preliminary studies, planning and strategy, implementation and development.

## Location and study sample

The study was conducted in Department of Computer Science Education, University of X, and Bandung. Subjects were lecturers (teachers) and students (learners). A snowball technique was used to select the sample as it allows researchers to determine the subject of research based on the needs of research.

## Techniques and Data Collection

Data was collected utilising the following techniques: observation, documentation study, interview, and questionnaire to seek the student's opinion of cyberblog learning.

### Research Instrument

Research instrument was used to calculate validity and reliability. Validity test is used to determine consistency and accuracy of data collected (i.e., 30 respondents) by using product moment correlation, while the reliability of an instrument is tested using Cronbach Alpha.

### Data Analysis

Two kinds of data analysis are used: qualitative and quantitative. Quantitative data analysis in this study considers the following approaches: analysis descriptive statistics to calculate Description Percentage and hypothesis testing to show the influence (positive or negative) of the independent variables.

## RESULTS AND DISCUSSIONS

Below are the findings of this study based on the interviews and discussions with the sample:

a. Students are constrained in logical thinking because they do not understand the process/ sequence of the material being taught and end up regurgitating what the teachers have taught them.
b. Students' ability depends on how well they understand what is being taught by their teachers.
c. The facilities available in the department of computer science education in University of X are sufficient and the classrooms and internet connection are capable of supporting ICT-based learning.

Based on the potential and problems that have been identified previously, the authors propose solutions to overcome problems that occur by utilizing existing facilities in the department of computer science education. The solutions can be described as follows:

a. Required media learning that encourages students to understand the concept of logical thinking independently so that students can understand the sequence of instructional material taught in class to ensure they really understand the content and not just imitate their teachers. Algorithms and programming are difficult subjects because the concepts are difficult to grasp requiring multimedia intervention.
b. By utilising the facilities available in the department of computer science education, researchers conducted cyberblog development specifically designed to assist students in logical thinking so that they are able to understand the material sequentially.

Therefore, this study proposed and developed multimedia based learning with cyber-blog system using IMSDD (Interactive Multimedia System of Design and Development). It also requires developing optimal software engineering. The IMSDD is used to develop the waterfall method adapted to the needs of multimedia application development.

## Cyberblog Product

Figure 2 shows the redeveloped Cyberblog. Its aim is to assist students in logical thinking with some adjustments as seen in Figure 3. There are two types of users, students and teachers (see Figure 4). Students have access to select subjects in which there are course materials and tests as a form of evaluation. Teachers determine where the material will be displayed and the matter of what will be used in the test and see the value generated by the students.

In Figure 4, blocky in cyberblog is a puzzle piece that contains the program code that must be compiled by the students appropriately so as to form a complete piece. If students have paired the whole piece of the puzzle, the program's source code will be displayed to give the correct answer. After the program's source code is displayed, the user can view the execution results in the form of CMD.

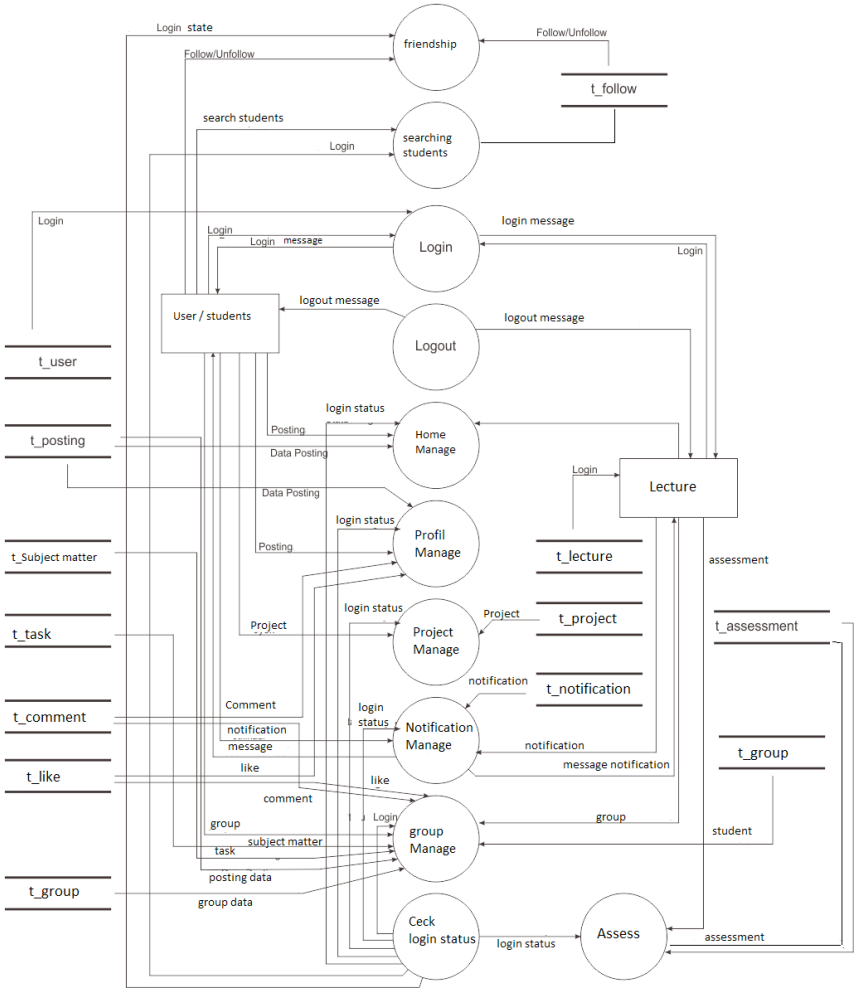


*Figure 2.* Software architecture on cyberblog

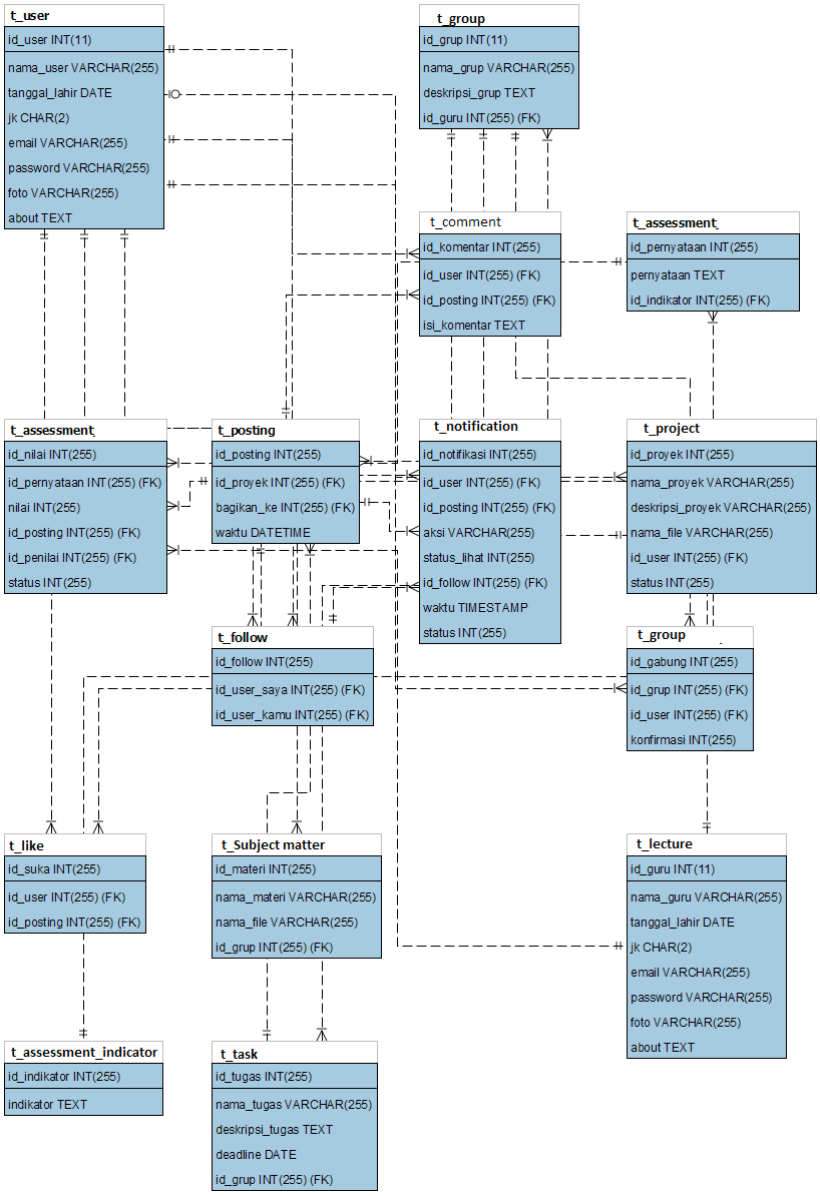


*Figure 3.* ERD cyberblog

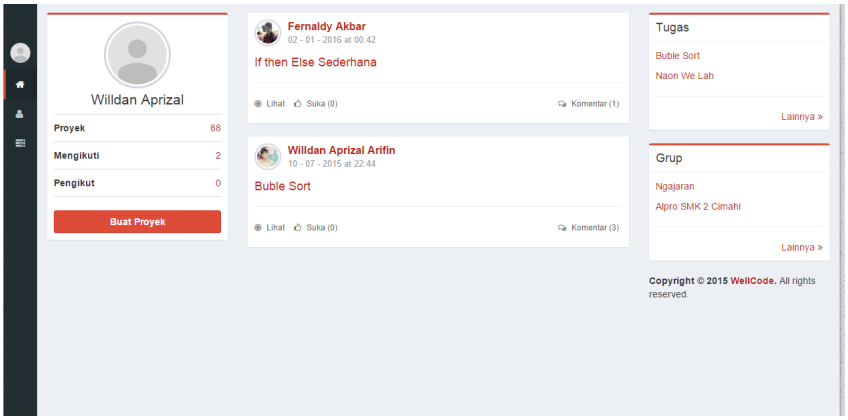


*Figure 4.* Redeveloped cyberblog

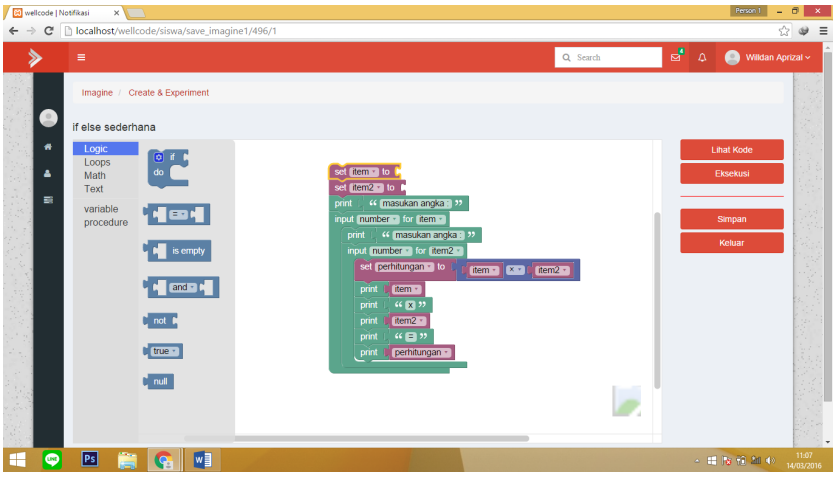


*Figure 5.* Blocky feature in cyberblog


*Figure 6.* The results of program execution

## Data Analysis

Quantitative data was a pre-test score and post-test score of the control group and experimental group.

**Pre-test data analysis.** Before being subjected to the experiment, students should accomplish the first pre-test to measure their initial ability. After that they perform post-test to determine the increase students' understanding of the concept. Table 1 is the descriptive results of the control and experimental group pretest.

Table 1
*Student initial ability*

| Value | Experiment | Control |
|---|---|---|
| Mean Value | 73,78 | 71,22 |
| Standard Deviation | 9,36 | 8,05 |
| Variance | 86,45 | 62,74 |
| DK | 58 | |
| $t_{count}$ | 1,58 | |
| $t_{table}$ | 2,00 | |
| $t_{count} \leq t_{table}$ | There is no difference | |
| $t_{count} > t_{table}$ | There is a difference | |

The experimental group's mean initial capability was 73.78 while the control group's mean initially capability reached 71.22. From the table, it is clear that there is no significant difference between the students' initial capabilities in both groups.

Table 1 also shows $T_{count}$ of 1.38, which is less than $T_{table}$ of 1.86 indicating the two groups had the same variance (homogeneous).

Based on the differences of two mean of the pretest value data obtained, the value of $T_{count}$ is 1.58. If the value of $T_{count}$ (i.e., greater than $T_{table}$), then there are differences in the student's ability as seen from the initial tests. In Table 1, the value of $T_{table}$ is 2.00. Because $T_{count}$ is less than $T_{table,}$ there is no difference in the ability of students in the initial tests.

**Post test data analysis.** Post-test is done to gauge the level of logical thinking of the student followed by data processing to obtain descriptive statistics for both experimental and control groups.

Table 2
*Students' mastery of the concept of logical thinking after the learning/research*

| Value | Experiment | Control |
|---|---|---|
| Mean Value | 82,23 | 74,22 |
| Standard Deviation | 8,86 | 8,65 |
| Variance | 80,22 | 76,58 |
| DK | 58 | |
| $t_{count}$ | 1,05 | |
| $t_{table}$ | 1,86 | |
| $t_{count} \leq t_{table}$ | There is no difference | |
| $t_{count} > t_{table}$ | There is a difference | |

Based on Table 2, 30 students from the experimental group attained 82.23 in terms of capability while 30 from control group attained 74.22.

Analysis showed $T_{count}$ of 1.05, which is less than $T_{table}$ of 1.86. It means that both groups have the same variance (homogeneous). Moreover, it can be seen that $T_{count}$ are in the reception area H1 (i.e., $t > T_{table}$) and there is an increased understanding of the concept of logical thinking by students in the experimental group

**Student logical thinking mastery test.** Tests to determine the increase in student's logical thinking mastery using a normalised gain showed mean gain between the groups. Table 3 shows the test results of student's mastery in logical thinking:

Table 3
*Student logical thinking mastery test*

| Data | Class | N | Mean | Standard Deviation |
|---|---|---|---|---|
| Post-test | Control | 30 | 65,22 | 8,65 |
| | Experiment | | 77,22 | 8,99 |

Improve understanding of the concept in the experimental group because the students do not merely passively receive materials, but actively construct their understanding of the stages of learning using redeveloped cyberblog.

Effectiveness is related to comparison between the objective of the study and the results. Thus, the study showed logical thinking is improved as a result of redeveloped cyberblog.

## CONCLUSION

The main findings of this study:

1. Interactive multimedia learning in the form cyberblog which is a tool delivers algorithm material. Multimedia development happens in several stages: analysis, design, development, implementation, and the assessment stages.

2. Student ability in logical thinking is increased as a result of 'redeveloped' cyberblog in learning.
3. Positive responses regarding e-learning using cyberblog because there is a blocky that helps them in sequence algorithms to view each case/problem.

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# The Prediction of Rockfall Run-Out Using CRSP 3D: A Case Study at Gunung Batu, Lembang, West Java, Indonesia

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## ABSTRACT

Rockfall is a type of landslide that involves a single rock movement. The impact of rockfall hazard can be reduced by predicting rockfall's motion and mitigate any negative outcome based on the predicted results. Gunung Batu Lembang is a rockfall prone area due to its steep contours compounded by weathering of andesite rocks. Gunung Batu is located in the active fault Lembang. Rockfall runout can be predicted using Colorado Rockfall Simulation Program 3 Dimension (CRSP - 3D) software. Results of modelling and simulation using the CRSP - 3D show that potential rockfall at between 73,124 meters and 86,565 metre, and all the rockfall at the toe of slope can be potentially hazardous. Based on predicted result, the first rockfall prone area is along the road and which necessitates the building of protective levee along the road.

*Keywords:* CRSP-3D, Rockfall, Run-out

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## INTRODUCTION

A landslide has seven types of movement, one of them is rockfall. According to De Blasio (2011), a rockfall is a single rock movement caused by the process of weathering, erosion, and the gravity of rocks located on steep slopes. Rockfall can assume the following movements: rolling, sliding, bouncing, free fall, or a combination of these movements.

The type of rockfall motion is strongly influenced by the slope angle and sphericity of rock as shown in Figure 1 a (De Blasio, 2011).

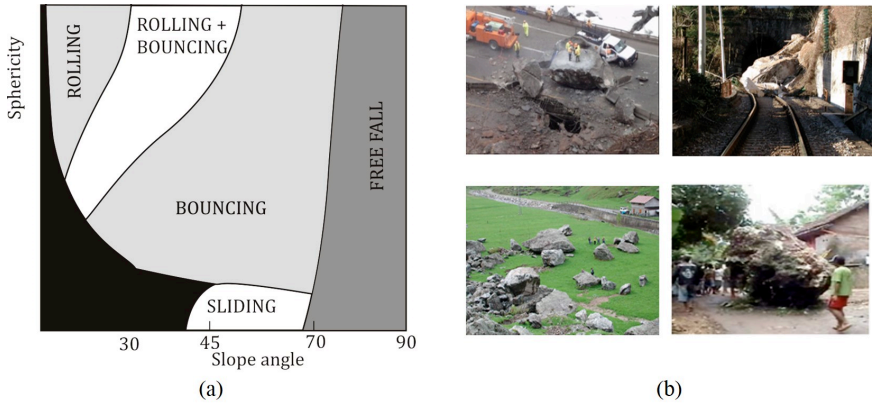



*Figure 1.* (a) Type of rockfall motion depends on slope angle and sphericity (De Blasio, 2011), (b) rockfall hazard (De Blasio, 2011; Karnawati, 2007)

Rockfall has become a safety threat for people who are travelling on or living along the highway, railway, as well those who live in settlements located in mountainous regions as shown in Figure 1 b. Rockfall has occurred in countries, such as France (Walter, Arnhardt, & Joswig, 2012), United States (Guzzetti, Reichenbach, & Wieczorek, 2003), Turkey (Topal, Akin, & Ozden, 2007), Italy (Chiessi, D'Orefice, Mugnozza, Vitale, & Cannese, 2010), Switzerland (Michoud et al., 2012) and Spain (Tanarro & Munoz, 2012). In Indonesia, the biggest rockfall disaster ever recorded occurred at Sleman, Yogyakarta (Karnawati, 2007) and at Kulon Progo (Hizbaron, Hadmoko, Samodra, Dalimunthe, & Sartohadi, 2010) In some mountainous areas, rockfall is very often reported (Chau, Wong, Liu, & Lee, 2003), Gardner (1970) reported that 563 rockfall occurred within just 842 hours based on observation in the area of Lake Louise, Canada. In Bandung Area (West Java, Indonesia), a potential rockfall area is Gunung Batu Lembang which is located in Lembang fault. Lembang fault is an active fault that lies from West to East located 10 kilometers in north of Bandung and known as 'caesarean active' (Fadillah, 2011) which means the area witnesses activities related to tectonics movement which could trigger and earthquake at any time. Furthermore, Gunung Batu Lembang has many boulders and cracks located on the edge of cliff.

To mitigate and prevent of disasters, scientific considerations are needed and therefore the purpose of this study is first to predict the rockfall runout in Gunung Batu, Lembang. Second, the data can be used for mitigation, such as determining the secure area of the rockfall disaster as well as erecting necessary barriers to prevent rockfall incidents. Many methods have been proposed to solve rockfall problem. The first was in 1963 proposed by Ritchie (Chau et al., 2003) who recommended building a ditch at the foot of the slope after observing that basalt

boulders were falling on the former. Subsequent developments has led to simulation/modelling using computers for predicting rockfall motion parameters. The modelling results were used to come up with mitigation efforts to prevent rockfall disaster.

One of the common methods to make predictions of rockfall movement is Geographical Information System (GIS), which is a computer system that can be used to process spatial data based on geographic coordinates. The GIS technology has been used to create a rockfall modelling (Dorren & Seijmonsbergen, 2003), and also predict the rockfall movement (Dorren, 2003; Marquinez, Duarte, Farias, & Sanchez, 2003). In addition to GIS technology, there are also other technologies that could be used in analysing and modelling rockfall, the LiDAR technology (Light Detection and Ranging) which is a light sensor technology that can be used to find out information of an object located in remote areas. The LiDAR technology has been used to analyse rockfall and create spatial models (Lan, Martin, Zhou, & Lim, 2010).

In this study, simulation of rockfall movement was performed using software that can be downloaded free of charge and easy to use i.e. Colorado Rockfall Simulation Program-3D (CRSP-3D). This method has been used by Pfeiffer and Higgins (1990) to predict the rockfall hazard in Gleenwood Canyon. The CRSP-3D is software developed by Colorado Department of Transportation, Federal Highway Administration (FHA), to address transport safety issues caused by rockfall. Modelling methods that used CRSP-3D is a Discrete Element Method (DEM) combined with general equations of motion to simulate movement of rockfall and its interaction with the surface of the slope (FHA, 2012). The program has many advantages, including predicting rockfall runouts by considering various input parameters corresponding to actual conditions, i.e. geometry contour slope, type of slope material as well as roughness and hardness slopes parameters. Additionally, CRSP-3D already considers the parameters of rockfall, i.e., density, shape and size of rock so the predictions generated are valid.

## METHODS

Modelling and simulation process begins with an observation to Gunung Batu Lembang to acquire data such as the contours of the slope, the mechanical property (roughness and hardness slopes), the analysis partition of the slope, and rock parameters are predicted to be fall (density, shape and size of rock). Slope geometry of Gunung Batu Lembang was obtained by marking the coordinates using GPS (Global Positioning Service) conducted along the top of Gunung Batu, body slopes, foot slope and residential areas. Mechanical properties of slope are obtained by observing and marking the coordinates of each type of slope material. Slope partitions are done at the location of the border slope by the road as the first hazard area of rockfall. Parameter rockfall is determined by observing rock location, position, shape, density and size of the rock.

Data acquisition process is shown in Figure 2. To generate a contour slope by using CRSP-3D, data obtained from Global Position System (GPS) was converted beforehand in the form of an excel worksheet using MapSource and Global Mapper software.

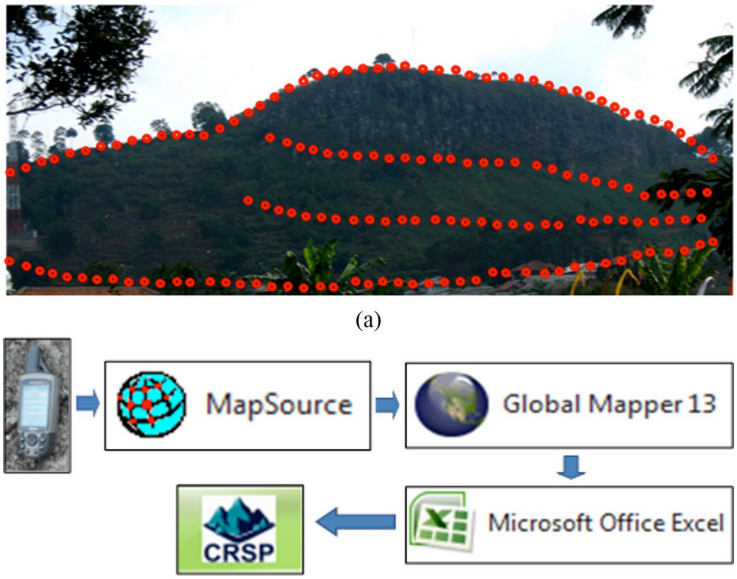


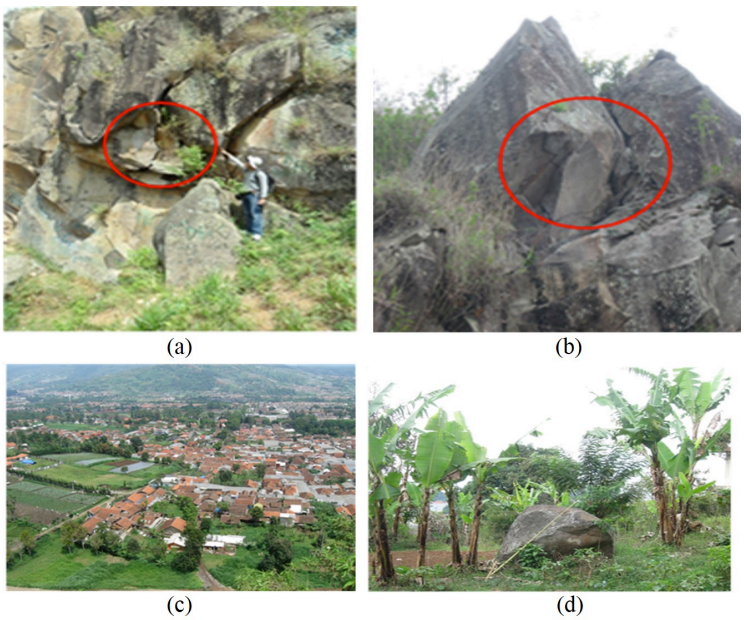

*Figure 2.* (a) Trajectory tracking using GPS, (b) contouring process in CRSP-3D

The CRSP-3D software must be calibrated in advance to obtain the value of the input parameters on CRSP applications such as geometry, roughness, hardness/stiffness of slopes, and suitable rock form. The calibration process is done by dropping a rock of a known size and shape at certain coordinates and compares the test results with a range of stone output results in CRSP-3D applications. In addition, to obtaining more accurate simulation results, the measurement of rockfall simulation should be done three times in each location (stone 1, 2 and 3) to see the consistency of the results of modelling and simulation generated by CRSP-3D.

## RESULTS AND DISCUSSIONS

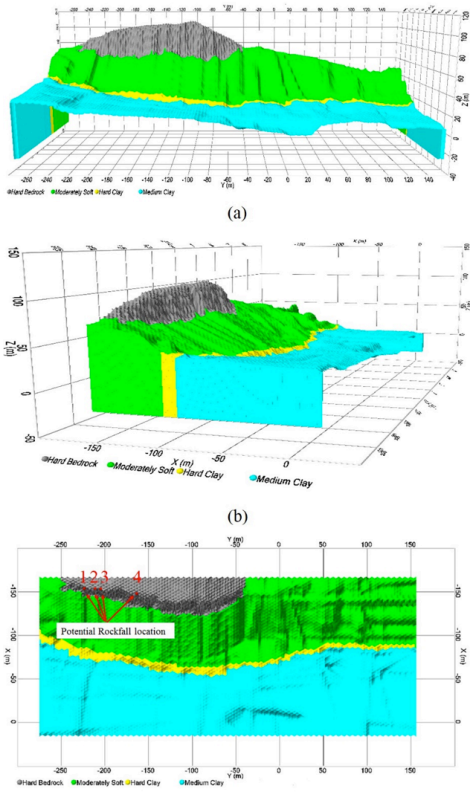
Rockfall disaster vulnerability is seen in the Gunung Batu area. Thus, prevention efforts are crucial as there are many residents living around the foot of the slope. The problem of rockfall is not new in the areas surrounding Gunung Batu. Boulders can be seen in the slope and rocks are even observed at plantations (see Figure 3).

Gunung Batu Lembang has four areas that have different properties: the top of the mountain is composed of boulders (hard bedrock), the slopes are covered by grass, the access road at the foot of the slope is made of soil that has been hardened (hard clay), and the areas where the locals reside are made of medium clay as shown in Figure 4. Some boulders that could potentially fall (rockfall) is seen in the form of lumps (boulder), crack rocks and lies at the edge of the cliff. There are at least four locations with boulders with diameter sizes ranging from 1.5 m to 2 m that can be a potential rockfall as shown in Figure 3 and Figure 4.



(a) (b) (c) (d)

*Figure 3.* Vulnerability of rockfall: (a), (b) rockfall potential, (c) dense population and (d) examples of boulders which are seen at the plantations




(a) (b) (c)

*Figure 4.* Results of CRSP-3D modelling: hard bedrock (grey), moderately soft (green), hard clay (yellow), medium clay (blue), the location of potential rockfall (red dot) viewed from (a) the front, (b) the side and (c) above Coordinate: x axis = longitude, y axis = latitude, and z axis = elevation

The potential rockfall runout from all locations as shown in Figure 4 (c) could be obtained from CRSP-3D simulation model. The result of rockfall movement simulation by CRSP-3D modelling is follows:

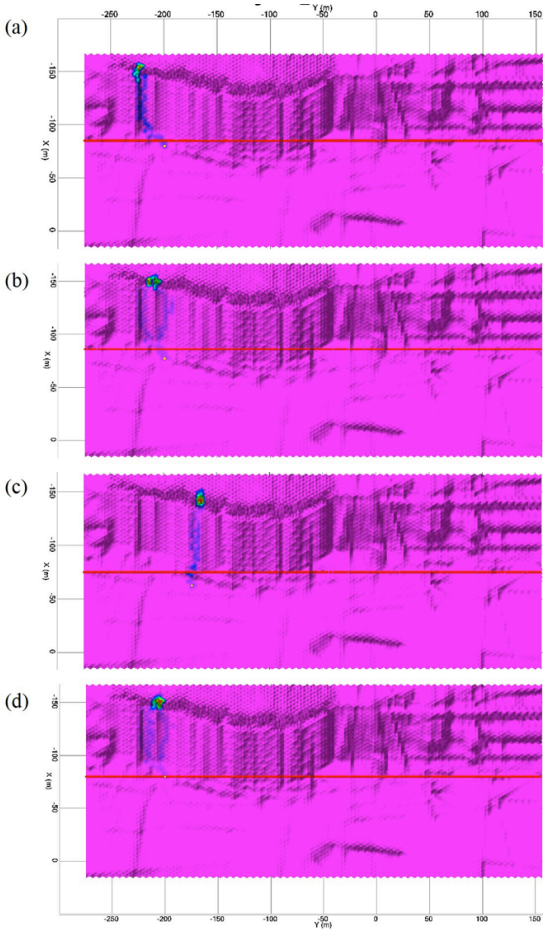



*Figure 5.* Rockfall movement simulation by CRSP-3D from location (a) 1, (b) 2, (c) 3, and (d) 4. The red line shows the partitions as borders between the slope and the road on each trajectory of rockfall

Figure 5 shows trajectory of rockfall movement for all potential location. In Figure 5 (a), the rockfall is able to reach the border of the slopes and roads, and Figure 5 (b), (c) and (d) show that the rockfall can potentially reach the street and the neighbourhood, which had occurred in Sleman (Karnawati, 2007) and in Kulonprogro (Hizbaron et al., 2010) as well as in the Gunung Batu itself (see Figure 2 and 3). Range of each potential rockfall runout can be seen in Table 1.

Table 1
*Potential rockfall runout in Gunung Batu Lembang*

| Potential Rockfall location | Run-out of potential rockfall (meter) | | |
|---|---|---|---|
| | Stone 1 | Stone 2 | Stone 3 |
| Potential Rockfall -1 | 73,582 | 73,582 | 73,582 |
| Potential Rockfall -2 | 73,096 | 76,096 | 76,096 |
| Potential Rockfall -3 | 74,124 | 73,124 | 73,124 |
| Potential Rockfall -4 | 86,565 | 85,565 | 86,565 |

Table 1 shows the simulation of three stones dropped at the same location (stones 1, 2 and 3) which have relatively same distance range. Thus, because the measurement was repeated three times the simulation results for each location of potential rockfall is accurate. Netti, Castelli & De Biagi (2016) revealed that the number of repetitions was helpful to determine the accuracy of the rockfall simulation. The more repetitions will reduce flaws in simulations. Table 1 also shows that the range of potential rockfall also vary with the farthest reaches of 86.565 meters (location number 4). Although the maximum range of potential rockfall from all locations is diverse, all potential rockfall has the capability to reach the border between the slope and the road even into residential areas as shown in Figure 5 (a), (b), (c), and (d). Therefore, Gunung Batu area is a susceptible area to catastrophic rockfall.

The modelling and simulation results can be used to create plan rockfall disaster mitigation activities, including notifications and alerts of rockfall disaster prone areas so that people can avoid the area. Besides that, the result of modelling can be used for the placement and design of retaining rockfall, as reported by Moon, Oh, & Mun (2014), which is important for catchfence design based on numerical analysis design. Giacomini, Thoeni, Lambert, Booth and Sloan (2012) also reported about retaining a rockfall with drapery systems for open pit high walls. The most common method to retain the rockfall is planting of trees along the slope as reported by Dupire et al. (2016). The trees dominated by conifer species act barriers to rockfalls. In the case of Gunung Batu, based on the results of modelling and simulation, the rockfall barrier could be built along the border road and slopes.

## CONCLUSION

Based on the observation in Gunung Batu, there are at least four locations of boulders that could potentially lead to a rockfall. Based on modelling and computer simulation, the prediction of potential rockfall at each location has a different range to reach the nearest and farthest at 73.124 meters and 86.565 meters respectively at the end of the slope of Gunung Batu.

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# Magnetic Properties of Co: $TiO_2$ Thin Films with Low Cobalt Concentration

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## ABSTRACT

The magnetic properties of Co: $TiO_2$ thin film with low cobalt concentration was investigated. The Co: $TiO_2$ thin films were grown on n-type Si (100) substrate using metal organic chemical vapour deposition technique. The cobalt concentration in the Co: $TiO_2$ thin film was determined using energy dispersive X-ray spectrometer and the magnetic properties of the film was determined using a vibrating sample magnetometer. The energy dispersive X-ray spectrometer results show that the cobalt concentration in Co: $TiO_2$ thin films (denoted by $x$) are $x$ = 0, $x$ = 0.2%, $x$ = 0.3%, $x$ = 0.7%, and $x$ = 1.1%. The vibrating sample magnetometer results indicate that each film (exclude $x = 0$) exhibits ferromagnetic properties at room temperature. Saturation magnetisation of Co: $TiO_2$ thin film varies from 1,0 emu/$cm^3$ to 4,4 emu/$cm^3$ and increases as the cobalt concentration in Co: $TiO_2$ thin film increases. On the other hand, magnetic coercivity of Co: $TiO_2$ thin films varies from 4 mT to 12 mT and decreases as the concentration of cobalt in Co: $TiO_2$ thin film increases.

*Keywords:* Co: $TiO_2$, magnetic properties, metal organic chemical vapour deposition, thin film

## INTRODUCTION

Cobalt-doped $TiO_2$ (Co: $TiO_2$) thin film began to attract attention since Matsumoto et al., (2001) reported that it showed ferromagnetic properties above room temperature (Matsumoto et al., 2001). The film was grown using PLD (pulsed-layer deposition) methods on $LaAlO_3$(001) and $SrTiO_3$(001) single crystal substrate. The emergence of hysteresis in the magnetisation curve indicates ferromagnetic properties of film at room temperature. Matsumoto et al. obtained

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the magnetic moment of the Co: $TiO_2$ film of 0.32 μB. The Co: $TiO_2$ film transparent in the visible and infrared light region and has an energy gap of 3.1 eV. As concentration of Co atom increases so does magnetisation.

Chambers et al. (2001) reported similar findings. They grew anatase Co: $TiO_2$ film on the $SrTiO_2$ and $LaAlO_3$ substrate using OPA-MBE (oxygen-plasma-assisted molecular-beam epitaxy). It was found the $TiO_2$ films doped by 3% of Co atoms showed ferromagnetic properties at room temperature. The magnetic moment of the film is 1.26 μB, about 5 times higher than that produced by Matsumoto et al., 2001.

Seong, Yoon, & Cho (2002) grew Co: $TiO_2$ thin films using metal organic chemical vapour deposition (MOCVD) technique. They examined the influence of impurity concentration (fraction of Co atom in $TiO_2$) on the ferromagnetic properties of Co: $TiO_2$ film. Ferromagnetic properties at room temperature were also observed in polycrystalline Co: $TiO_2$. According to them, the ferromagnetic properties of the film are dependent on the distribution of Co atoms in the film. As Co atoms increased so did the saturation magnetic moment and magnetic coercivity of films.

There are various growth techniques of $TiO_2$ or Co: $TiO_2$ on thin films, among which are PLD (Matsumoto et al., 2001; Chambers et al., 2001), sputtering (Park, Ortega-Hertogs, Moodera, Punnoose, & Seehra, 2002; Yoo et al., 2007; Heo, Lee, & Boo, 2005; Hasan, Haseeb, Masjuki, Saidur, & Hamdi, 2010), and MOCVD (Bernardi et al., 2001; Seong et al., 2002; McClure, Kayani, Idzerda, Arenholz, & Cruz, 2008; Saripudin, Saragih, & Arifin, 2014). However, compared with other methods, MOCVD has several advantages, i.e., high productivity, high growth rate, and it can grow films in various surface forms, freely manipulating the stoichiometry of the film during growth, can grow the films uniformly over a large area with a very smooth surface, can grow at relatively high pressure and relatively low operating budget (Sandell et al., 2002; Awschalom, Loss, & Samarth, 2013; Cho, Chung, & Moon, 2001). In this research, the Co: $TiO_2$ thin film was grown using MOCVD technique.

Generally, films with high Co atom concentrations, above 3%, have the ferromagnetic properties of Co: $TiO_2$ thin films, (Matsumoto et al., 2001; OPA-MBE (Chambers et al., 2001) ; Seong et al., 2002). As far as we know, there have been no studies which have investigated the ferromagnetic properties of Co: $TiO_2$ thin films with low concentrations (less than 3%). Therefore, in this study, we focus on investigating the magnetic properties of Co: $TiO_2$ thin films with low concentration of Co atoms and whether the ferromagnetic properties of Co: $TiO_2$ thin film was detected as well as their characteristics.

## MATERIALS

The materials used in this experiment consisted of titanium (IV) isopropoxide (TTIP or $Ti(OC_3H7)_4$) 99,99%, *Sigma Aldrich Chemical Co., Inc.*), tris 2,2,6,6-tetramethyl–3,5-heptanedionato cobalt (III) ($Co(C_{11}H_{19}O_2)_3$ or Co(TMHD)3, *Strem Chemical, Incorporation*), and tetrahydrofuran (THF) 99,99%, *Sigma Aldrich Chemical Co., Incorporation*.

## METHODS

The growth of Co:$TiO_2$ thin film is divided into three stages: preparatory, growth, and cooling. The preparatory phase consists of preparing the precursor material and washing the substrate. The tube is filled with a mixture of 20 mL of TTIP and 20 mL of $Co(TMHD)_3$. Earlier, 900 mg powder $Co(TMHD)_3$ was dissolved in 20 mL of THF to obtain the precursor Co in liquid form. This is only done in the initial setup or if the precursor material in the evaporator tubes has been exhausted.

Washing substrate is a first stage towards the process of growing the film. The silicon substrate was washed using liquid acetone for 10 minutes, then with methanol for 10 minutes, and terminated by etching it with a mixed solution of HF de-ionised water for five minutes. Washing the substrate by acetone and methanol aims to remove organic materials that may be present on the substrate surface. Meanwhile, substrate is washed using HF solution mixed with de-ionised water aimed at etching the silicon oxide that may occur on the surface of the substrate. Subsequently, the substrate is dried by spraying $N_2$ gas with technical purity of 99.999%. After that, the substrate is inserted into the reactor chamber and placed on molybdenum heating plate using silver paste adhesive.

The second stage is the growth of thin films using MOCVD technique. In this experiment, the precursor material contained in an evaporator tube is heated to a temperature of 100°C for the growth of the Co: $TiO_2$ film. The vapour is then driven by argon gas at a rate of 70 sccm to the reactor chamber where the substrate is located. The substrate is heated at a constant temperature. Total reactor pressure is about $10^{-3}$ torr. The growth time is 120 minutes for each film.

The third or final stage is cooling. Cooling stage is after the film growing is completed. Cooling to the room temperature is done at a rate of 200°C/h.

### Co Concentration and Magnetic Measurement

The concentration of Co atom in Co: $TiO_2$ was measured by energy dispersive X-ray spectrometer or EDS (JEOL tipe JSM-6510LA) while the magnetic properties of Co: $TiO_2$ thin films was measured using the vibrating sample magnetometer or VSM (Oxford 1.2 T). Magnetic properties were measured at room temperature of 300 K. In addition to Co: $TiO_2$ films, the magnetic properties of $TiO_2$ films were also measured.

## RESULTS AND DISCUSSIONS

Five thin film samples were grown and the Co atom concentration in the film was measured using EDS. The results showed that the four samples had concentrations of Co atoms, each for $x = 0\%$ (pure $TiO_2$, without Co atoms) $x = 0.2\%$, $x = 0.3\%$, $x = 0.7\%$, and $x = 1.1\%$. Each sample was measured using VSM magnetic properties.

Figure 1 shows the relationship between magnetisation and external magnetic field (M-H curve) of the Si substrate (Figure 1(a)) and $TiO_2$ thin films (Figure 1(b)). In Figure 1(a), the greater the value of H, the smaller the value of M. This shows that Si substrate has the negative magnetic susceptibility ($\chi$ = gradient of the curve is negative) and hence, the Si substrate has

diamagnetic properties. This is due to the non-cooperative behaviour of the electron orbit when there is an external magnetic field. Diamagnetic materials are composed of atoms that do not have a net magnetic moment, i.e., all orbits are filled and there are no unpaired electrons.

On the other hand, in Figure 1(b), the greater the value of H, the greater the value of M. This shows that $TiO_2$ thin film has positive magnetic susceptibility ($\chi$ = gradient of the curve is positive). In other words, the $TiO_2$ thin film has paramagnetic properties. This shows that each $TiO_2$ atom has a permanent dipole moment generated by a mutually exclusive process and which is not perfect from an orbital magnetic moment and/or electron spin. When there is no external magnetic field, the magnetic moments of atoms are randomly oriented. When an external magnetic field is given, the magnetic moments of the atoms are parallel, by means of rotating, so the relative permeability is increased to greater than 1. Thus, the total magnetic moment continues to increase linearly with increasing external magnetic field. The paramagnetic properties of $TiO_2$ films can be derived from the sub-stoichiometric oxygen generating paramagnetic ions $Ti^{3+}$ and/or the presence of undesirable impurities (Sangaletti et al., 2006).

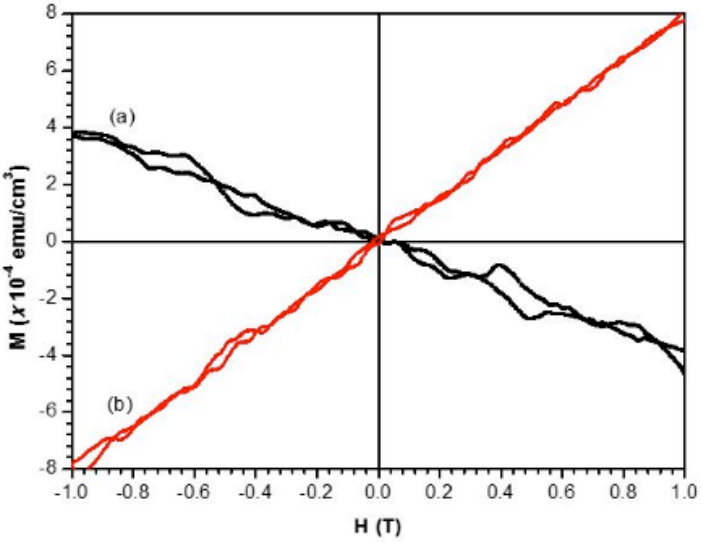


*Figure 1.* M-H curve for: (a) Si substrate and (b) $TiO_2$

M-H curves of Co: $TiO_2$ thin films for Co atom concentrations of $x$ = 0.3% and $x$ = 1.1% is shown in Figure 2. The curve does not show the existence of saturation magnetisation. Instead, magnetisation actually appears to increase almost linearly when the external magnetic field increases. This occurs due to the paramagnetic properties effect of $TiO_2$ which is not shown on the graph.

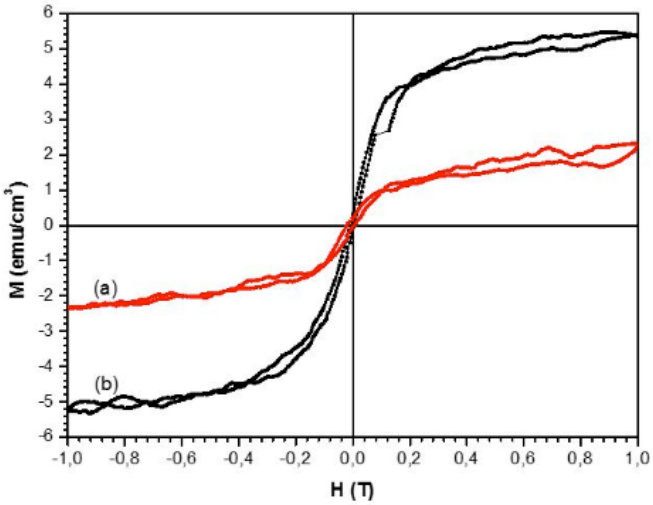


*Figure 2.* M-H curves of Co: $TiO_2$ thin films for (a) x = 0,3 % and (b) *x* = 1,1 %

Referring to the Zajac theory, the emergence of the M-H curve as shown in Figure 2 shows the contribution of the paramagnetic effect of $TiO_2$. Measurable magnetisation is a combination of effects from the ferromagnetic properties of Co and paramagnetic properties of $TiO_2$. Therefore, the M-H curve is then decomposed into two components, i.e., ferromagnetic, FM, and paramagnetic PM (Zajac et al., 2003).

Figure 3 shows the decomposition results of the M-H curve of the Co: $TiO_2$. thin film for *x* = 1.1% (decomposed from Figure 2(b)). Figure 3(a) is the total magnetisation, a combination of ferromagnetic contributions of Co and $TiO_2$. paramagnetic contribution. After deducting the paramagnetic effect of $TiO_2$. (Figure 3(b)), a hysteresis curve was obtained which shows the ferromagnetic properties of Co: $TiO_2$. thin film (Figure 3(c)). Thus, it appears that the M-H curve indicates saturation.

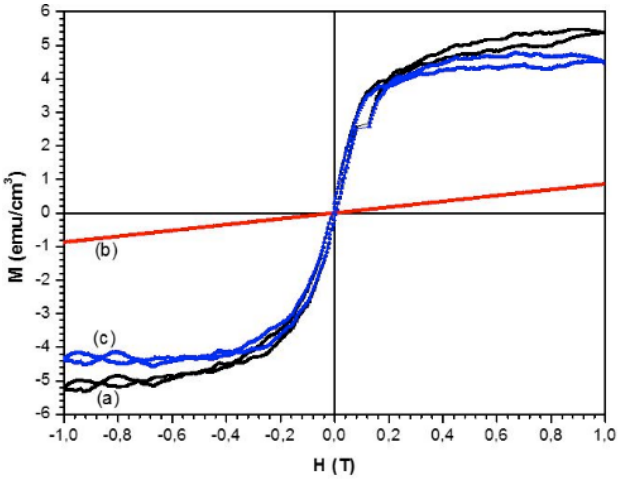


*Figure 3.* Decomposition results of the M-H curve of Co: $TiO_2$ thin films for *x* = 1,1 %: (a) before decomposition, (b) $TiO_2$ paramagnetic effect, and (c) after decomposition

Figure 4 shows the M-H curve of the Co: $TiO_2$ thin films for $x$ = 0.2% and $x$ = 0.7%. It is clear there is diamagnetic effect of the substrate on the Co: $TiO_2$ thin films. Diamagnetic si substrate effect on M-H curve is common, readable by the results of VSM on the thin film. Therefore, to get the curve M-H thin film that actually, the results of a VSM test reading corrected (reduced) in advance by the effect.

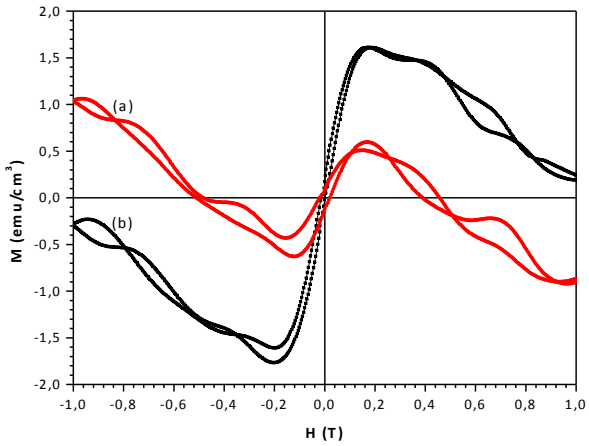


*Figure 4.* M-H curves of Co: $TiO_2$ thin films for (a) $x$ = 0,2 % and (b) $x$ = 0,7 %.

Figure 5 shows the M-H curves of Co: $TiO_2$ thin films for $x$ = 0.7%, before (Figure 5(a)) and after being corrected (Figure 5(c)) by the diamagnetic effect of the substrate (Figure 5(b)). In the figures, it appears that M-H curve of the film form a ferromagnetic hysteresis as in general.

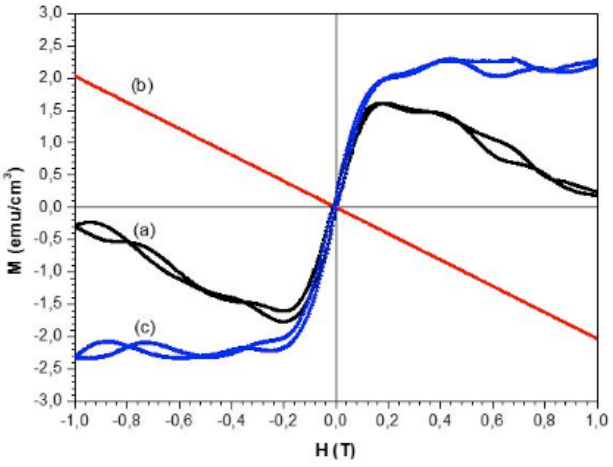


*Figure 5.* M-H curves of Co: $TiO_2$ with $x$ = 0,7 %: (a) before corrected, (b) diamagnetic effect of substrate, and (c) after corrected

After paramagnetic or diamagnetic effect is subtracted from the M-H curves, overall, the hysteresis curve of Co: $TiO_2$ thin films are shown in Figure 6. The films are measured at room temperature. The existence of hysteresis at room temperature shows that the films Co: $TiO_2$ grown are ferromagnetic at room temperature.

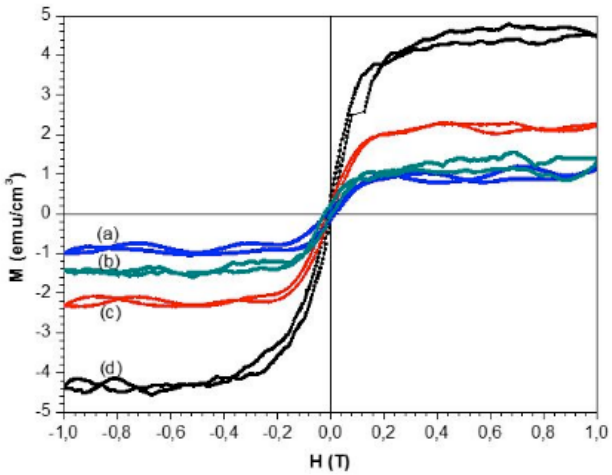


*Figure 6.* Ferromagnetic properties of Co: $TiO_2$ thin films for (a) $x$ = 0.2 %, (b) $x$ = 0.3 %, (c) $x$ = 0.7 %, and (d) $x$ = 1.1 %

From the M-H curve, mathematically, the magnetic coercivity value is the value of H when M = 0, denoted by $H_c$. Therefore, based on Figure 6, magnetic coercivity values of Co: $TiO_2$ thin films produced in this study ranged from 4 mT (40 Oe) to 14 mT (140 Oe). This magnetic coercivity value is low, less than 1000 Oe. Materials with $H_c$ <1000 Oe include those with soft magnetic response (Awschalom et al., 2013). A magnetic polarisation film with soft magnetic response is to be reversed so that the energy consumption is low. Thus, the Co: $TiO_2$ thin films produced in this study had a soft magnetic response that its magnetic polarisation is reversed.

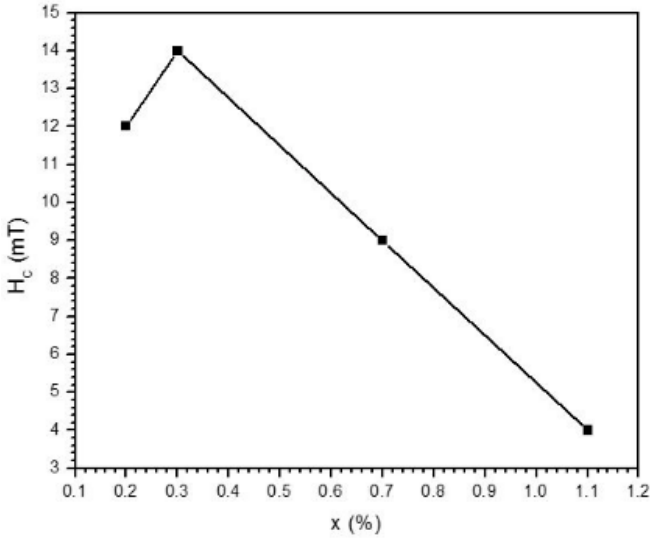


*Figure 7.* Magnetic coercivity, $H_c$, versus concentration of Co atom, $x$

A graph of magnetic coercivity versus concentration of Co atom is shown in Figure 7. The magnetic coercivity increased from 12 mT to 14 mT when the concentration of Co atom increased from 0.2% to 0.4% and vice versa. From the graph, it can be said that the value of the magnetic coercivity decreases when Co atom concentrations increase. A similar situation was observed by Seong et al. (2002). The decline is related to the tendency of atoms that form $Co_{1-x}T_{ix}$ clusters at a high concentration of Co atom. The $Co_{1-x}T_{ix}$ clusters have soft magnetic properties that depress the magnetic coercivity value (Seong et al., 2002).

The value of saturation magnetisation is the value of *M* when the curve has been flat or not depending on increasing *H*. From Figure 6, saturation magnetisation of Co: $TiO_2$ films in this study were in the range of 1.0 to 4.4 emu/cm$^3$. This is much lower compared with findings of earlier studies in the range 20-70 emu/cm$^3$ (Seong et al., 2002) and 20-50 emu/cm$^3$ (Stampe, Kennedy, Xin, & Parker, 2002).

Saturation magnetisation increased with increasing Co atom concentrations, as shown in Figure 8. The results of this study are similar with that of Seong et al., (2002). They showed the effect of the Co concentration 3% to 12% on the saturation magnetisation. When comparing the Co concentration ratio in this study (0.2% - 1.1%) and Seong et al., (2002) (3% - 12%), it is believed that the low value is related to the low concentrations of Co atoms in the Co: $TiO_2$ thin film.

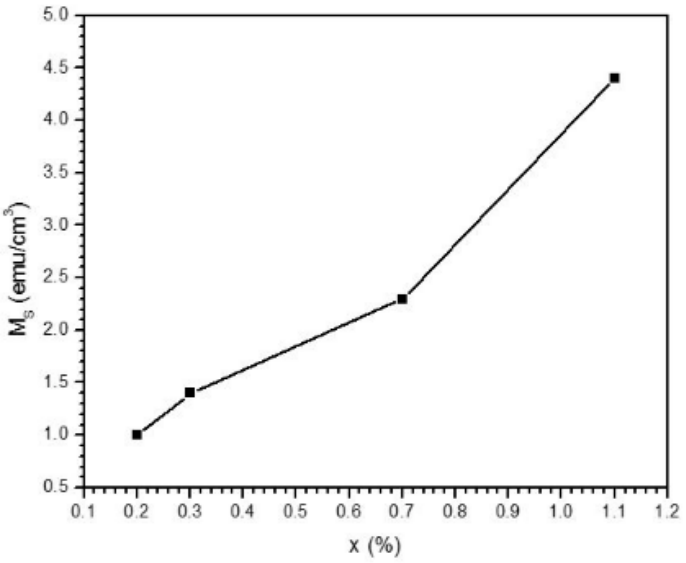


*Figure 8.* Saturation magnetisation, $M_S$, versus concentration of Co atom, *x*

The value of saturation magnetisation rises with increased concentration of Co atoms in the Co: $TiO_2$ thin film which indicated that Co atoms entered into the $TiO_2$ lattice and contributed to ferromagnetic properties of the film. The increase in saturation magnetisation shows that Co atoms have replaced Ti atoms randomly in the matrix lattice of $TiO_2$.

The magnetic moment of the Co: $TiO_2$ thin film produced in this study was in the range 1.2 to 1.6 μB/Co. The value of the magnetic moment is within the range that is commonly produced by other researchers. Generally, the value of saturation magnetic moment of the Co: $TiO_2$ thin film obtained were in the range of 0.03 to 1.7 μB/Co (Matsumoto et al., 2001; Chambers et al., 2001; Stampe et al., 2002; Shinde et al., 2003; Jeong, Heo, Norton, & Hebard, 2005; Griffin, Pakhomov, Wang, Heald, & Krishnan, 2005; Lee, Kumar, Marún, de Jong & Jansen, 2010; Singh et al., 2012). Some researchers have produced saturation magnetic moment higher than 1.7 μB/Co (Seong et al., 2002).

For the same film growth method, the MOCVD, the magnetic moment of the film Co: $TiO_2$ produced in this study is higher than McClure, et al.'s, i.e., 0.35 μB/Co (McClure et al., 2008). Although not explicitly stated, the results of Seong, et al.'s research (2002), indicate that the magnetic moment of the Co: $TiO_2$ thin film is in the range of 2.0 - 2.8 μB/Co for Co concentrations in the range of 3-12%. Thus, the magnetic moment of the Co: $TiO_2$ thin film in the current study is lower. The difference in the magnetic moment and content of Co may be due to differences in the film growth conditions.

## CONCLUSION

This study investigated the magnetic properties of Co: $TiO_2$ thin films with low cobalt concentration. It was shown that even with low cobalt concentration, the Co: $TiO_2$ thin films exhibit ferromagnetic properties at room temperature. Saturation magnetisation of film increases as the concentration of cobalt ion in $TiO_2$ builds.

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# Effect of Curcumin (Turmeric) Supplement on Maximal Oxygen Uptake ($VO_{2max}$) and Lactate Threshold in Human

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## ABSTRACT

Many studies have reported on the antitumor, antioxidant, antiarthritic and anti-inflammatory properties of curcumin. The present examined effects of curcumin together with exercise to increase $VO_{2max}$ and lactate threshold in human. In a study on animals, 10 -week-old male Wistar rats were divided into non-eTR and eTR groups. We used low (50 mg/kg-BW/day) and high doses (100 mg/kg-BW/day) of curcumin dissolved in dimethyl sulfoxide (DMSO). These doses were injected intraperitoneally into all animals for two hours before swimming exercise using Western blot (WB) analysis. In the study on humans, the sample was divided into two groups and the duration who were asked to consume two capsules (@ 550 mg) per day for 6 weeks. Aerobic exercise (jogging) was scheduled 4 times a week during the period, at vigorous intensity (60-90% maximum heart rate). The level of $VO_{2max}$ and lactate threshold was examined pretest and posttest. Results showed that low doses and high doses curcumin treatment significantly increased COX-IV protein expression. Furthermore, 1.1-gram curcumin/day for 6 weeks significantly increased $VO_{2max}$ and lactate threshold on human. The results showed that curcumin treatment can optimise human performance through its ability to increase $VO_{2max}$ and lactate threshold.

*Keywords:* Aerobic exercise, curcumin, lactate threshold, $VO_{2max}$

## INTRODUCTION

Excellent physique and good psychological health are important for performance in sport. Previous study have reported the use of ergogenic aids combined with training, mechanical device, nutritional practice, pharmacological approach, or physiological technique to improve sports performance which is (Porrini & Del Bo, 2016). Ergogenic

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aids refer to use of amino acid, blood doping, manipulating exercise methods and, equipment, and drugs or hormone to enhance performance. However, performance can be impaired by some alleged use of ergogenic substances or phenomena (Porrini & Del Bo, 2016). A study in Italy showed that almost 94% of coach and trainers provided their athletes with nutritional supplements (Porrini & Del Bo, 2016) to increase sports performance. Ergogenic aids can be in the form of food source too (Silver, 2001).

Polyphenols has attracted the attention of researchers and food manufacturers for over a decade. This is due to the antioxidant properties of polyphenols, their abundance in our diet, and their probable role in the prevention of various diseases associated with oxidative stress, for example cancer, cardiovascular and neurodegenerative diseases.

Furthermore, in many medicinal plants, polyphenols modulate the activity of a wide range of enzymes and cell receptors (Manach, Scalbert, Morand, Remesy, & Jimenez, 2004); (Middleton, Kandaswami, & Theoharides, 2000). Some plants contain several thousand molecules of a polyphenol structure (i.e., several hydroxyl groups on aromatic rings), and edible plants have been identified as consisting of several hundred compounds classified into different groups based on the function of phenol rings they contain and the structural elements that bind these rings to one another. The phenolic acids, flavonoids, stilbenes, and lignans are different in each plant. Oxygenated heterocycle (ring C) is formed by the flavonoids. This substance share a common structure consisting of 2 aromatic rings (A and B) are bound together by three carbon atoms. These may be divided into 6 subclasses as a function of the type of heterocycle involved: flavonols, flavones, isoflavones, flavanones, anthocyanidins, and flavanols (catechins and proanthocyanidins). In addition to this diversity, various carbohydrates and organic acids may be associated with polyphenol.

Turmeric is a spice belonging to the ginger family (Zingiberaceae) and has a component called Curcuma longa (Nandiyanto et al., 2016). This is described as horizontal underground stems with shoots and leaves called rhizomes. The spice is notable for its vibrant yellow colour. Curcuminoids is largely derived from fat-soluble polyphenolic pigments. The yellow pigment is segregated from the rhizomes of Curcuma longais termed curcumin, or turmeric, as it is the natural phenol curcuminoid. The safe consumption of curcumin is easily confirmed by the fact that for hundreds of years it has been part of the diet of people in a number of countries. Several previous studies have reported the antitumor, antioxidant, antiarthritic and anti-inflammatory properties of curcumin. This correlation was shown using GOLD and AutoDock analysis as well as validated targets of anticancer therapy (COX-2, PhenolsulphoTransferases, Matrix metalloproteinases (MMPs), P450 and TNF-alpha). It was observed in the binding affinity of BDC against the targets that these derivatives are potent procarcinogen activating enzyme inhibitors (Figure II-8). Curcumin, a hydrophobic natural product, comprises two phenolic rings. Each ring is replaced with methoxy ether functionality in the ortho-position and attached to each other by an aliphatic unsaturated heptane linker in the para-position with an α, β diketonic functionality on carbon-3 and -5. The electrophilic α, β-unsaturated carbonyl groups are capable of reacting with a nucleophile such as glutathione (Scapagnini et al., 2002). Results from a number of studies suggest that the diketone functionality is able to go through reversible tautomerisation between enolic- and ketonic-forms (Payton, Sandusky, & Alworth,

2007). Commercial curcumin characteristically comprises three main curcuminoids: curcumin (~77%), dimethoxy curcumin (~17%) and bisdemethoxycurcumin (~3%). Findings of earlier studies have shown that curcumin have ability to increase mitochondrial biogenesis through increased cAMP (Hamidie, Yamada, Ishizawa, Saito, & Masuda, 2015). Furthermore, Japanese researchers have suggested that curcumin treatment regulated exercise-induced oxidative stress (Takahashi et al., 2014). Both results indicated that curcumin treatment have the ability to increase performance via regulated activity on mitochondria.

An increase in muscle mitochondrial content is one of the most important factors responsible for improved endurance-exercise performance in response to training. These typical doubling of muscle mitochondria that occurs during training plays an important role in the increase in maximal Oxygen uptake ($VO_{2max}$). The utilisation of this substrate has the ability to increase oxidation of fat relative to carbohydrate, increase lactate threshold, and fatigue resistance (Calvo et al., 2008; Davis, Carlstedt, Chen, Carmichael, & Murphy, 2010; Holloszy & Coyle, 1984). Indeed, these studies have shown that treatment with polyphenol quercetin increases $VO_{2max}$ and endurance capacity.

Earlier studies have also reported on the correlation between the exercise and anti-inflammation and antioxidant properties of curcumin effects (McFarlin et al., 2016). However, there is no proven effect of curcumin treatment in increasing $VO_{2max}$ on human. Therefore, this study examines first, effect of curcumin treatment on $VO_{2max}$ and lactate threshold on humans, and second, effect of single bout curcumin treatment on mitochondrial marker COX IV expression. The findings point to the effectiveness of curcumin treatment combined with exercise in increasing COX-IV protein expression, $VO_{2max}$ and lactate threshold and ultimately to improve sports performance.

## MATERIALS AND METHODS

### Animals Study

The study used 10-week male wistar old rats weighing 282-375g. The animals were exposed to a 12h light dark photoperiod. A standard diet and water were provided *ad libitum* (Oriental Yeast, Tokyo, Japan). The Ethics Committee on Animal Experimentation of Kanazawa University (Protocol #: AP-10187) had approved all procedures. The animals were randomly divided into two groups: the first group was fed 50mg curcumin /kg-BW/day with eTR while the second group =was fed 100mg 100 mg/kg-BW/day with eTR and eTR group. Low doses of curcumin (50 mg/kg-BW/day) or high doses of curcumin (100 mg/kg-BW/day) were dissolved in dimethyl sulfoxide (Sigma-Aldrich, New Jersey, USA). All animals were injected intraperitoneally with curcumin once daily two hours before the swimming exercise.

### Exercise Training

The rats swam for two hours. They swam in four 30-min bouts separated by 5 min of rest. A weight that was equal to 2% of body weight was tied to the body of the rat after the first 30-min bout. All the rats swam in a barrel filled to a depth of 50 cm. The swimming area was 200 $cm^2$/rat.

**Western Blotting.** Animals were anesthetised (50 mg of pentobarbital sodium per 100 g of body weight). For biochemical studies, gastrocnemius (Gas) was quickly isolated. Then, the tissues were washed in ice-cold saline mixture. Next, the tissues were removed from the connective tissues and nerves, and then frozen in liquid nitrogen. Nuclear proteins were isolated using a modification of the protocol by Blough, Dineen and Esser (1999). Approximately 40 mg of muscle was homogenised in 500 µl of ice-cold buffer A (250 mmol/l sucrose, 10 mmol/l NaCl, 3 mmol/l $MgCl_2$, 1 mmol/l dithiothreitol (DTT) (Wako, Tokyo, Japan), 1 mmol/l PMSF (phenylmethylsulphonyl fluoride) (Wako, Tokyo, Japan), and 2 µl/40 mg tissue protease inhibitor cocktail (Wako, Tokyo, Japan), on ice for ~30 s. The homogenate was then spun in a centrifuge for 5 minutes at 500*g* at 4°C. The supernatant, representing a crude fraction, was used as the total tissue fraction in the immunoblots. The remaining pellet was resuspended in 500 µl of ice-cold buffer B (50 mmol/l Tris (Wako, Tokyo, Japan), pH 7.5, 1 mmol/l EDTA (Wako, Tokyo, Japan), 1 mmol/l EGTA (Wako, Tokyo, Japan), 1 mmol/l DTT (Wako, Tokyo, Japan), 50 mmol/l NaF (Wako, Tokyo, Japan), 5 mmol/l Na pyrophosphate (Wako, Tokyo, Japan), 50 mmol/l $MgCl_2$ (Wako, Tokyo, Japan), 10% glycerol (Wako, Tokyo, Japan), 1% Triton X-100 (Wako, Tokyo, Japan), 1 mmol/l PMSF (Wako, Tokyo, Japan), and 2 µl/40 mg tissue protease inhibitor cocktail and placed on ice for 10 minutes, with occasional mixing. The resuspended pellet was spun in a centrifuge for 5 minutes at 3,000*g* at 4°C. The supernatant, representing the nuclear fraction, was extracted and stored.

Western blot analysis was performed as previously described (Furuichi, Sugiura, Kato, Shimada, & Masuda, 2010). In brief, equal protein amounts (4.5 µg/lane) of samples were loaded onto SDS-PAGE gels 12.5% and proteins were transferred to a polyvinylidene fluoride (PVDF) membrane. The membrane was incubated in a blocking buffer. Then, with a COX-IV (1:1000 dilution, Abcam, Cambridge, England) A GAPDH (1:100 dilution, Abcam, Cambridge, England), it was then reacted with the secondary antibody. Finally, the signals were visualised by enhanced chemiluminescence (ECL) (GE Healthcare, Piscataway, NJ, USA). The signal intensity was quantified with imaging software (Image J, NIH, USA).

**Human Study.** Generally, randomized pretest-posttest comparison group was used as research design, but this study also used 2 x 2 crossover design in order to compare the effect of treatment within the sample. All samples received two treatments, then the results were compared. The study also avoided the variances of the sample which may affect to the results if it compared both the experiment and control group only.

**Sample.** Twelve students from the programme of sport science, Universitas Pendidikan Indonesia, were recruited for the study.

**Instrument**. Cardiopulmonary exercise test (Cosmed T 150, Rome, Italy) with a gas analysis method was utilised as the instrument to obtain the data.

**Protocol.** $_xVO_{2Ma}$ was measured using 12 km/h protocol, while LT was predicted using modified v-slope.

**$VO_{2Maa}$ Procedure.** The Sample was divided into two groups randomly. Group 1, the experiment group, received aerobic exercise and curcumin as treatment. Group two, the control group only received aerobic exercise without curcumin. This study was divided into 2 periods, each period completed in six weeks. Curcumin (Borobudur, Semarang, Indonesia) was orally consumed in form of 2 capsules (@ 550 mg) per day during the treatment period. Aerobic exercise (jogging) was scheduled 4 times in a week during the period, using vigorous intensity (60-90% maximum heart rate) based on American College of Sport Medicine Guidelines (Heyward & Gibson, 2014). This study applied 4-weeks-wash-out-phase. In order to avoid the carry out effect from previous period in the next period, the group which previously was the experiment group, switched and then became the control group. At the beginning of each period, the sample performed underwent level of VO2Max and lactate threshold.

## RESULTS

### Animal Study

Figure 1 shows curcumin treatment together with exercise increases COX-IV expression. Values are means ± SD, n = 6. *: (asterisk shows significant difference from DMSO ($P < 0.05$)). CD 50 = curcumin 50 mg/kg-BW/day in DMSO, CD 100 = curcumin 100 mg/kg-BW/day in DMSO. These results indicate that curcumin treatment together with exercise increased the mitochondrial marker (COX-IV) in musculus gastrocnemius.

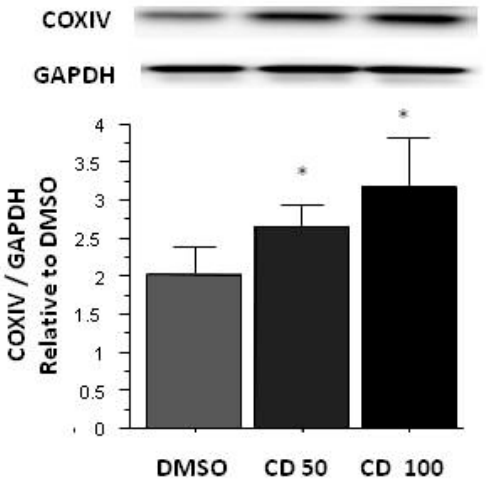


*Figure 1.* Curcumin treatment together with exercise increase COX-IV expression

Based on our hypothesis, single bout curcumin treatment may have the potential for an additive or synergistic effect on mitochondrial biogenesis. Content of mitochondrial in skeletal muscle was tested using COX subunit IV (COX-IV) protein expression. Single bout curcumin treatment together with exercise increase mitochondria marker COX-IV in skeletal muscle for low doses (50 mg/kg-BW/day. Furthermore, high doses (100 mg/kg-BW/day) curcumin treatment

indicated increased COX-IV protein expression 1.5-fold (Figure 1). This result indicated that curcumin has ability to be addictive effect of exercise to increase mitochondrial marker COX IV.

Figure 2 shows curcumin treatment increases $VO_{2max}$. Values are means ± SD n = 12. *: (Asterisk show significant difference from Pre- Test ($P < 0.05$)). These results indicated that 6 weeks curcumin treatment increased $VO_{2max}$.

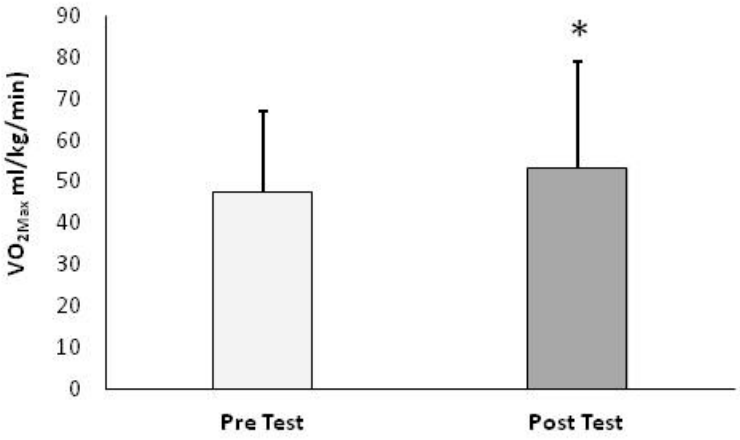


*Figure 2.* Curcumin treatment increases $VO_{2max}$

## Curcumin Treatment Increase $VO_{2max}$

To know the effect of curcumin treatment effect on human and we interested to determine effect curcumin on 6 weeks aerobic exercise. Our result showed that means of VO2 max pretest is 47,44 ml/kg/min compare with $VO_{2max}$ posttest is 53,41 ml/kg/min, our result indicated that 6 weeks curcumin treatment increase $VO_{2\,max}$ (Figure 2).

Figure 3 shows curcumin treatment increases lactate threshold. Values are means ± SD n = 12.*: Asterisk shows significant difference from Pre- Test ($P < 0.05$). These results indicated that 6 weeks curcumin treatment increased lactate threshold.

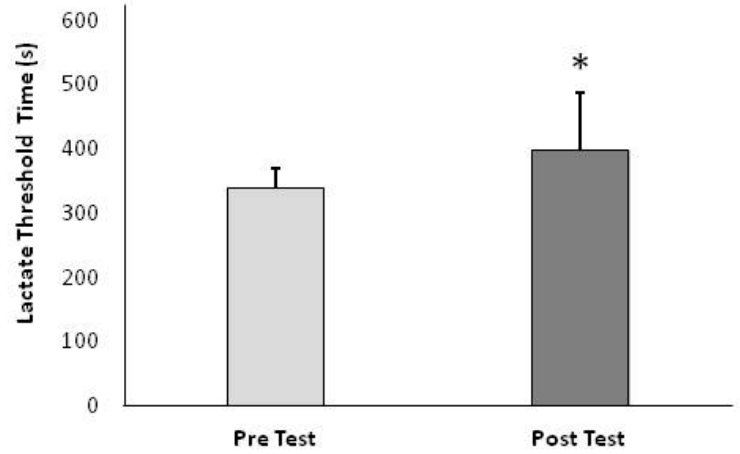


*Figure 3.* Curcumin treatment increases lactate thresholds

### Curcumin Treatment Increases Lactate Threshold

We were interested to see the effects of 6 weeks curcumin treatment on lactate threshold. Our results showed that means of lactate threshold pretest is 338,75 while the second and curcumin treatment increase means of lactate threshold posttest be 398,66 second or increase around 59,91 second. This result indicated that curcumin has the ability to increase lactate threshold (Figure 3).

## DISCUSSIONS

Similar with our previous study which indicated that curcumin treatment increases addictive effect of endurance training to increase mitochondrial marker COX-IV protein expression (Hamidie et al., 2015), the current study also showed that single bout curcumin treatment increases mitochondrial marker COX-IV protein expression. One study also indicated that curcumin has ability to inhibits PDE (Phosphodiesterase) which regulated cAMP to convert AMP (Abusnina, Keravis, & Lugnier, 2009). The result was support by our previous study which showed that curcumin increased cAMP. Based on this result we speculated that indeed curcumin has ability to increase mitochondrial biogenesis on cell environment. Furthermore, our result showed low dose curcumin treatment (50 mg/kg-BW) has significant effect to increase mitochondrial marker COX-IV (Figure 1).

Based on result above, the researchers determined the effect of curcumin treatment on human study, in particular, to know its effect on aerobic capacity, including $VO_{2max}$ and lactate threshold. Several human studies evaluated effect of polyphenol on aerobic performance and also maximal oxygen capacity ($VO_{2max}$) (Davis et al., 2010) (Malaguti, Angeloni, & Hrelia, 2013). However, no study has determined effect of curcumin on maximal oxygen uptake on human. Previous studies have suggested that exercise induced oxidative stress in human cell (Santos et al., 2016) (Powers & Jackson, 2008). Under normal conditions, oxidative stress is biological pathway which has important roles in the body. Commonly, overproduction of reactive oxygen species (ROS) or a defect in endogenous antioxidant defence system, including enzymatic and non-enzymatic antioxidants, has been defined as oxidative stress (Yavari, Javadi, Mirmiran, & Bahadoran, 2015). In order to suit skeletal muscle, this conditions promote oxygen flux, which finally leads to increased production of ROS and free radicals (Kelkar, Subhadra, & Chengappa, 2008). Exercise increases the oxygen uptake 10 to 20 fold and pushes the generation of ROS and free radicals and correlation to attack biological macromolecules, especially DNA, polyunsaturated fatty acids, amino acids and active proteins (Lambertucci, Levada-Pires, Rossoni, Curi, & Pithon-Curi, 2007). During exercise, in metabolic rate and consumption of oxygen is increased due increases=d temperature and decreases in PH of cellular muscle which accelerate the production of free radicals. Debates are ongoing on the origins of the ROS production. However, the skeletal muscle has been thought as the major source of ROS generation (Cooper, Vollaard, Choueiri, & Wilson, 2002; Powers & Jackson, 2008).

The ROS activates muscles during exercise such as eosinophils, neutrophils, phospholipase A2 dependent processes, mitochondria, and some immune cells including macrophages, nicotinamide, xanthine oxidase adenine dinucleotide phosphate (NADPH) oxidase, and monocytes. (Cooper et al., 2002). Thus, mitochondria is shows the correlation of production

of ROS and free radical and indeed previous studies have suggested this (Zorov, Juhaszova, & Sollott, 2014). Some dietary antioxidants have been identified. These could contribute to protection against free radicals production and oxidative damage, induction of antioxidant signalling pathways, promotion of the endogenous antioxidant defence system, and attenuation of oxidative stress and consequently, prevention of related disorders. Turmeric is a spice from the rhizomes belonging to a ginger family (Zingiberaceae) component. This is called Curcuma longa. Curcumin was reported to have antitumor, antiarthritic, antioxidant, and anti-inflammatory properties. Previous studies have shown the anti-inflammatory properties y of curcumin and its ability to reduce muscle damage (McFarlin et al., 2016). Furthermore, curcumin as a supplement has strong antioxidant capacity (Landeros et al., 2017), even stronger than resveratrol (Aftab & Vieira, 2010). An increase in muscle mitochondrial content is one of the most important factors responsible for increasing endurance-exercise performance. These typical doubling of muscle mitochondria occurs during exercise. These plays an important role for increasing maximal Oxygen uptake ($VO_{2max}$). The utilisation of this substrate has ability to increase oxidation of fat relative to carbohydrate, fatigue resistance, and increase lactate threshold. Indeed, the current study has shown that curcumin increases protein mitochondrial marker COX-IV (Figure 1) in animal study. Our results prove that curcumin increase oxygen maximal capacity and lactate threshold (Figure 2 and 3). Based on above evidence we can surmise that curcumin potentially can increase human performance with its ability to be have strong antioxidant capacity and furthermore its ability to decrease mitochondrial ROS production.

## CONCLUSION

In conclusion, single bout curcumin increases mitochondrial marker COX-IV protein expression on animals study; furthermore, oral consumption of curcumin oral at 1,1 gram / days for 6 weeks has the potential to increase maximal oxygen uptake $VO_{2max}$ and lactate threshold. Taken together, the study suggests that curcumin can increase human sports performance through its ability to increase $VO_{2max}$and lactate threshold.

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# Smart Home System to Support Bandung Smart City Programme

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## ABSTRACT

Smart home is a system that controls electrical equipment remotely via WLAN and Internet. The Smart Home system was created using Raspberry Pi as a data processor, Android Smartphone as a user interface, the relay module as electronic appliance controller, Wi-Fi dongle as a communication medium and a router for port forwarding. In addition, the system is equipped with a security system that can be used to monitor the situation around the home via a webcam as IP Camera, PIR sensor for motion detection and GSM modem for sending SMS and telephone. The test results showed that the Smart Home system can work properly to control four loads at once via the internet or through the media WLAN. The features of the security system works well to monitor the situation through the application interface based on Android and warnings in the form of SMS and telephone numbers sent to the user when the PIR sensor detects movement. Therefore, the smart home system is stable, safe, reliable, easy to use, thus, contributing to efficient energy usage in order to conserve precious natural resources by reducing electrical energy consumption.

*Keywords:* Energy Saving, Raspberry Pi, Smart Home

## INTRODUCTION

There are a number of studies on smart city (Alamsyah, Susanto, & Chou, 2016; Jokinen, Latvala, & Lastra, 2016; Anggoro, Nainggolan, & Purwandesi, 2016; Purnomo, Heryadi, Gaol, & Ricky, 2016; Ikpehai, Adebisi, & Kharel, 2016; Siregar, Nasution, & Fahmi, 2016; Djimantoro, 2016; Dustdar, Nastic, & Scekic, 2016; Rathore, Ahmad, & Paul, 2016; Schleicher, Vögler, Dustdar, & Inzinger, 2016; Shwe, Jet, & Chong, 2016; Arroub, Zahi, Sabir, & Sadik, 2016). Bandung, Indonesia's third largest city, is an example of a leading Smart City. Therefore,

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this study focuses on creating a smart home in an effort to save energy, the basis of which is home automation.

Home Automation is also known as Domotics, a combination of the word domestic (housemaid) and informatics (informatics). Home Automation replaces a variety of human intervention in household chores by using a preprogrammed electronic system (Dennis, 2013).

Home Automation is use of technology at the home environment to improve the ease, comfort, safety and energy efficiency (Rao & Uma, 2015). It is the control of various household electronic equipment, both when we are at home and remotely. Currently, remote controls and voice commands can be used to control home appliances automatically (Kaur, 2010).

Previous studies have looked at smart home systems using Arduino (Behera, Devi, & Mishra, 2015; Adriansyah & Dani, 2014) and raspberry (Khedkar & Malwatkar, 2016; Ballesteros, Calderon, Calderon, & Strauss, 2015) as data processor and blue tooth (Ramlee, Othman, Leong, Ismail, & Ranjit, 2013; Li Chen, Logenthiran, & Woo, 2016) and WLAN as remote media, hence, the present study has developed smart home systems using Raspberry Pi and use WLAN as remote media. The present researchers have used internet as remote media (Ballesteros et al., 2015) so electrical switching monitoring at home can be done from afar and with some development of the prototype, this system can help the Bandung smart city program in terms of having important information to be monitored online.

## METHODS

This is an experimental research with a focus on home automation and security system/home monitoring. The home automation system serves to control (turn off or turn on) electrical equipment, while the security system serves to monitor the situation around the house. A block diagram of the system is shown in Figure 1.

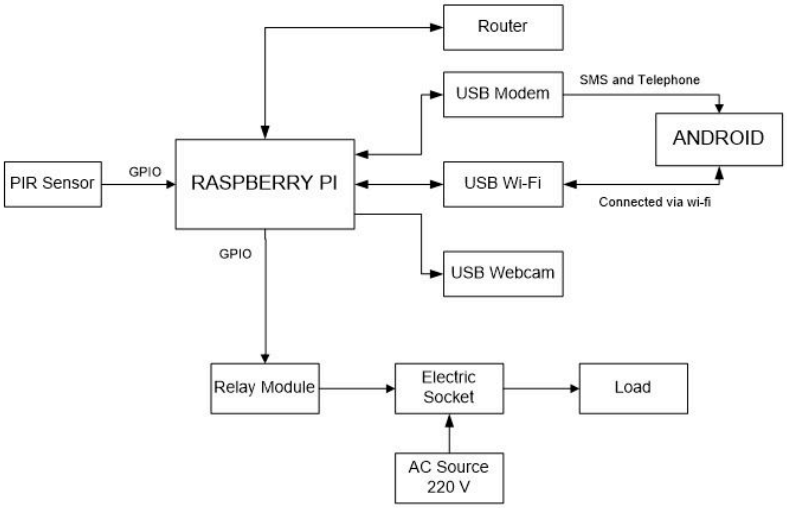


*Figure 1.* Block diagram of the system

Figure 1 shows that the system consists of Raspberry Pi B +, 4 channel relay module 5V, 4 pieces of light fittings, PIR sensor, webcam, USB Wi-Fi dongle, GSM modem, router and Android-based smartphones. Raspberry Pi B + acts as a microcontroller to control (turn on or off) electrical equipment. The electrical equipment is controlled via the Android-based applications in internet communication media.

The home automation systems uses a motion sensor (PIR) and a webcam to monitor the situation around the house. The PIR sensor will function when there is a trigger in the form of movement. When there is movement, the PIR sensor then sends input to the Raspberry Pi to send SMS and make phone calls using a GSM modem. In addition, when there is movement, the webcam will record and store video and photos. Webcams can be used as a medium for monitoring the situation around the house by streaming via Android based smartphone or through a web browser on a PC / laptop.

In this project, the Raspberry Pi model B + acts as a microcontroller and a server. The role of Raspberry Pi as the microcontroller is to control (turn on or off) the electrical equipment. The electrical equipment is controlled using Android-based applications. The Raspberry Pi Foundation on its official website revealed that the Raspberry Pi is a credit card-sized computer that can be connected to a monitor or TV and uses a standard USB mouse and keyboard. This mini device can be used as a normal computer and to learn a programming language such as Scratch and Python (a programming language primarily on Raspberry Pi). This device uses a Linux-based operating system and Raspbian that is a native operating system of the device. Raspberry Pi has similar functions like a computer desktop such as browsing the Internet, play high definition video, create spreadsheets and even play games. It is not only able to function as a normal computer but can also be used as a microcontroller for Raspberry Pi which has GPIO pins (General Purpose Input Output). Input sources needed are 2A / 5 VDC. Raspberry Pi comes with GPIO pins that can be directly connected with various sensors. Figure 2 shows the Raspberry B+ hardware.

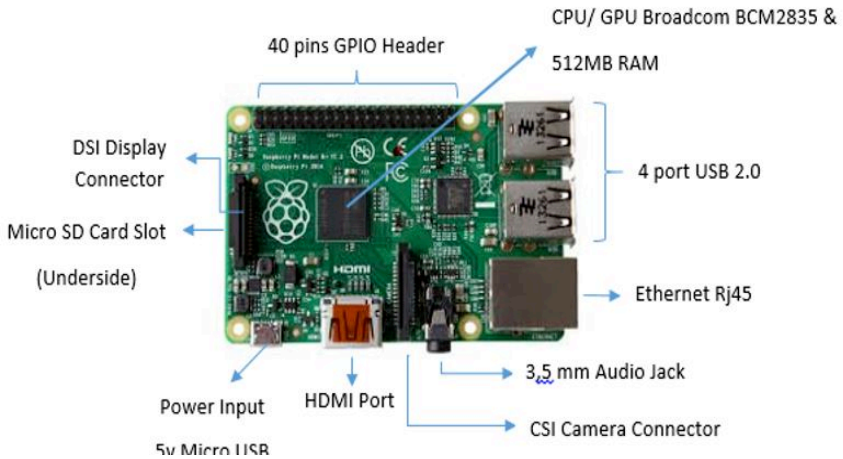


*Figure 2.* Raspberry B + Hardware

PIR sensors are used to detect motion and when there is a movement, the PIR sensor will provide output to raspberries to send SMS and make calls. The PIR motion sensors are typically used to detect human movement which is at reaching area. Basically, PIR is made of pyroelectric sensor that can detect infrared radiation levels. All objects emit infrared; the hotter the object, the greater the radiation (Ada, 2016).

The USB Wi-Fi dongle is used as a medium of communication between the Raspberry Pi and Home Automation applications pre-installed on Android-based smartphone. The modem is used to send SMS and make phone calls when motion is detected by the PIR sensor. The USB webcam is used to monitor the situation around the house. When movement occurs, the webcam will record and save the recording to a chosen folder.

In the android based smartphone, there is an application to turn on or turn off electrical appliances by changing the state GPIO on WebIOPi. The application can also be used for recording the streaming webcam. Relay module acts as a switch that will turn on and turn off electrical equipment in accordance with an output from Raspberry Pi. On the router Port Forwarding is a feature that allows for open access to the local network to be accessible from the internet.

## Raspberry Pi Programming

Software of the Raspberry Pi using Python programming language and script writing is created using nano editor on Raspberry Pi. This program is part of the system security features. When the main program on the Raspberry is running, the former will also initialize GPIO pin, which specifies the name of the pin used and determines the state of GPIO to be input or output. When the PIR sensor detects motion, the PIR sensor will provide HIGH output to Raspberry. If the GPIO pin Raspberry connected with PIR sensor gets a HIGH input, then the program will make a call to another subprogram. There are two subprograms, one is the subprogram that contains an order to send SMS and the other is a subprogram that contains commands to make a phone call. When the second subprogram is called, Raspberry will send AT commands (commands to the module / modem GSM) to the GSM modem. Then the GSM modem will send SMS and make phone calls to a designated number. The Raspberry will give instructions to the PIR sensor to delay / pause for 30 seconds. In addition, at the same time (when the PIR sensor detects motion), a webcam video recording is made and will be stored in designated folders. Figure 3 is a flow chart of the design program of the Raspberry Pi.

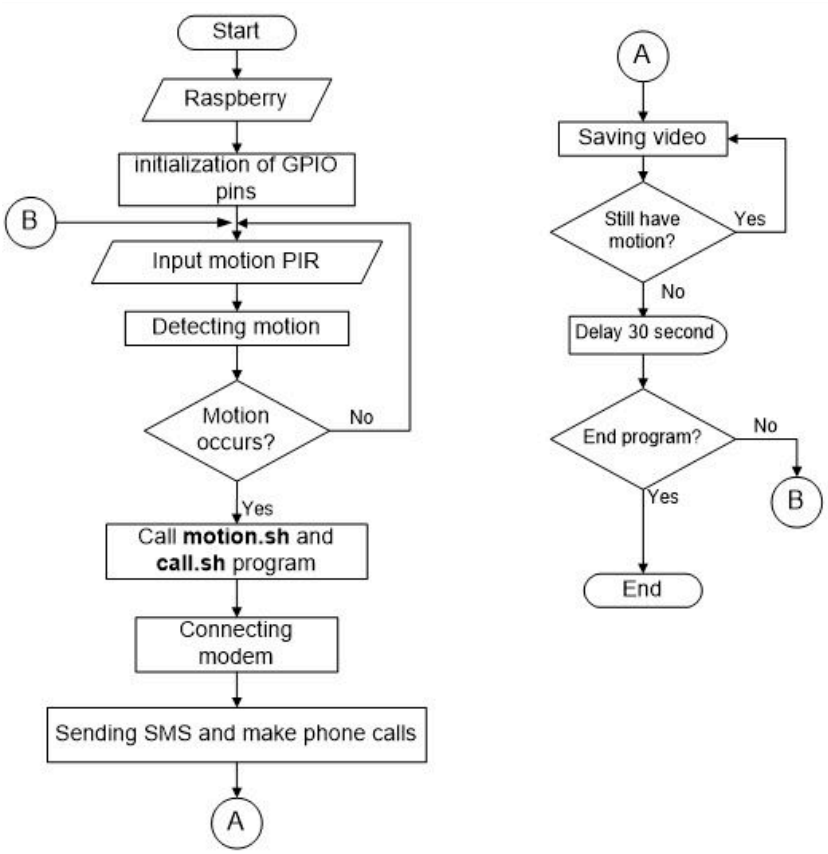


*Figure 3.* Flowchart of Main Program on Raspberry

This Android based application is created using Eclipse program. Application on Android is divided into two programs, the main program to control the load and the other for streaming video. The program that control the load is the core of the Home Automation system. Figure 3 shows the necessary package used to control the Raspberry Pi GPIO. The next step after import a package is to initialize GPIO and set up connections. Connection settings are intended to make an application to connect with WebIOPi, then a class is developed to contain the host, port, username and password to login WebIOPi. The next step is to perform settings on the check box. In this program, the check box is used to change the state GPIO to be input or output. If the check box is active, it will serve as a GPIO input, otherwise, if the check box is not active then it will serve as a GPIO output. To control the load, then the state must be in good GPIO output (the check box is not active).

In addition, to turn on or turn off the load, it needs toogle button. Toogle button serves to change the state GPIO be high or low. To control the load, then the state should be in conditions of low GPIO because the relay used is active low (active when getting input 0 / low). Figure 4 is the flowchart Design Load Control.

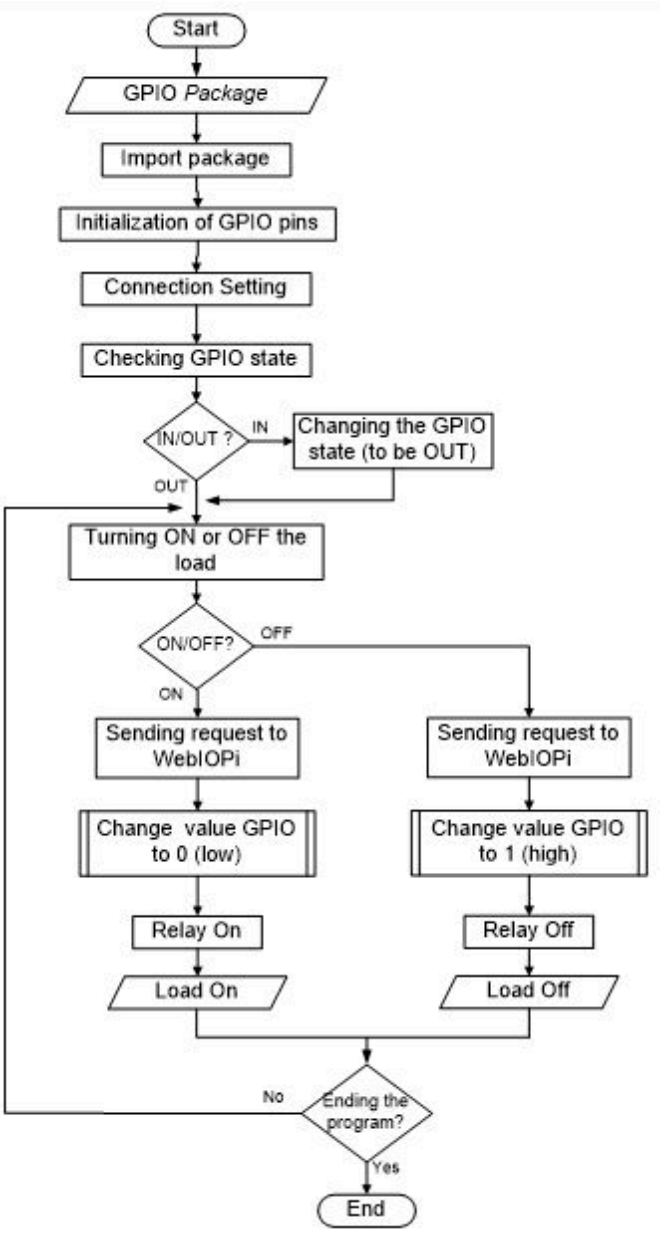


*Figure 4.* Flowchart Design Load Control

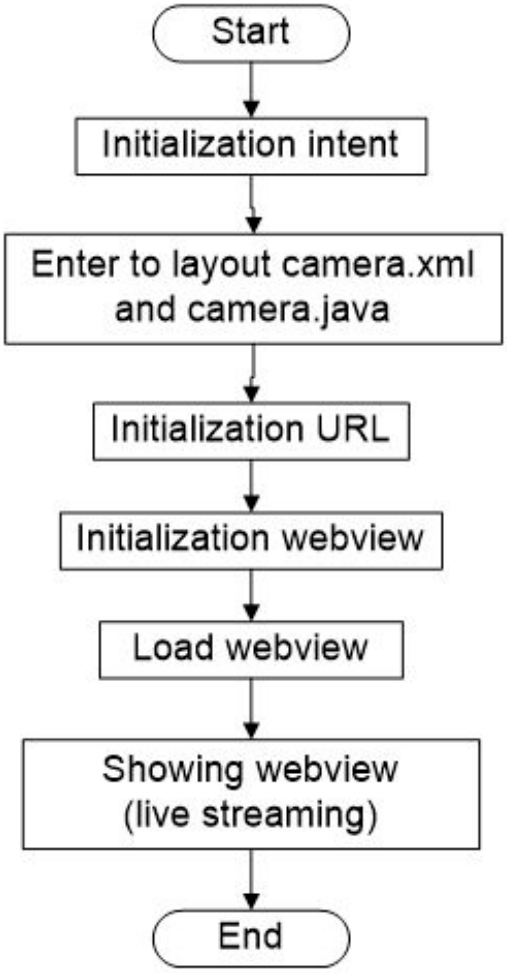


*Figure 5.* Flowchart program streaming video

The second program is for streaming video that is captured by the webcam. Flowchart of design program for streaming video that is captured by the webcam via Android is shown in Figure 5. Thus, the first step in developing this program is to initialize intent on major programs to be able to communicate with this streaming program. Camera.xml program is used to set the display layout program on Android-based smartphone. Next, on the camera java program, initialisation of URL and WebView takes place, as well as loading and displaying web pages streaming video.

## RESULTS AND ANALYSIS

### Testing of Load Control

The purpose of the test load control is to determine the performance of the system that has been created. In this test load, four lamps are used. This testing is done by turning on the electronic

equipment one by one, and then turning on all loads simultaneously. Testing was conducted on two different communication media: WLAN and Internet.

Testing of both communication media was done on the system using two methods. The first is by turning on and turning off the lights one by one at 5 times. The result is that each load can be controlled properly. The second is by turning on all load at the same time as well as 5 times and the result is that all of the load can be switched on and off properly.

## Testing of PIR Sensor

PIR sensor testing was conducted to determine the sensitivity of the PIR sensor to detect movement. Testing was conducted in a room in a way to move around the PIR sensor with different distances and angles until it finds a maximum distance of PIR sensor detects movement. Figure 6 is a picture of PIR sensor test scenarios from various angles while Table 1 shows the test results.

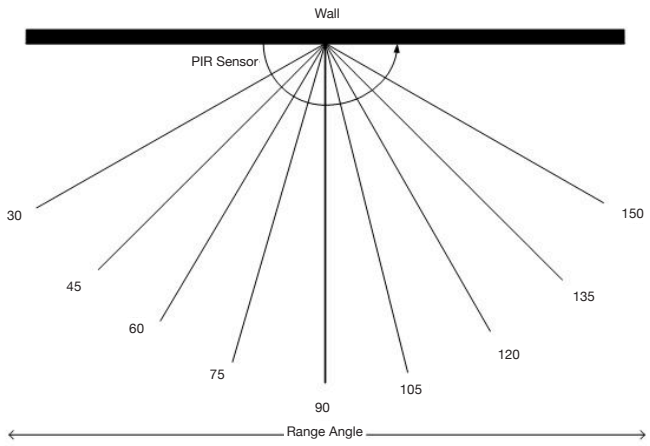


*Figure 6.* PIR sensor test scenarios from various angles

Table 1
*Result of PIR sensor testing*

| Distance | Angle | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 30° | 45° | 60° | 75° | 90° | 105° | 120° | 135° | 150° |
| 1 m | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| 2 m | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| 3 m | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| 4 m | √ | √ | √ | √ | √ | √ | √ | √ | - |
| 5 m | - | - | √ | √ | √ | √ | - | - | - |
| 6 m | - | - | - | √ | √ | √ | - | - | - |

Based on testing of the system, it has function to control the load well on the WLAN communication media. In a radius of 1-4 meters, motion sensor can detect at each vertex specified. But at 5 meters upwards there are some blank spots that can't be detected and the sensor can only detect a corner approaching a perpendicular position; thus storage should be kept in the middle of the room where people are not expected to enter.

**Program to Save Energy.** In general, a middle class family uses 1300 VA for lighting, heating and electrical machinery. Assumed power used for outside lighting is 100 VA and inside lighting is 400 VA. Electrical equipment using heating such as iron, rice cooker and dispensers use 500 VA. Remaining power is used for electrical machinery such as water pumps, refrigerators and fans of 300 VA.

Outdoor lighting is expected to last for 12 hours, at 18.00 until 06.00. The below expresses energy consumption for one day (outdoor lighting):

$$\frac{12\ hours\ \times 100\ VA}{1000} = 1{,}2\ kWh$$

So, for a month, energy consumption is

30 days x 1,2 kWh = 36 kWh

But in reality, majority of the population in developed cities leave their lights on Saturday and Sunday as they leave to the outskirts of the city to visit families or for holidays. During 8 days in a month, namely the weekends, energy consumption is:

8 days x 24 hours x $\frac{100\ VA}{1000}$ = 19,2 kWh

The remaining 22 working days in a month) energy usage is

22 days x 1.2 kWh = 26.4 kWh

Energy needed for a month without turning off outdoor lighting when the home is empty:

19.2 kWh + 26.4 kWh = 45.6 kWh

So, there is difference between energy usage with and without using smart home system as expressed below:

45.6 kWh – 36 kWh = 9.6 kWh / month

So, if we use a smart home system, we can save energy 9.6 KWH per month because the lights can be controlled at a distance during weekdays and weekends.

That is savings that can be made for outdoor lighting in one house a month, assuming if a big city has 1000 homes whose occupants always turn on outdoor lighting when on holiday, it can be estimated energy saved is

9.6 kWh x 1000 = 9.6 MWh.

Besides saving energy, setting programming electrical equipment in accordance with the time needed can extend the lifespan of the equipment. And then with remote settings, these tools can help to facilitate efficient energy usage. Because it has security features, this tool also provides additional security advantages for homeowners.

## CONCLUSION

This research was focused on the Smart home which has various benefits such as saving energy, saving lifetime of household appliances, facilitate the work of switching energy, as well as having benefits for home security monitoring. Based on results obtained, the system works properly using WLAN and internet media as expected.

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# Developing a Maximal Leg Power Device Using Ultrasonic Sensor with Liquid Crystal Display

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## ABSTRACT

Auto technology is a new breakthrough in developing devices related to sports enhancement. Therefore, the purpose of this study was to develop a device based on ultrasonic sensor using a liquid crystal display to maximise leg power. The components of the new device are a microcontroller ATMEGA-328, liquid crystal display and HC-SR04 ultrasonic sensor. The study was conducted in the laboratory of sport science, faculty of sport and health education, Indonesia University of Education. Ten students from Sport Science study program were recruited as samples. A prototype of maximal leg power measurement device was invented and results showed that there were no significant differences between auto and manual testing. However, the device can be used to determine maximal leg power more accurately, easily and effectively.

*Keywords:* Leg power, liquid crystal display, Microcontroller, Ultrasonic sensor, Vertical jump

## INTRODUCTION

According to (Dolezal, FRESE, & LLEWELLYN, 2016); Choukou, Laffaye, & Taiar, 2014); Buckthorpe, Morris, & Folland, 2012; Cancelacarral et al., 2016) technological advances have contributed to rapid innovations especially in all fields especially in sports. According to (Rusdiana et al., 2016) Australia, Germany, China, and South Korea are already using advanced technology in sports science by setting up sports laboratories such as JISS (Japan Institute of Sports Sciences), BIS (Beijing Institute of Sports), and AIS (Australian Institute of Sports)in an effort to improve performance in sports.

However, in Indonesia, investment in high-technology sports equipment is limited due to costs. An athlete's performance can be measured through use of technology via physical fitness test and measurement.

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(Samozino, Morin, Hintzy, & Belli, 2008); Cormie, McCAULLEY, & McBRIDE, 2007); Cormie, Mccaulley, Triplett, & Mcbride, 2007) state that test is an instrument that is used to obtain information about a person or an object, while the measurement is the process of gathering information. Therefore, tests and measurements using technology have high validity compared with manual testing. Additionally, technology driven devices help to effectively evaluate an athlete's performance by identifying his/her weaknesses or mistakes that can later be addressed during training (Feeney, Stanhope, Kaminski, Machi, & Jaric, 2016). Physical fitness refers to flexibility, speed, strength and endurance. Muscle explosive power or often referred to as power is an important component of physical fitness. Pazin, Bozic, Bobana, Nedeljkovic, & Jaric, 2011) suggest that strength is the ability of muscles to perform contractions in order to raise tension on a muscle.

Power muscle limb (Pazin, Berjan, Nedeljkovic, Markovic, & Jaric, 2013); Hasselgren, Olsson, & Nyberg, 2011) especially leg power is needed in almost all sports, including athletics, aquatics and games such as basketball, soccer, badminton, tennis and other sports (Cuk, Markovic, Nedeljkovic, Ugarkovic, Kukolj, & Jaric, 2014); Lesinski, Muehlbauer, & Granacher, 2016). According to (Sleivert & Taingahue, 2004) explosive power is the ability to perform maximum strength in a short time. Pazin, Berjan, Nedeljkovic, Markovic, & Jaric, 2013 define power as the ability of muscles to direct maximum force in a very quick time. In order to obtain a large repulsion and high speed, an athlete must have great power leg. So powerful legs are the driving force at the time of repulsion in order to obtain vertical velocity (Shu et al., 2016; Beck, Ye, & Wages, 2015).

A conventional or modern technological approach can be used to measure the power of limbs; the former is a vertical jump test using a ruler and chalk and manually calculated based on scores. These results are used as an indicator to measure the power of the leg. The higher the jump, the greater the leg power (Feeney et al., 2016, 2016; Arnold, Joke, & Megan, 2015).

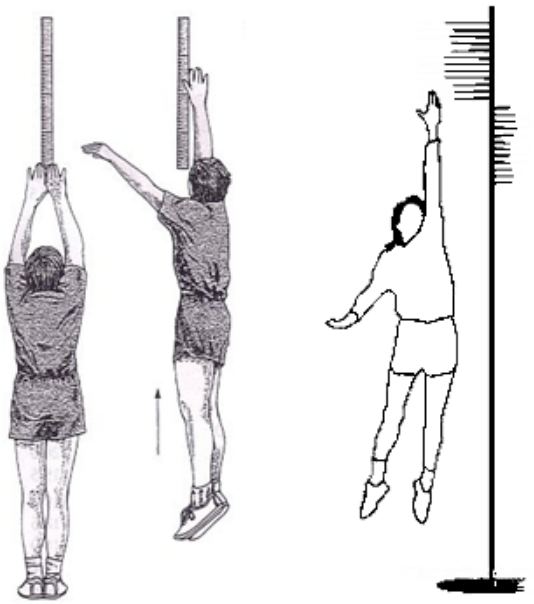

*Figure 1.* Leg power testing manual using vertical jump technique

Along with technological advances in the sport, especially in the field of test and measurement, various tests and measurements of leg power have been developed and mass produced. One is manufactured by the Japanese company Takei such as vertical jump mat and Takei 5414 jump test product. This instrument is equipped with sensors and LED display. The calculation result is automatically recorded (Whitmer, Fry, Forsythe, Andre, Lane, Hudy, & Honnold, 2015).

*Figure 2.* Leg power testing device (Takei jump 5414 and vertical jump mat)

The other leg power measuring device which is more accurate, using a three-dimensional approach, is AMTI Force and Motion. The AccuPower is AMTI's portable solution for jumping and power analysis. It uses Hall Effect sensors to accurately measure ground reaction forces while allowing for internal amplification and high overload protection on all axes. The AccuPower interfaces directly with a computer via a convenient USB or RS-232 connection and comes bundled with a powerful AccuPower Software (Belli et al., 2008).

*Figure 3.* Leg power Device 3D AMTI Accupower and software analysis

Thus, the purpose of this study was to develop a tool to measure the power limbs through a vertical jump test based on auto ultrasonic sensor with a liquid crystal LED display. This tool can be used for measuring leg power in improving the performance of athletes.

## METHODS

The Research and Development (R & D) method used to test the effectiveness of the product measure leg power using vertical jump test. Below is a step by step illustration of the research and development method (Choukou et al., 2014).

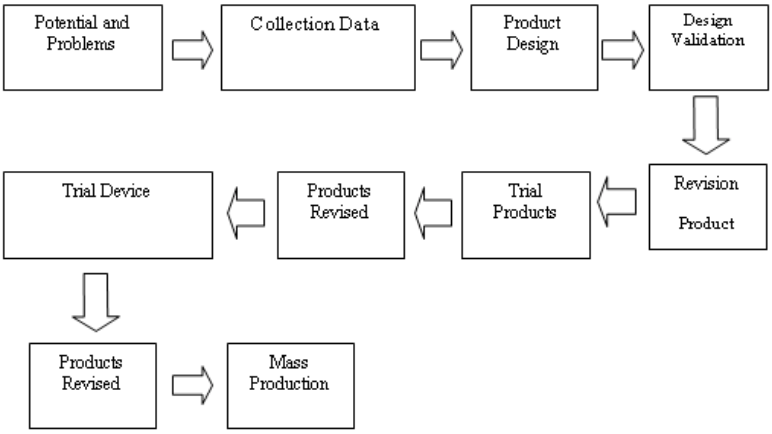


*Figure 4.* Diagram R & D Research methods procedure

### Design Validation

According to (Choukou et al., 2014) a process design validation activity is vital to evaluate the design of products. Thus this tool must also be judged on its effectiveness by experts.

### Product design improvement

Design improvements are made subject to feedback and validation from experts. Weaknesses are addressed and if there are no problems detected, the product will be tested directly.

**Trial Product.** The trial product is a type of feasibility assessment device. In this case the trial products will be used vis a vis the samples according to the needs of analysis. Tests are also conducted to determine the device quality.

## RESULTS DAN DISCUSSIONS

### Prototype Product

This device measures leg power using vertical jump technique approach and the results are displayed in the box on the Liquid Crystal Display.

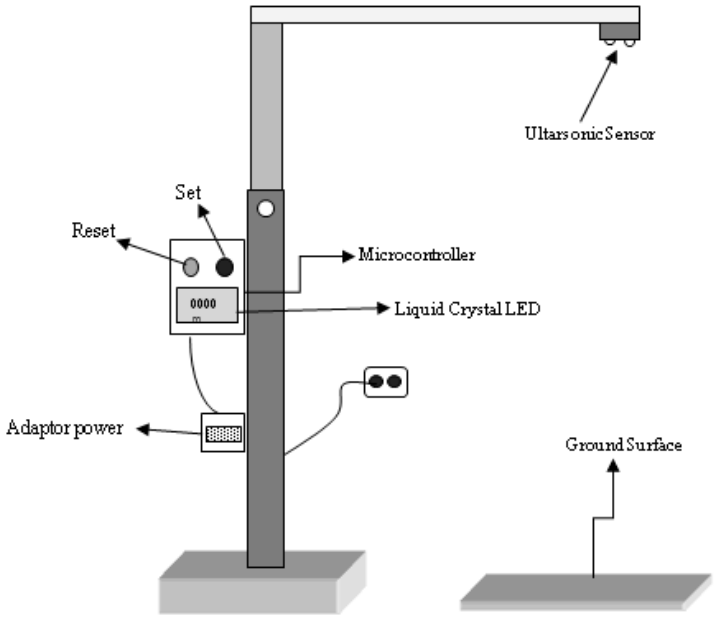


*Figure 5.* Prototype of leg power device

## Product Development

Sensor circuit: The sensor used is HC-SR04 ultrasonic sensor which serves as the sender, receiver and controller of ultrasonic waves. The sensor is placed in the upper beam pole which aims to detect an object in the radar sensor. When the mast is lowered or increased, it will adjust the height of the sample, so long as these sensors can reach an object and perform the calculation.

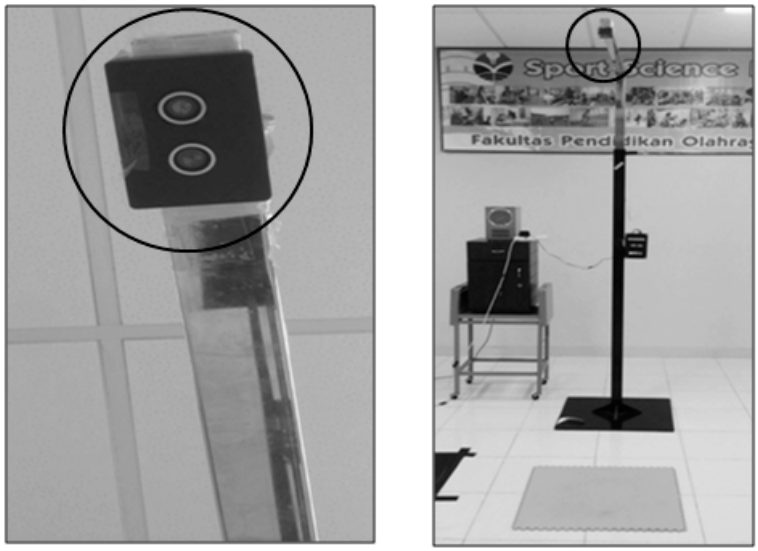

*Figure 6.* Sensor HC-SR04 ultrasonic

Bar and Cables: The pole is made from iron and stainless steel. The cable is a special sensor cable 1.5 mm diameter with an overall length of 4 meters. It is connected through the top of the pole and made in such a way to make it look presentable. When the mast is raised or lowered to adjust the cable, it will not affect the latter.

**Liquid Crystal LED Display.** On the surface of the box, there is a liquid crystal display, reset switch and set. The LCD serves as a data viewer in the form of characters, letters, numbers or graphs. The reset switch works to restore the calculation or if an error occurred in the calculation. The switch is set to work when the microcontroller is powered or ready for use with an object detected by the sensor. The button then sets the time used before the results of automatic calculations. While the components in the box is a microcontroller, breadboard, resistors and wires microcontroller as the centre of the data processing, in this tool microcontroller serves as the Reset-Set, the incoming sensor data, the incoming voltage and counter. The microcontroller is ATMEGA 328, and connects Board Arduino Uno to the computer using a USB cable or power supply with AC to DC adapter or battery to power it. Resistors are electronic components with two poles that can be used to stem the flow of electricity when there is electrical voltage between the two poles. The resistors are usually part of an electronic circuit. Breadboard is a basic construction of an electronic circuit and is the prototype of an electronic circuit.

**How the device works.** The first step is to connect the adapter to an AC voltage source, push the "ON" button on the adapter, then the Liquid Crystal Display will be up and running.

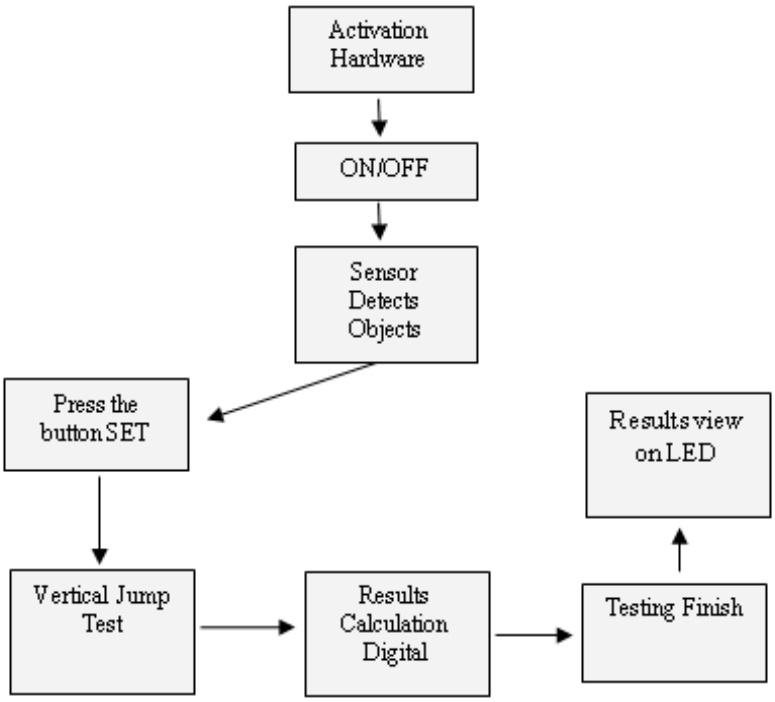


*Figure 7.* Structure of the workings device system

Then Ultrasonic Sensor HC SR-04 will detect an object. Before starting the test, make sure the object is in place and once detected the distance between the head of the sample to the sensor and then press the button on the box set. Then sample the motion jump to the fullest. The object jumps should lead to an ultrasonic sensor is above the pole. After that, the results will appear on the LCD.

**Trial Product.** The trial involved 10 students from the sport science program and the experiment was conducted in the laboratory of the faculty.

*Figure 8.* Trial device testing

Table 1 shows the results of average value of leg power for manual, 52.1cm, and auto, 49.3cm. The average value of vertical jump test manually and using the sensor was different, the value of the former is lower compared, a difference of less than 3cm.

Table 1
*Results of trial leg power test auto vs manual*

| No | Subject | Results (cm) | |
|---|---|---|---|
| | | Vertical jump test manual | Vertical jump test auto |
| 1 | A | 54 | 51 |
| 2 | B | 56 | 52 |
| 3 | C | 52 | 49 |
| 4 | D | 47 | 45 |
| 5 | E | 54 | 52 |
| 6 | F | 53 | 49 |
| 7 | G | 44 | 40 |
| 8 | H | 58 | 56 |
| 9 | I | 61 | 59 |
| 10 | J | 42 | 40 |
| | Sum | 521 | 493 |
| | Means | 52.1 | 49.3 |

These results indicate that the manual test is less accurate due to human error. However, results show the t value 26.022 < 2.262, thus, H0 is accepted. Which means there is no significant difference using an auto measuring device and manual.

## CONCLUSION

This device can be used to determine the maximum leg force and power more accurately, easily and effectively. Results show there was no significant differences between auto and manual testing. However, the average value was different, the auto test was lower than manual. This means that the auto test is more accurate than the manual.

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# The Implementation of Latent Semantic Indexing on Knowledge Retrieval Process in Knowledge Management System Development

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## ABSTRACT

This study examines Latent Semantic indexing (LSI) using Singular Value Decomposition (SVD) in the knowledge retrieval process, namely indexing Indonesian text. There are three stages in this process: (1) text processing, which consists of tokenisation, filtering, and stemming process, (2) developing LSI using SVD and (3) evaluating and measuring performance. The result showed Mean Average Precision around 77.90% on scenario matrix dimension 120 and average precision for first retrieval around 83.33% on scenario matrix dimension 90.

*Keywords:* Knowledge Retrieval, LSI, SVD

## INTRODUCTION

Knowledge management is very important for the success of any organisation (Fitriasari, Sofia, Suputra, Wirya, & Dini, 2012). In an organization, knowledge resides in various forms, such as documents, electronic databases, codified human knowledge stored in expert system, documented organisational procedures and processes and tacit knowledge acquired by individuals and networks of individuals (Tan, Teo, Tan, & Wei, 1998)

Knowledge management has four "knowledge processes", namely: (1) creation, (2) storage and retrieval, (3) transfer, and (4) application. Each process is not monolithic but are interlinked and affect one another (Alavi & Leidner, 2001).

Storage, organisation and retrieval of memory or knowledge of an organisation are important aspects for a knowledge management system that must be applied effectively (Babu, Vardhan, & Kuar, 2012).

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Thus, knowledge retrieval mechanism that is easy to remember and to use is essential in the strategy of Knowledge Management in an organisation (Tan et al., 1998). In the absence of an effective retrieval process, the knowledge that has been created and stored as an organisational knowledge cannot be transferred to the user actor and the knowledge application process would not be efficient.

Referring to this framework, the retrieval process can be seen as the link between the process of creation and transfer of knowledge to application. The ISO/IEC 2382-1 defines information retrieval as acts, methods and procedures carried out to retrieve stored data in order to provide information on the needed subject. The main purpose of information retrieval mechanism is to meet the users' information needs by retrieving all documents that may be relevant and, at the same time, leaving irrelevant documents on the list of search result. Such system uses a heuristic function to obtain documents relevant to the user's query. Some of the methods used in information retrieval mechanisms are Boolean, Probabilistic, Vector Spaces, Fuzzy, P-Norm and Network Inference.

However, the process of retrieving organisational knowledge is not easy because the knowledge is stored in various forms and components and can be both structured and unstructured. Search and retrieval using a regular query cannot find knowledge that is relevant to the needs of users. Moreover, technically, if the process of knowledge retrieval is performed using regular search that only relies on keywords or regex rules, in order to obtain relevant results, the number of rules that should be used will be very large and difficult to monitor (non-scalable) along with increasing scope of knowledge stored.

In the search for the most effective way to retrieve information, it is important to consider existing models since using available models and methods is very helpful in the decision-making process and has an important role in knowledge management (Babu, Vardhan, & Kuar, 2012). Latent Semantic Indexing, as proposed by Phadnis et al., (2014), has its advantages as a means of retrieving information, in that, it retrieves documents efficiently. It is a method of retrieval and indexing by means of a mathematical technique called Singular Value Decomposition (SVD) (Praks, Dvorsky, & Snase, 2003). Several research groups have used LSI for knowledge retrieval (see Table 1).

Table 1
*Implementation of LSI based on references*

| Implementation | Reference |
|---|---|
| Query processing for medicine document | (Guo, Berry, Thompson, & Bailin, 2003) |
| The Arabic document retrieval | (Muqthader, 2007) |
| Nursing Knowledge Classification | (Chinchanikar, 2009) |
| Document retrieval for a very large data set | (Zaman, 2010) |
| Chinese Information Retrieval | (Luo, 2013) |
| Topic Modelling for Knowledge Discovery | (Xu, Li, & Craswell, 2013) |
| Idenditification of domain term in the source code | (Sharma, 2014) |
| Semantic search technology | (Li, Bhatia, & Cao, 2015) |
| Automating Traceability Link | (Mounika & Babu, 2016) |

The SVD is usually used in a variety of applications, such as latent semantic indexing, collaborative filtering and general expression analysis (Rajamanickam, 2009). It is the most powerful decomposition algorithm in the LSI process in terms of the number of documents returned (Jaber Amira & Milligan, 2012).

The use of SVD for latent semantic indexing has been done by several research groups, as seen in Table 2.

Table 2
*Function of SVD based on references*

| Function | References |
|---|---|
| Capturing the geometric structures of motion data | (Prabhakaran, Nadin, & Khan, 2006) |
| Band and Sparse matric | (Rajamanickam, 2009) |
| Looking up document | (Da, 2015) |
| Clusters inter document | (Zhang, Xiao, Li, & Zhang, 2016). |

However, as seen in Table 1, LSI is the most popular knowledge retrieval mechanism in which the indexing system is predominantly based on English. There are limited sources of its implementation with its index based on a mix of English and non-English language. Therefore, this study discusses the implementation of LSI with SVD with concerns over indexing texts in Indonesian language.

## METHODS

### Text Processing and Index Development

The study examined selected theses written in Indonesian language submitted to Department of Computer Science Education of Indonesia University of Education (UPI). However, as the theses were related to computer science, English terms were widely used.

The document collection stage went through several phases before data could be used to develop the index. Those stages were tokenisation, filtering, and stemming. Tokenisation is the process of separating words contained in sentences or paragraphs which would later be processed in text analysis. A token is separated by spaces and punctuation. Each token then went through the stage of case folding in which a token was converted to lowercase to facilitate the next text processing. Tokens obtained from the tokenisation process were then filtered and tokens/terms listed in stop-word list went through the removal process

After being filtered, the tokens were stemmed. Stemming is a process of tracing the words in a document to their root by following certain rules. As an illustration, the terms "*bersama*" (together), "*kebersamaan*" (togetherness), "*menyamai*" (equal), are stemmed to their root, which is "*sama*" (same). There are several algorithms available for stemming Indonesian language, such as Nazief-Andriani's algorithm, Arifin-Setiono's algorithms, and Mustafa-Idris's algorithms. Stemming in this study employed Nazief-Andriani algorithms on program implementation.

From the results of the text processing, 2868 unique terms and term-document matrix sized 139x2868 were obtained. This matrix was further processed in matrix decomposition phase using SVD (Singular Value Decomposition) technique, which was followed by the development of latent semantic index. The matrix decomposition was reduced into a matrix of r-dimensional space. R value was determined by the researcher.

## Evaluation *Scenario*

The system was evaluated using multiple evaluation scenarios. The case tested in this study was to determine the best r parameter in building sub-matrix.

In the early stage, the results of singular value decomposition of matrix A, from the collection of research documents, are expressed as follows (Zhang, Xiao, Li, & Zhang, 2016):

$$A = \quad U \quad \sigma \quad V^T$$

$$A = [u_1, u_2, u_3, \ldots, u_k] \begin{bmatrix} \sigma_1 & 0 & \cdots & 0 \\ 0 & \sigma_2 & \ldots & 0 \\ \vdots & \ldots & \ddots & \vdots \\ 0 & 0 & \ldots & \sigma_k \end{bmatrix} \begin{bmatrix} v_1^T \\ v_2^T \\ \vdots \\ v_k^T \end{bmatrix}$$

with $k$ as the number of singular values of A($\sigma$1, $\sigma$ 2,….,$k$ ). Then, from $k$, $r$ as the largest singular value was selected, which is $\sigma 1 \geq \sigma 2 \geq \ldots . \geq \sigma r > 0$, with $r<k$. After the value of $r$ was determined, the matrix derived from the decomposition was reduced into $r$-dimensional space.

The value of $k$ (or the number of document collections) in this research is 139. Experiments were conducted on the value of $r$ by applying systematic sampling technique. The members of $R$ sample were selected by multiplication of 10, from which 13 samples were selected for the value of $r$, namely 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 120, 130. Each $r$ value was then evaluated to find the value of r that gave the maximum value of MAP (Mean Average Precision).

## RESULTS AND DISCUSSIONS

The effectiveness and efficiency of information retrieval are affected by the quality of its index. The selection of appropriate values of $r$ parameter will affect the index built from the collection of documents. Indexing distinguishes a document from others in the collection. A small size index can give poor results and could neglect relevant documents. Yet, an index with large size results in the discovery of documents that are not relevant and reduces the search speed.

Best $r$ parameter is determined by selecting a scenario that provides the highest MAP. Not only will the highest MAP enable relevant documents to be found more quickly and precisely, it will also affect the ranking of documents. This is because changes in the size of matrix dimensions influence the calculation of cosine similarity between the query and the documents.

To get the value of MAP for each scenario $r$ parameter, the calculation on precision value at each point of retrieval for each scenario was done. The results of the calculation precision in the range of scenario $r$ with parameter of 10 to 60 are shown in Figure 1. The results of the

calculation on precision of scenarios of $r$ = 70 to 130 are shown in Figure 2. Precision and MAP are expressed as follows (Manning, Raghavan, & Schutze, 2009):

$$\boldsymbol{Precision} = \frac{\#(\boldsymbol{relevant\ items\ retrieved})}{\#(\boldsymbol{retrieved\ items})}$$

$$MAP(Q) = \frac{1}{|Q|}\sum_{j=1}^{|Q|}\frac{1}{m_j}\sum_{k=1}^{m_j} Precision(R_{JK})$$

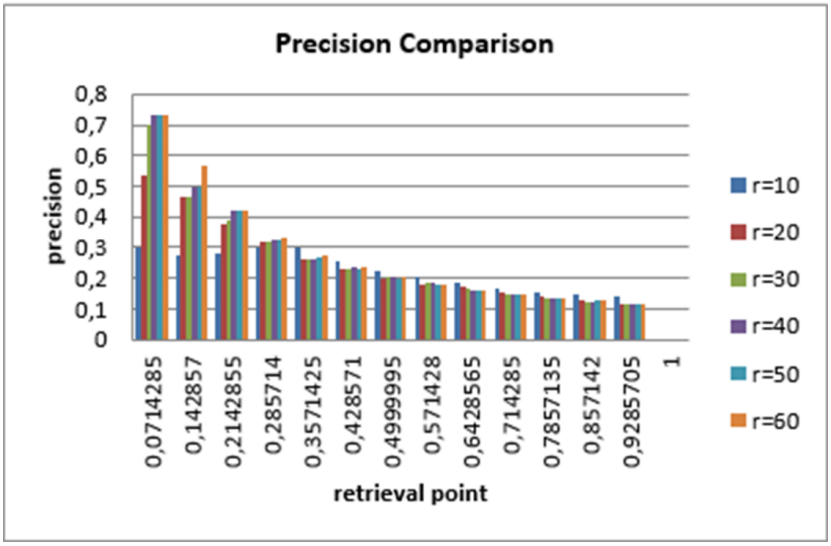


*Figure 1.* Comparison of Precision value for scenarios r = 10-60

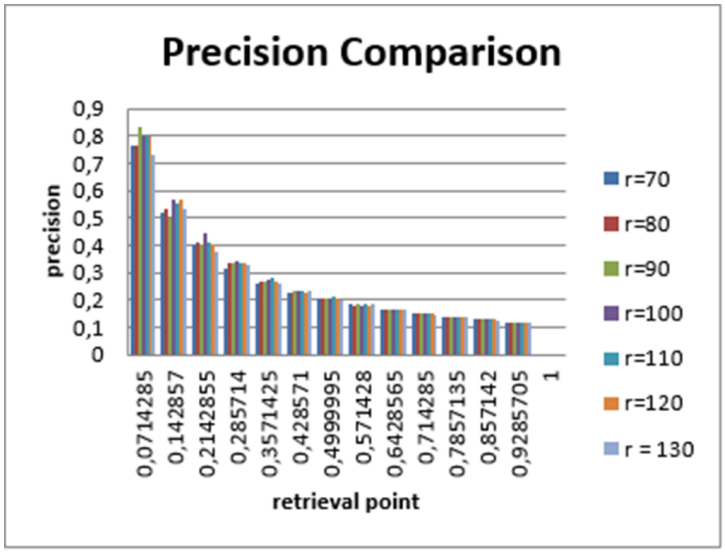


*Figure 2.* Comparison of Precision value for scenarios r = 70-130

The test results of all scenarios show r scenario with parameter value of 120 provides good precision value and the highest MAP is 77.90 %, as shown in Table 3

Table 3
*Comparison of MAP value in each scenario the value of r*

| MAP | R Parameter Value |
|---|---|
| 10 | 0.33503824 |
| 20 | 0.58148742 |
| 30 | 0.67072885 |
| 40 | 0.70011206 |
| 50 | 0.70313966 |
| 60 | 0.73573703 |
| 70 | 0.72484149 |
| 80 | 0.74624535 |
| 90 | 0.74422495 |
| 100 | 0.77728778 |
| 110 | 0.76744631 |
| 120 | 0.77905532 |
| 130 | 0.74130575 |

The results of the study show that latent semantic indexing is possible. It is proven by the discovery of almost all relevant documents at the first retrieval point. Some documents that do not contain the keyword in the title but contain related methods and is relevant to the query are also detected by the system. This is influenced by the application of LSI which can determine the semantic relationships between words in a document, in the term-document matrix used. Therefore, the quality of the built index will significantly affect the performance of the search. Good index will also lead to good search results.

However, there are some shortcomings, which are mainly related to the index used. The index quality is determined by the quality of term at the text processing stage.

Tokenisation uses a primitive separation technique which separates words with spaces and punctuation as references. Such a method has its disadvantages. As a result, there are irrelevant terms unfiltered and are listed in the list of terms.

For examples:

"*dianggapakuratdalampengenalanwajahadalahjaringan*"

"*Dibutuhkan*"

"*Desainperancangan*"

It occurs because as computer is not like human brain, the tokeniser is unable to recognise whether a group of characters that it separates is a meaningful or not. If an author miss-typed some words and they are not checked at the pre-data processing, the words will be taken into the list of terms and influence the size of the matrix and the process of index development.

In addition, for phrases in Indonesian, such as "*rumahsakit*" (hospital) and "*perguruantinggi*" (university), the tokeniser will separate them into distinct words, namely "*rumah*" (house), "*sakit*" (ill), "*perguruan*" (school) and "*tinggi*" (high). In Indonesian, such phrases form a single phrase. Separating "*rumahsakit*" into "*rumah*" and "*sakit*" changes the meaning of the phrase.

Moreover, as a result of the conversion of the letters into lowercase, some terms such as "*Budi*" (name of a person) might lose its meaning as it would be referred to as the same like in the phrase "*budipekerti*" (good personal characters).

In terms of filtering, stop words list that is used is that of standard Indonesian and have not been adjusted to the existing collection of documents. Yet, a word that appears too often is considered as unimportant and included in the list of stop-words.

In terms of stemming, the algorithm used is a stemming algorithm for Indonesian. The drawbacks of stemming used in this system are as follows:

a. In the document collection used in the study, many English terms are not affected by the stemming algorithm. English terms remained because many important terms in English are used in the field of computer science. Hence, there are some English terms left unfiltered and included in the term-document matrix processing.

b. The stemming process allows two phrases whose meanings are similar to be much different. For example, the words "*depolitisasi*" (depoliticisation) and "*politisasi*" (politicisation), which have similar meaning, will be stemmed into token "*depolitis*" and "*politis*", which have different meanings.

c. As the stemmer applies the rules on each term/token passing through text processing, many terms may lose their intended meaning. Terms such as "*wartawan*" (journalist), "*karyawan*" (employee), "*peragawan*" (male model) will be converted via a stemming process into "*warta*" (news), "*karya*" (works) and "*peraga*" (model). Phrases that have name meaning such as "*gunawan*" and "*setiawan*" would also change to "*guna*" (use) and "*setia*" (loyal), which deviate from their original meaning.

Therefore, it can be concluded that text processing performed in this study can process terms contained in the collection of documents However, for collection of documents with larger size and more diverse types of documents, further related research needs to be conducted.

## CONCLUSION

The LSI module can be used on a collection of documents to index and to rank relevant documents. R values that is ideal in the implementation of LSI on the collection of documents in this study is 120, since the value of $r$ = 120 gives MAP of 77.90% and with an average precision of 80

Based on the evaluation and performance measurement, latent semantic indexing method gives a fairly good performance, with a mean average precision of 77.90% in value scenarios $r$ = 120 and average precision for first retrieval of 83.33% in the first scenario $r$ = 90,

In addition, based on the identified shortcomings, the importance of an effective means of indexing texts, particularly those from non-English language, is inevitable. Hence, further research on the development of indexing process are essential.

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# A Stand-alone Application Software of Graph Plot for Digital Signal Processing

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## ABSTRACT

This paper discusses the application of software design to display graph plots of Digital Signal Processing (DSP) results. This design uses MATLAB programming language by utilising the MATLAB GUI. This application was built using MATLAB R2012a for the 32-bit version and MATLAB R2014a for the 64-bit version. The application can plot graphs of digital signal processing results such as sampling, convolution, deconvolution, Discrete Time Fourier Transform, Z Transform, FIR Digital Filters, IIR Digital Filters and many others. The software can be installed on all windows operating system and function as a stand-alone program with all supporting files integrated in one package installer and therefore, easily distributed. By using this application, we can resolve many cases on DSP simply and interactively.

*Keywords:* Application software, Digital Signal Processing, Graph Plot, MATLAB, Stand-alone

## INTRODUCTION

Digital technology is used in almost all areas of life that utilise electronic devices and computers. Digital Signal Processing (DSP) in particular, is the most important part of the technology determines the quality of output produced (Tan & Heinzelman, 2003; Abdel-Qader, Bazuin, Mousavinezhad, & Patrick, 2003)

DSP involves of computational mathematics (German-Salloa, 2014; Ownby, & Mahmoud, 2003) that is often difficult to understand without the aid of a visual

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presentation (McClellan, Schafer, & Yoder, 1998). For example, in the sampling process, when a sinusoidal signal with the following equation

$$x(t) = A\cos\left(\Omega_0 t + \phi\right) \tag{1}$$

is sampled using sampling rate $f_T$, then the sampled signal

$$x\left(nT\right) = A\cos\left(\Omega_0 nT + \phi\right) \tag{2}$$

is the value of signal *x(t)* at the time of t = nT or (0T), (1T), (2T) and so forth with the value of T is (Mitra, 2011)

$$T = \frac{1}{f_T} \tag{3}$$

Without the aid of a visual presentation, the previous sampling process is quite difficult to be understood for beginners. The plot process of signal sampling requires considerable time, and will be even longer for multiple values of T. The visual presentation is also necessary in other cases (Jamehbozorg & Radman, 2013; Ambikairajah & Epps, 2011). Utilising a computer program for visual presentation of the DSP results can be a solution in which the plot image can be displayed in just 1 to 10 seconds.

In this study, MATLAB programming platform was used by utilising the GUI facility to design the program in the form of windows so that users can easily run the application even if they don't have much understanding programming language (Hailan & Wei, 2012). The type of data is also not important. The user only needs to place a value on the variables to be used (Li, Harari, Wong, & Kapila, 2004).

Using MATLAB GUI to develop MASTERS (Multimedia systems in Telecommunication, Medical and Remote Sensing applications) had been done previously in the form of Virtual Laboratory (Alexiadis & Mitianoudis, 2013). Meanwhile, Kulmer, Wurzer, and Geiger, (2016) used MATLAB GUI to develop the MRLT (Magnitude Response Learning Tool) as a learning game to estimate magnitude response of LTI (Linear Time Invariant) systems based on pole/zero chart. The difference between those studies and the current one is the MASTERS Virtual Laboratory was designed for solving and explaining more complex concepts of DSP such as audio, image, and video encoding and compression, video and audio streaming and medical image processing (Alexiadis & Mitianoudis, 2013), while this graph plot application software was designed for explaining basic concepts of DSP. The MRLT was designed with a limited scope that is a magnitude response of LTI system (Kulmer et al., 2016), while this application software covers a wider scope to display graph plots of DSP results. The study covers basic DSP problems such as signal forms, signal operations, system response and system operations. This application software accommodates 32 bit as well as 64-bit computer versions using MATLAB R2012a and MATLAB R2014a respectively. In order to facilitate the distribution, the application was designed to be installed on all windows operating system and stand-alone with all the supporting files integrated in one package of installer (Andreatos & Zagorianos, 2009).

## Design of Application Software

The software is designed to display the plot of digital signal processing's results. The input of this application is parameters value required in signal operation. For example, a plot graph of convolution result between discrete signal $x(n) = \delta(n) + \delta(n-1)$ and system impulse response $h(n) = \delta(n) + \delta(n-2) + \delta(n-3)$can be found by inserting the discrete signal and impulse response's weights to application. As many as 45 types of signals can be displayed using this application, namely several types of analog signals, discrete signals, signal sampled result, convolution, deconvolution, discrete time Fourier transform, transformation Z, until the digital filter. The number of displayed signals can be increased by updating the software program.

The users can easily change the value of some parameters and see the changes on the graph plot. The mathematical equations used can also be displayed in order to provide complete information about the related signal processing.

## System Flow Chart

Figure 1 is a flow chart that shows how the application is developed. The first display is a welcome menu window that has a selection of ENTRY and EXIT buttons. The ENTER button selection will take the user to the menu options consisting of main options and additional menus. The main menu selection is a graph plot of some signal processing operations, while the additional menu is in the form of magnifying glass and calculator functions. The graph plot will then appear after the user enters the value of parameters in the provided space.

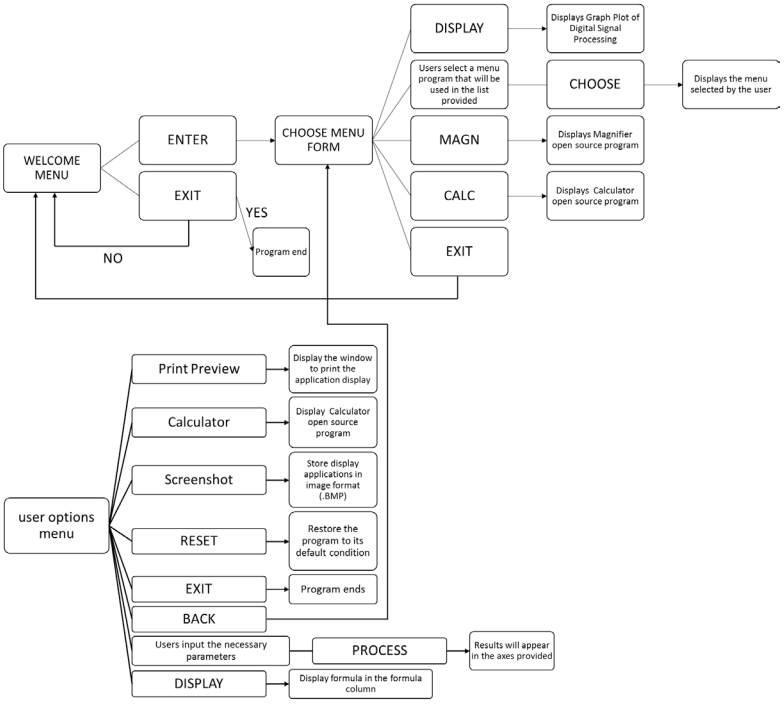


*Figure 1.* System Flow Chart

### Software Programming

The software is combined into a single entity through the facility of Deployment Tool available on MATLAB (Oyetunji & Ale, 2013). This application is designed to accommodate the 32 bit as well as 64-bit versions of windows operating system. These versions were built using MATLAB R2012a and MATLAB R2014a respectively. In order to facilitate the distribution, the applications were designed to be installed on all windows operating system and stand-alone with all the supporting files integrated in one package of installer so it can be run on any computer device without installing MATLAB program (Kumar, Raja, & Selvan, 2012).

Furthermore, the program was tested on three computers with different specification in order to determine their operating performance.

### Graph Plot of Digital Signal Processing

This application provides the appearance of graph plots for 45 signal types of Digital Signal Processing. One graph plot that can be displayed is the signal from the sampling process. The parameters entered are analog signal frequency to be sampled and the sampling period. The sampling process has to fulfil the Nyquist condition, namely signal with frequency $f_0$ has to be sampled with a sampling rate $f_T \geq 2\ f_0$ so that signal source can be generated back from the signal sampling results (Mitra, 2011; Mathumisaranon & Chayratsami, 2013). By using this application, graph plot of signal of sampling results, whether it fulfils the Nyquist condition or not, can be displayed by changing the parameters.

## RESULTS AND DISCUSSIONS

Tests were conducted to determine the general specification of the application software developed and the displays graph plot generated.

### The System Hardware and Software Specification

System specifications were obtained from the testing of software installation on three different specification of computers. Table 1 shows the system hardware and software specifications of the application software. From Table 1, it can be seen that the software can be installed on all windows operating system, accommodate the 32 bit as well as 64-bit versions, and can use any Intel processor as well as AMD x86 which supports instruction set of SSE2. RAM minimum specification is 512 MB, and Hardisc minimum capacity is 2 GB. Software resolution is fixed size of 1344 x 634 pixels.

Table 1
*The system hardware and software specification*

| | |
|---|---|
| Operating System | Windows XP Service Pack 3, Windows Server 2003 R2 with Service Pack 2, Windows Vista Service Pack 1 or 2, Windows Server 2008 Service Pack 2 or R2, Windows 7 and Windows 8.1 |
| Platform | 32 bit or 64 bit |
| Processor | Any processor Intel as well as AMD x86 which supports instruction set of SSE2 |
| RAM | Minimum of 512 MB (at least 1024 MB Recommended) |
| Hardisc | 2 GB (minimum for installation storage) |
| Software resolution | 1344 x 634 |

## The Display of Graph Plot

In order to clarify the application of graph plot, the following two problem-solving are described.

The test of graph plot display was conducted by solving the problems of the Digital Signal Processing. The result showed that all the buttons worked and all of the graph plot can be displayed on the main axes. To view the graph plot application in problem solving, the following illustration of two problems and solutions as examples with the aid of graph plot.

- Sampling Process: A sinusoidal signal with 5 Hz of frequency and amplitude of 1, yields the following equation:

$$x(t) = \sin\left(10\pi t\right) \tag{3}$$

In order to meet Niquist condition, the signal must be sampled with a sampling rate $\geq 10$ Hz or sampling period $\leq 0.1$ s. In the first case, a sampling rate of 50 Hz or sampling period of 0.02 s was used. In this case, Nyquist condition was fulfilled, a plot of signal of sampling result is shown in Figure 2. In the second case, the parameters of the sampling rate were converted to 8 Hz or sampling period of 0.125 seconds, which does not meet Nyquist condition, and the plot of signal of sampling result can be seen in Figure 3.

Both plots of the sampling result signal show the differences between sampling process that meet the Nyquist condition and vice versa. For the adequate sampling process, signal source can be reproduced from the signal of sampling results (Ludeman, 1987; Oppenheim & Schafer, 2013).

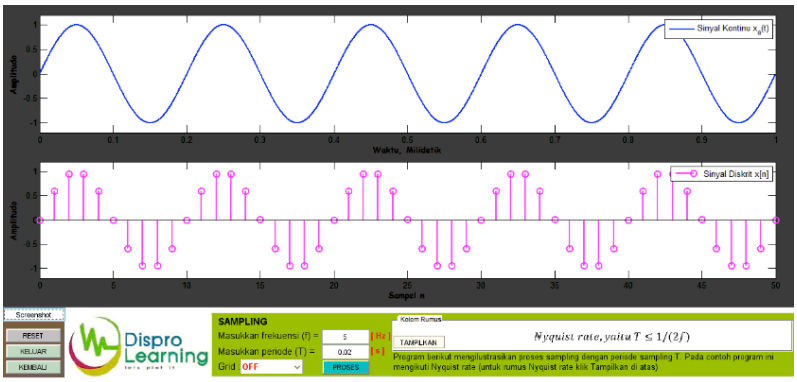


*Figure 2.* Plot of the sampling result signal at 5 Hz of signal frequency and 50 Hz of sampling rate

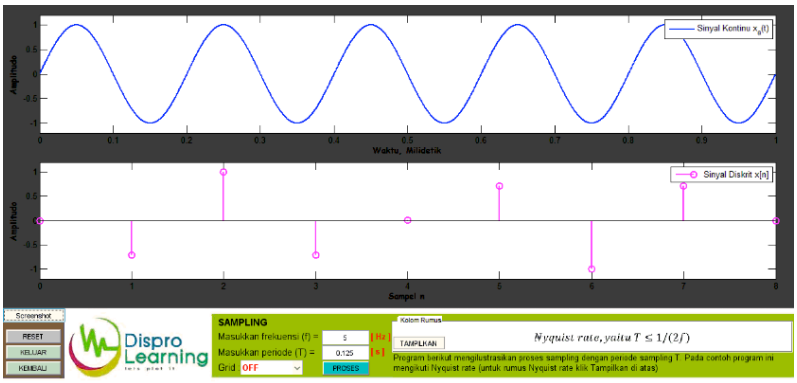


*Figure 3.* Plot of the sampling result signal at 5 Hz of signal frequency and 8 Hz of sampling rate

- Butterworth Lowpass Filter Order and Frequency Response using BZT Method: BZT method (Bilinier Z Transform) is the IIR (digital filter that has Infinite Impulse Response) digital filter design technique using the transformation of s-domain to z-domain (Thede, 2005)

In this mapping, all jΩ axis in the s-plane were mapped into the unit circle in the z-plane; all points of the Left Half Plane of s were mapped into a unit circle in the z-field, while all points in Right Half Plane were mapped outside the unit circle (Proakis & Manolakis, 2007). This mapping was carried out based on the following equations:

$$s = \frac{2}{T}\left(\frac{1-z^{-1}}{1+z^{-1}}\right) \tag{7}$$

$$z = re^{j\omega} \tag{8}$$

$$s = \sigma + j\Omega \tag{9}$$

where:

ω: digital frequency

Ω: analog frequency

$$\Omega = \frac{2}{T}\tan\frac{\omega T}{2} \tag{10}$$

Filter order obtained from equation

$$N = \left\lceil \frac{\log_{10}\left(\left(10^{\frac{K_1}{10}}-1\right)\Big/\left(10^{\frac{K_2}{10}}-1\right)\right)}{2\log_{10}\left(\frac{\Omega_1}{\Omega_2}\right)} \right\rceil \tag{11}$$

where:

$\Omega_1$ : *cut-off* analog frequency

$K_1$ : 3 dB of damping

$\Omega_2$ : *stop-band* a*nalog frequency*

$K_2$ : damping at *stopband* frequency

For example, in the case of designing of low pass digital filter with spec: 2 kHz of 3 dB cut-off frequency, 30dB of minimum damping occurs at 4,25 kHz of frequency and 10 kHz of sampling rate. Using eq. (7) to (11) we obtained $\Omega_1 = 14.53 \times 10^3$ rad/s, $\Omega_2 = 83.31 \times 10^3$ rad/s and filter order = 2

Transfer function of low pass filter Butterworth order 2 (Thede, L.D., 2005)

$$H(s) = \frac{\Omega_c^2}{s^2 + s\sqrt{2}\Omega_c + \Omega_c^2} \tag{12}$$

By inserting the value of Ω1 to Ωc and using eq. (7), we have

$$H(z) = \frac{0.20657\left(1 + 2z^{-1} + z^{-2}\right)}{1 - 0.36953z^{-1} + 0.19582z^{-2}}$$

By inserting specification parameter values required for the application software of graph plot, the coefficient of H (z), filter order and the plot of response filter signal will be obtained quickly. The result of response signal plot is shown in Figure 4.

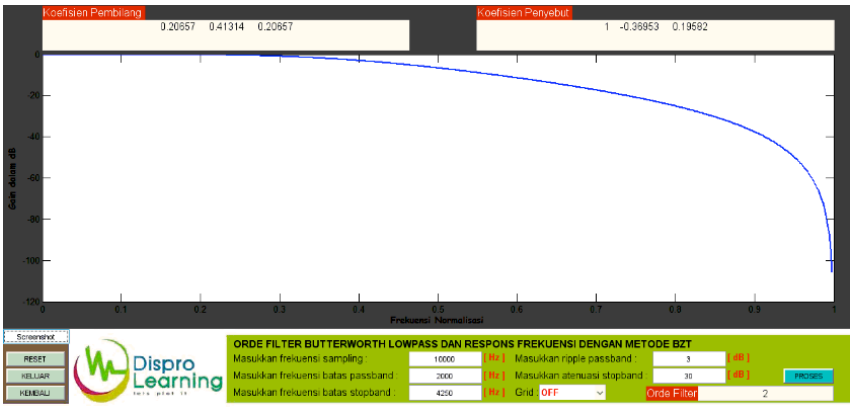


*Figure 4.* Plot of response signal of *low pass* filter using BZT method

## CONCLUSION

This paper describes the results of design software to plot a graph of Digital Signal Processing using MATLAB programming language. The application can be run on any Windows operating system platform with computer specifications of low end to high end. The application was successful using MATLAB R2012a for the 32-bit version and MATLAB R2014a for the 64-bit version, as stand-alone software with all the supporting files integrated into one package installer. From the test results, the application software developed can properly and quickly solve the problem of Digital Signal Processing such as sampling process and IIR digital Filter design as described above in The Display of Graph Plot Section.

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# An 8-Slotted Waveguide Antenna with Cross-Shaped Slot At 2.3 GHz for LTE Applications

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## ABSTRACT

This paper discusses the design and realisation of an 8-slotted waveguide antenna with a cross slot design for Long Term Evolution (LTE) applications. The method used in this paper is simulation, fabrication, and measurement. The simulation was carried out using 3D Electromagnetic Simulator. The designed antenna was made of brass plate with thickness of 0.8 mm. The overall dimension of this antenna is 113 mm x 59 mm x 813 mm with the slot dimension of 57.22 mm x 7.85 mm. The result of simulation confirmed that the antenna has the bandwidth of 133.9 MHz at the frequency of 2.28 to 2.41 GHz with -10dB return loss. The result confirmed that the antenna has 164.3 MHz bandwidth from 2.28 to 2.44 GHz with a similar return loss.

*Keywords:* Antenna, cross slot, LTE, waveguide

## INTRODUCTION

Long Term Evolution (LTE) technology is a new service that has high capacity and speed in mobile system. It is a next step to fourth-generation wireless (4G) of radio technology which is designed to increase capacity and speed of mobile telephone network. Thus, LTE is commonly called fourth-generation (4G) wireless service (Krenik, 2008) offering downlink capacity up to 100 Mbps, uplink capacity up to 50 Mbps, and Radio Access Network (RAN) less than 10 ms. The LTE supports bandwidth efficiency for operator from 20 MHz down to 1.4 MHz and support for both Frequency-Division Duplexing (FDD) and Time-Division Duplexing (TDD). This technology is intended to increase high data transfer while reducing operational cost

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(Ghosh, Xiao, Ratasuk, Rottinghaus, & Classon, 2008). There are many bands and frequencies that can be used for TDD LTE (Remy, 2014), and in Indonesia, used band 40 has a frequency range between 2.3 and 2.4 GHz (Liu, Fang, Zhi, Bai, & Zeng, 2017; Palola et al., 2014; Palolo et al., 2014; Sidik, Fathany, & Alam, 2015).

An important device in LTE technology is antenna. An antenna with omnidirectional radiation pattern usually has wide bandwidth but low gain (Sun, Ban, Lei, & Li, 2012) while an antenna with directional radiation pattern has narrow bandwidth but high gain. One of the antennas that can be implemented for LTE technology with directional radiation pattern is a waveguide slot antenna. The directional antenna available widely in market are microstrip, Yagi, and parabolic antenna. Microstrip antenna has compact size but low gain (Biswas & Gupta, 2015; Sugianto & Hariyadi, 2013; Wong, Islam & Kibria, 2014) while the gain of Yagi and parabolic antenna is high but the fabrication of these types of antennas is relatively complex and costly. While waveguide slot antenna with simple design and higher gain with elliptical shape of slot has been designed (Al-Husseini, El-Hajj, & Kabalan, 2013) it works at 3 GHz so it is not suitable for TDD LTE application in Indonesia.

Waveguide slot antenna with circular polarisation has been developed by research groups (Montisci, Musa & Mazzarella, 2004; Satnoor, Vani, Konda, Mulgi, & Hunagund, 2008) using longitudinal slot configuration. The waveguide slot antenna with plate-laminate can be found in some reports (Hirokawa, Tomura, Miura, Zhang, & Ando, 2011; Hirokawa, 2012), the fabrication is not easy. Previous research also shows the design of a planar slotted waveguide array antenna for X-band Radar, (Bhatti, Park, Im, & Park, 2011), while this study's proposed antenna is an 8-slotted waveguide antenna with cross shape of slot for TDD LTE application. The new antenna was made of brass plate with thickness of 0.8 mm has directional radiation pattern, high gain, and the frequency range is 2.3 to 2.4 GHz with return loss less than -10 dB.

## LITERATURE REVIEW

### Waveguide Slot Antennas

Waveguide slot antennas have applications in missile, spacecraft and airborne radar (Oliner, Jackson, & Volakis, 2007) industries. Waveguide slot antennas are the simple-shaped antennas with slots that are arranged like an array. The slots which are milled into the surface of the waveguide will discontinue the flow of current along the waveguide, creating the current that flows around the edges of the slots. To have good control of the excitation of a linear slot array, it is recommended that the waveguide only operates in a single mode, preferably the lowest mode (Oliner et al., 2007). For rectangular slot waveguide antennas, the mode was TE10 (Pozar, 2012). When a waveguide as shown in Figure 1 is excited with a $TE_{10}$ mode and the ends are terminated in a matched impedance, the electric field ($E$) and magnetic field ($H$) are given by (1) to (3) (Oliner et al., 2007):

$$H_x = \frac{-\beta_z}{\omega\mu} E_0 \sin\left(\frac{\pi x}{a}\right) e^{-j\beta z} \tag{1}$$

$$E_y = E_0 \sin\left(\frac{\pi x}{a}\right) e^{-j\beta z} \tag{2}$$

$$H_z = \frac{j\beta_x}{\omega\mu} E_0 \cos\left(\frac{\pi x}{a}\right) e^{-j\beta z} \tag{3}$$

The relationship between the propagation constant and the guided wavelength ($\lambda_g$) is as follows:

$$\beta_x = \frac{\pi}{a} \tag{4}$$

$$\beta_z = \sqrt{k^2 - \beta_x^2} = \frac{2\pi}{\lambda_g} \tag{5}$$

$$k = \frac{2\pi}{\lambda} = \frac{\omega}{c} \tag{6}$$

$$\lambda_g = \frac{\lambda}{\sqrt{\lambda_c^2 - \lambda^2}} \tag{7}$$

$$\lambda_c = 2 \tag{8}$$

Where:

$\alpha$ = waveguide width (m)

$\beta$ = phase constant (rad/m)

$k$ = wavenumber (rad/m)

$\omega$ = angular frequency (rad/s)

$\lambda_g$ = wavelength in waveguide (m)

$\lambda_c$ = cut-off wavelength (m)

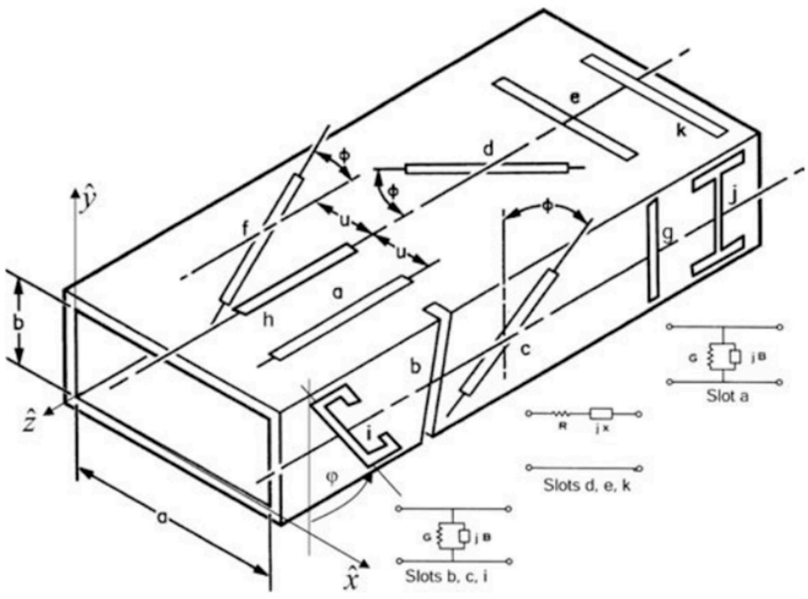


*Figure 1.* Slots cut in the walls of a rectangular waveguide (Oliner et al., 2007)

### Waveguide Antenna Design

This study designed its antenna using a software called 3D Electromagnetic Simulator, which functions to optimise the antenna in determining its dimension that are suitable for LTE application. The 8-slotted waveguide antenna is made of brass plate. The distance between short-circuit waveguide terminal and the closest is $\lambda_g$ (Oliner et al., 2007). The antenna is measured to verify the characteristics or parameters of the antenna, including return loss, VSWR, gain, and radiation pattern.

### The Specifications of 8-slotted Waveguide Antenna

In designing the 8-slotted waveguide antenna, there are some important parameters shown in Table 1 as reference in the simulation and measurement.

Table 1
*The specification of 8-slotted waveguide antenna*

| Parameter | Specification |
|---|---|
| Centre Frequency | 2.35 GHz |
| Bandwidth | 100 MHz (minimum) |
| Return Loss | < -10 dB |
| Impedance | 50 Ohm |

## RESULTS AND DISCUSSIONS

### Optimisation of Antenna Dimension

The optimisation was carried out to get the waveguide antenna dimension as per requirements. The following was optimised: slot length (p), distance between the closest slot and the probe (r), distance between slot and the centreline (x), and the probe length (d). Figure 2 shows the final simulation result of return loss after optimisation. The final design of the 8-slotted waveguide antenna with a cross-shaped design is shown in Figure 3 and the list of antenna dimension can be seen in the Table 2.

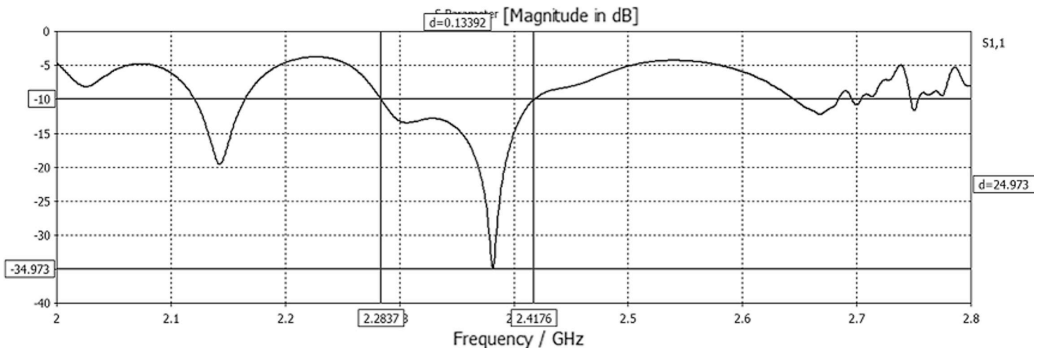


*Figure 2.* The final simulation result of return loss

Table 2
*The size of the 8-slotted cross shaped waveguide antenna cross-shaped*

| Dimension | Size |
|---|---|
| *a* | 113 mm |
| *b* | 59 mm |
| *p* | 57.22 mm |
| *l* | 7.85 mm |
| *j* | 78.5 mm |
| *x* | 23.4 mm |
| *t* | 39.25 mm |
| *r* | 185 mm |
| *d* | 33.8 mm |
| Material Thickness | 0.8 mm |

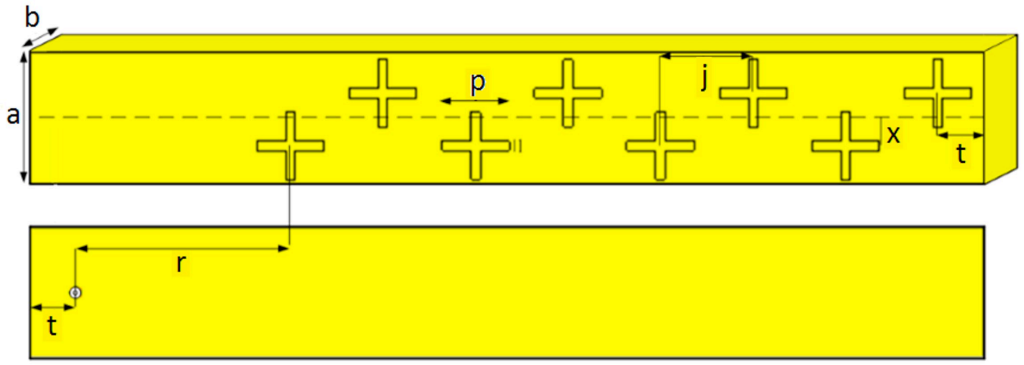


*Figure 3.* The dimension of 8-slotted waveguide antenna with a cross-shaped design

## Antenna Fabrication

The 8-slotted waveguide antenna was fabricated using brass material with 0.8 mm thickness. The dimension of the antenna is similar to the final simulation, 113 mm x 59 mm x 813 mm as shown in Figure 4.

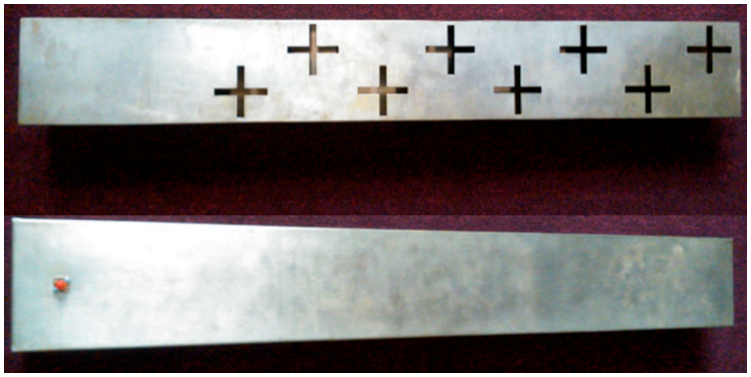

*Figure 4.* The fabrication of the 8-slotted waveguide antenna with a cross-shaped design

**Return Loss and Bandwidth.** Figure 5 shows the graph of the return loss based on the simulation and measurement result of the 8-slotted waveguide antenna. It can be seen is a changing of antenna frequency and bandwidth. This difference is caused by the loss and bending in the connector cable, in which the cable is very sensitive especially during the antenna measurement. If the cable is touched or loosened, it will change the measurement result. However, the frequency of fabricated antenna is still like the initial specification. Based on the measurement result, the return loss of this antenna is less than -10 dB for the frequency from 2.3 to 2.4 GHz. However, the bandwidth of the fabricated antenna is wider than the simulated antenna.

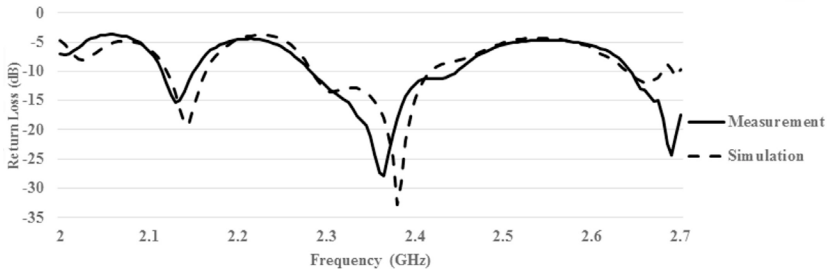


*Figure 5.* The comparison of return loss between the simulation and measurement result

**Antenna Gain.** It is found that the result of gain from the simulation and measurement is different, as shown in Figure 6. The gain result from the measurement tends to be higher than the simulation result. The gain from the measurement result ranges from 13 to 15 dBi, while that from the simulation result is 13 dBi. This difference may be caused by the existence of other objects around the area of measurement.

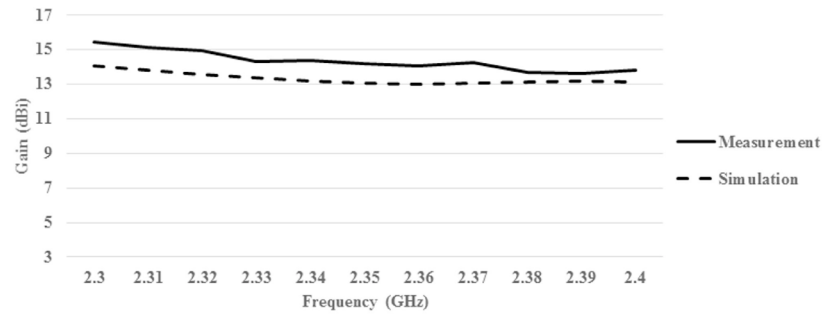


*Figure 6.* The comparison of antenna gain between the result of the simulation and measurement

**Radiation Pattern.** Figure 7 shows the graph of radiation pattern from the result of simulation and measurement of the 8-slotted waveguide antenna. From Figure 7, the radiation pattern between the simulation and the measurement result is quite likely unidirectional as per the criteria. As the measurement of the pattern was carried out with the elevation angle of 10° the result was imprecise.

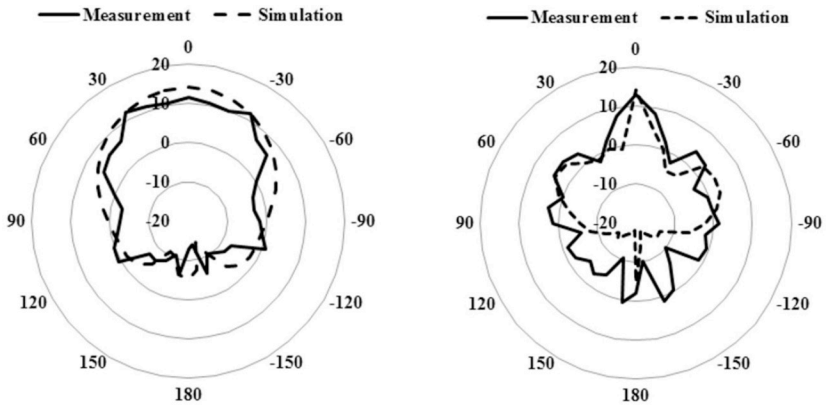


*Figure 7.* The comparison of radiation pattern between the result of simulation and measurement (a) H-plane (azimuth) (b) E-plane (elevation)

## CONCLUSION

This study designed and measured an 8-slotted waveguide antenna with a cross-shaped slot. In order to obtain the required antenna specification, optimisation was conducted in terms of dimension of slot length, distance of the closest slot to the probe, distance of the slot to the centerline, and probe length. Based on the result of simulation and measurement, our proposed antenna has the return loss less than -10 dB for the frequency range 2.3 to 2.4 GHz. The gain of our proposed antenna is around 13 – 15 dBi and the radiation pattern is unidirectional. So, it can be said that this antenna corresponds with simulation results and can be used for TDD LTE application.

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# Sound Pollution and Fog Smoke Handling Situation in Airport and Its Implication on Airport Service Quality

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## ABSTRACT

Aircraft noise and fog still become the problem at many airports affecting the comfort of passengers and those living at its vicinity. Further, it causes many accidents or crashes due to decreased of the visibility. The purpose of this research is to analyse how noise and smog can be managed for the safety and comfort of passengers and residents living near the airports. The case study is International Airport Sultan Mahmud Badaruddin II Palembang and 90 passengers were interviewed through a questionnaire in order to understand how the airport manages smog and noise pollution.

*Keywords:* Airport Noise, Airport Service Quality, Smog, Sound Pollution

## INTRODUCTION

Airport is the nodal centre in air transport network (Wang, Mo, Wang, & Jin, 2011). An airport is an anomaly in the air transport industry as planning, designing, and managing of the airport which is a local affair, while it serves the international crowd and the global industry (Page, 2014). The airport service industry consists of many components that work together to ensure smooth experience for the passengers. In general, the main components of the airport are: system of air traffic control, airside, which consists of runways, taxiways and aprons, the landside consists of passenger, cargo terminal, and access roads, as well as parking and access to a network service at the airport, and logistics facilities and equipment (Barnhart, Belobaba, & Odoni, 2003).

For tourists, the airport is no longer just a place of transit but also as a gateway where new passengers evaluate the city from what

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they feel the first time. A study described that the airport is a starting point in creating the image of a city because the first thing travellers see will create a "*Hello Effect*" of assessing a city based on their experience (Page, 2014).

The airport also evokes the memory. The identity of the city is y inherent in the design of an airport (Sepe, 2013). A strong memory is created from passengers' experience (both happy and sad) which leads to communication between people in a certain place, inside the airport, so the *sense of a place* is actually created (Page, 2014). A study indicated that an airport is no longer only an infrastructure but also creates an experience that in the next will create a satisfied customer (Gibbert, Leibold, & Probst, 2002).

Airports are very important for a country or city as it has a big influence in the economic survival of a city or country; a study mentioned that good experiences at the airport will provide benefit: (Lorentzen & Hansen, 2009) (1) increased customer satisfaction, the potential to make a visit future or a return visit, and enhance the reputation (of a city); (2) can help in increasing *non-aeronautical* revenues airport; (3) influence the selection of airlines and airports, and it also affects the airline's decision in choosing the airport as a connecting *hub*; and (4) can be used as a differentiator airports, especially when there is a regional transit *hub* in the same.

Therefore, an airport is obliged to provide a good experience by offering good quality of service, as an airport service quality directly affects the passengers' experience (Pantouvakis, 2010) without noise and air pollution.

Noise pollution or noise disturbance is excessive noise that may harm the activity or balance of human or animal life. The sources of most outdoor noise are machines and transport systems, motor vehicles, aircraft, and trains (Berglund, Hassmen, & Job, 1996). High noise levels can contribute to cardiovascular problems in humans and an increased incidence of coronary artery disease (Stansfeld & Matheson, 2003). In animals, noise levels can either increase or minimise the risk of being killed by their predators while in the human kingdom, increased noise levels can interfere with reproduction and navigation, and contribute to permanent hearing loss (Todd et al., 2015). Countries which face dangerous levels of noise pollution are India, United Kingdom, and United States.

Noise pollution can originate from aircraft take-off and landing. In US, there are federal standards and guidelines for highway and aircraft noise management while different states and local governments typically have very specific statutes on building codes, urban planning, and roadway development (Boutatis, 2001).

Noise originating from aircraft continues to be a problem at many airports and the subject of many studies (Ramita & Laksmono, 2011; Sintorini, Hutapea, & Vicaksono, 2009; Sutopo, Rianto, & Ng, 2012). However, these studies did not examine the impact of noise and air pollution, namely smog, on the tourism industry

Smog is a type of air pollutant. The term 'smog' was coined in the early 20$^{th}$ century as a portmanteau of the words smoke and fog to refer to smoky fog, and describes its opacity, and odour. Modern day smog, like in Los Angeles for example, is a type of air pollution derived from vehicular emission from internal combustion engines and industrial fumes that react in the atmosphere with sunlight to form secondary pollutants; these combine with the primary emissions to form photochemical smog (Kaufman, Espey, & Englin, 1996). In cities such as Delhi, smog severity is often aggravated by stubble burning in neighbouring agricultural

areas. The atmospheric pollution levels of Los Angeles, Beijing, Delhi, Mexico City, Tehran and other cities are increased by inversion that traps pollution close to the ground. It is usually highly toxic to humans and can cause severe sickness, shortens life or eventual death. Causes of smog are coal, transport emissions, photochemical smog, and natural causes (Rani, Singh, Chuhan, Sharma, & Maheshwari, 2011).

Smog is a serious problem in many cities and continues to poses risks to human health (Grimm et al., 2008). Ground-level ozone, sulphur dioxide, nitrogen dioxide and carbon monoxide are especially harmful for the elderly, children, and people with heart and lung conditions such as emphysema, bronchitis, and asthma. It can inflame breathing passages, decrease the lungs' working capacity leading to shortness of breath and pain when inhaling deeply, wheezing, and coughing. It can cause eye and nose irritation and it dries out the protective membranes of the nose and throat and interferes with the body's ability to fight infection, increasing susceptibility to illnesses (Liu et al., 2016). Hospital admissions and respiratory deaths often increase during periods when ozone levels are high. Delhi (India), Beijing (China), London (UK), Mexico City (Mexico), Santiago (Chile), Tehran (Iran), Los Angeles (US), Ulaanbaatar (Mongolia), Pakistan, Indonesia (Southeast Asia) are examples of places that are affected by smog.

In airports, fog often causes inconvenience to passengers in addition to increasing risks of accidents due to decreased visibility and bad weather; it (smog) also can cause delay in arrival and take-off contributing to air traffic at a busy airports.

Therefore, the quality of service at the airport can be significantly affected by pollution. Therefore, the aim of this research is to offer solutions on improving quality of service at Sultan Mahmud Badaruddin II Palembang international airport by following recommended safety standards and guidelines which will be discussed in this paper.

## METHODS

This study looks at two variables: air pollution/smog and noise. This is a descriptive research and adopts a qualitative method. It is a cross sectional study of Sultan Mahmud Badaruddin II Palembang International Airport Observation and survey questionnaire methods were used to obtain data related to management of noise and smog pollution at Sultan Mahmud Badaruddin II Palembang International Airport. The sample size was 90 passengers and data was analysed using SPSS IBM 22.0 for windows.

### Noise Analysis in SMB II Palembang

Sound is a sensation or feeling generated by the human auditory organ when the sound waves are formed in the air through the vibrations it receives. Sound waves are longitudinal as it enters the ear at a frequency 20-20000 Hz; the so-called range of audible sound intensity level is expressed in units of bel or decibel (dB). Noise pollution or noise can be defined as unwanted sound causing disturbances. Thus, sounds which are not desirable are considered noise.

Sultan Mahmud Badaruddin II Palembang International Airport is the only airport in South Sumatra Therefore, it must meet the international and global requirements and specifications. One of it is the airport must be free of obstructions, fixed and mobile.

When calculating the effects of noise on health and quality of life, the focus should be on the intensity of the sound, which is calculated with a scale of decibels (dB). Airports can be regarded as the greatest source of noise. When someone's house is in the flight path, the noise level can reach 130-150 dB. At a busy airport, even when there are no planes taking off or landing, the noise effects can still be felt 15 miles away. According to a research by The National Institute for Occupational Safety and Health, US, only a maximum exposure of 85 dB and for a maximum period of 8 hours per day is permissible, even with ear protectors.

The decree by the Indonesia Minister of Environment No. 48 of 1996 on Noise has not set the standard for the areas surrounding the airport. In addition, the worldwide regulation governing flight safety has changed and the airport should adopt international standards to ensure passenger safety.

The runaway at Sultan Mahmud Badaruddin II Palembang International Airport is far from residential homes and public facilities and hence, it is safe (see Figure 1). It means that Sultan Mahmud Badaruddin II Palembang International Airport has proper environmental safeguards and safety for the community.

*Figure 1.* Aerial Photographs International Airport Sultan Mahmud Badaruddin II Palembang

In managing the existing noise at the airport, the building has a good sound proof system. The thickness of the glass and the spaciousness of the building (road space and the lounge) ensures the noise level is manageable (see Figure 2) so that the noise does not become a problem to negatively impact airport service quality

Passengers who have to board the aircraft at the field when the jet-bridge cannot be used at that time usually face problems with the noise. Some passengers are not satisfied with the surrounding because of the noise (see Table 1 and Table 2). Employees working in the

field as the ramp agent usually wear earmuffs, but are still exposed to noise. A research by Sintorini shows the percentage of the employee's suffering from hearing disorders (see Table 3). However, the airport regulation for employees to use earmuff is sometimes not adhered to the latter. In this regard, the airport should be more assertive.

Table 1
*Aircraft noise level*

| No. | Aircraft Seri | Time | Landing (dB(A)) | Take off (dB(A)) |
|---|---|---|---|---|
| 1 | Garuda B737 Seri 800 | 09.00 | 83 | - |
| 2 | Wings Air ATR 72 | 09.00 | 83 | - |
| 3 | Wings Air ATR 72 | 09.20 | - | 83.1 |
| 4 | Lion Air B737 Seri 900 | 09.35 | 89.7 | - |
| 5 | Garuda B737 Seri 800 | 09.40 | - | 72.9 |
| 6 | Lion Air B737 Seri 900 | 10.15 | - | 71.1 |
| 7 | Merpati MA 60 | 10.20 | 70.2 | - |
| 8 | Sriwijaya B737 Seri 200 | 10.35 | 97.6 | - |
| 9 | Garuda B737 Seri 800 | 10.55 | 91 | - |
| 10 | Sriwijaya B737 Seri 200 | 11.00 | 97 | - |

Table 2
*Summary of airport experience in Sultan Mahmud Badaruddin Ii Palembang International Airport*

| No. | Sub Variable | Score Total | Number of Questions | Average Score | % |
|---|---|---|---|---|---|
| 1. | *Experience of park* | 480 | 1 | 480 | 12.46 |
| 2. | *Experience of Security Screening* | 477 | 1 | 477 | 12,39 |
| 3. | *Experience of queued check-in* | 472 | 1 | 472 | 12,26 |
| 4. | *Experience of Check-in Process* | 475 | 1 | 475 | 12,33 |
| 5. | *Experience of Airport Environment* | 496 | 1 | 496 | 12,88 |
| 6. | *Experience of Airport Facilities* | 484 | 1 | 484 | 12,57 |
| 7. | *Experience of Disembark from Airplane* | 485 | 1 | 485 | 12,59 |
| 8. | *Experience of Out from Airport* | 482 | 1 | 482 | 12,53 |
| | Total | 3851 | 8 | 3851 | 100 |

Table 3
*Hearing disorders of Airport employees*

| Disorders | Sum (People) | Percentage (%) |
|---|---|---|
| Hearing Disorders during work | 27 | 22,5 |
| Enhancement of Hearing Disorders | 16 | 13,3 |

*Figure 2.* Layered glass walls at the waiting room and corridor

## Smog or smoke fog

Smog or smoke fog is the result of anthropogenic activities that increase air pollution that are harmful to the environment and humans. Smog occurs when sunlight reacts with emissions of pollutants from motor vehicles, industries, paints, solvents and gasoline fumes. This reaction leads to formation of ground-level ozone, a major component of smog.

Smog or smoke fog in Palembang is caused by forest fires in Kalimantan and Pekanbaru whereby the combustion fumes covers Palembang affecting its visibility. It is a big problem affecting airport operations. Public Relations Manager of Angkasa Pura II Achmad Syahir said on September 2016, many airports were affected by smog, among them were Palembang, Pontianak, Jambi, Pekanbaru, whereby the visibility ranged from under 200 meters to 1,000 meters.

The smog increases flight hours as the aircraft attempts to land and also increases the air age of aircraft faster than it should and thus, maintenance costs become costly. This shows that the smog not only impacts on passengers but also the airlines.

In other parts of the world such as London, fog is a big problem. According to telegraph.co.uk, on December 17, 2016, 50 flights were cancelled due to fog that covered Heathrow airport. In Abu Dhabi, flights were delayed for four hours due to heavy fog. This certainly has an adverse impact on passengers because they have to wait longer. Described in a study, traffic barriers such as flight delays, automobile accidents due to poor visibility are the most common negative effects of fog.

Usually, there is a delay of one or two days at Sultan Mahmud Badaruddin II Palembang airport due to smog c and passengers admitted to being uncomfortable due to the pollution. Figure 3 shows that that 63% were unhappy over the services provided by the airport. Lack of maintenance or improvement is another grievance whereby some passengers found themselves sitting on the floor due to lack of seats. This gives a negative impression of the airport (see Figure 4).

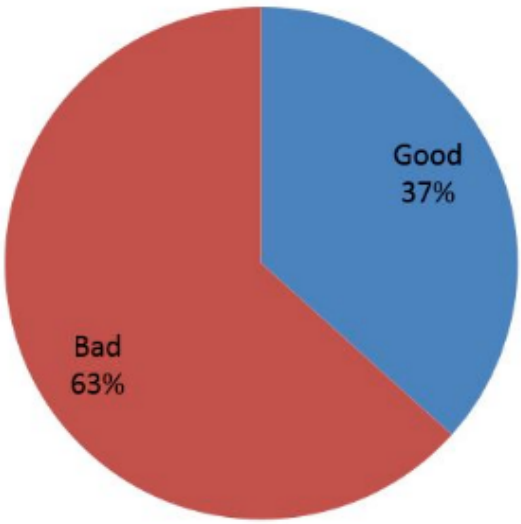


*Figure 3.* Passenger Perception of smog at Sultan Mahmud Badaruddin II Palembang International Airport

*Figure 4.* . The atmosphere in the SMB II Palembang Airport

It was found diversion received the lowest votes including the review of the maintenance carried out by the airport in case of urgent matters such as providing additional seats.

Table 4
*Summary of airport experience in Sultan Mahmud Badaruddin Ii Palembang International Airport*

| No. | Sub Variable | Score Total | Number of Questions | Average Score | % |
|---|---|---|---|---|---|
| 1. | *function* | 5738 | 12 | 478.17 | 34.63 |
| 2. | *Interaction* | 1,397 | 3 | 456.67 | 33.07 |
| 3. | *Diversion* | 4907 | 11 | 446.09 | 32.30 |
| | Total | 12 042 | 26 | 1380.93 | 100 |

Nevertheless, the airport has attempted to provide additional seats at the airport lounge. Thus, it is clear smog can be a major problem if didn't deal with immediately as it directly impacts on tourism as well as airport operations. Another option is to provide free gas masks to passengers but it is only a short-term solution.

## CONCLUSION

Based on the analysis, it can be concluded that the noise and smog management at Sultan Mahmud Badaruddin II Airport in Palembang is acceptable. The effects of noise are minimised and the runway is far from residences which is consistent with international standards. Smog on the other remains an issue due to its adverse effect on health. Its management can be improved.

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# The Effect of Environment Temperature and Humidity on Corrosion Rate of a Condensing Unit

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## ABSTRACT

This study aims to determine the rate of corrosion of a condensing unit. Condensing unit is the main component of a split air conditioner which is installed outside a building (outdoor) and is always exposed to the elements as well humidity. Such conditions make the condensing unit vulnerable to corrosion. Further, the corrosion affects the performance of the air conditioner. Temperature and humidity (air velocity, hot and cold temperature) greatly affect the corrosion rate. This is an experimental study and data was based on observation and analysed using the formula corrosion rate. The results indicate that $FeFe_2O_4$ and FeO compounds affect corrosion rate. Specifically, the rate of corrosion on the metal plate of condensing units is 0.054 millimetres per year (mpy) at an ambient temperature of 30°C and 85% humidity.

*Keywords:* Atmospheric, condensing, corrosion, humidity, metal

## INTRODUCTION

Condensing unit (or outdoor unit) of a split air conditioner is a main component installed outside a building. It is usually placed on the roof or wall of a building, which is exposed to sunlight, hot and cold air, and humid wind (Tidblad et al., 2016). Such conditions can potentially lead to corrosion of the condensing unit (Azwar, 2011). The metal plate which is exposed to outside air and affected by the temperature and humidity can cause corrosion (Simillion, Dolgikh, Terryn, & Deconinck, 2014). The quality of metal plate determines the rate of corrosion and its corrosion will affect the heat transfer process. Therefore, the heat must be removed from the room via conduction and convection. A delayed process of removing the heat will interfere with the phase change of the refrigerant in

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the condensing unit. The refrigerant generated by the condensing unit contains liquid and gas phases. Supposedly, the phase of the refrigerant is in the form of liquid. Corrosion of the condensing unit degrades its performance and inefficient electrical consumption. The air it produces is also less cold.

The rate of corrosion on each metal plate varies, depending on the quality, thickness and environment conditions. Plates which have good quality and thickness tend to have lower corrosion rate. Good environments also reduce the rate of corrosion of metal plates. The corrosion rate is influenced by the layer (coating) covering the plates. The quality and thickness of the layer tend to restrain the rate of corrosion of the metal plates. The corrosion rate of metal plates is also affected by the duration of contact with the environments. Environments containing high salt and moisture levels tend to accelerate the rate of corrosion (Mohammedi, Ismail, Rehamnia, Bensalem ,& Savadogo, 2015). Thus, the rate of corrosion of metal plates of a condensing unit is influenced by several factors, including: quality, thickness, layer (coating) and environmental conditions. No previous stuy has specifically measured the corrosion rate of a metal plate on a condensing unit. The current research focuses on corrosion in marine environments, steel pipes, copper pipes, aluminium, pollution and its inhibitors.

Environmental temperature and humidity accelerate the growth of microorganisms on a plate in the condensing unit. These microorganisms will accelerate the corrosion on the surface of the metal plate. The microorganisms that affect corrosion rate among others are bacteria, fungi, algae, and protozoa (Venzlaff et al., 2013). Corrosion has a major influence on the degradation of the material in the environment (Vasudevan & Sadananda, 2015). The effect of initiation or the rate of corrosion in an area and microorganisms are associated with the surface. Corrosion attaches to the metal surface in the form of a thin layer (bio deposit) and a thin film layer (biofilm). The film layer usually appears in a circle form with a certain diameter. If it is exposed to the environment, it can cause localised corrosion. Organisms in the deposit layers have a profound effect on chemicals in the environment between the surface of the metal/film or metal/deposit without considering the effect of the bulk electrolyte property (Dyah, Agung, & Bagusnovan, 2013).

Corrosion is an electrochemical process. In corrosion on a metal plate, a certain part of the iron plates acts as anode, so that the metal plate experiences oxidation [22].

$$Fe(s) \leftrightarrow Fe^{2+}(aq) + 2e \quad E^{o} = +0.44 \text{ V}$$

The electrons released by the anode flow to other parts of the iron which acts as the cathode, so that oxygen is reduced.

$$O_2(g) + 2H_2O(l) + 4e \leftrightarrow 4OH\text{-}(aq) \quad E^{o} = +0.40 \text{ V}$$

or

$$O_2(g) + 4H+(aq) + 4e \leftrightarrow 2H_2O(l) \quad E^{o} = +1.23 \text{ V}$$

Iron ions formed on the anode are then oxidised to form ferric ion, which then forms the compound of hydrated oxide, $Fe_2O_3$. $xH_2O$, that is rust. The part of the iron that acts as an anode and acts as the cathode depend on various factors, such as impurities or density differences of the metal. Due to the migration of ions and electrons, rust is often formed in areas far from the surface of the corroded iron (Valeh-e-Sheyda & Rashidi, 2016). The colour of the s from yellow to brownish red and even black. The colour depends on the amount of $H_2O$ molecules bound to rust. The rate of corrosion is defined as the amount of metal that is lost or removed from the area of the anode or the number of deposited metal (plating) on the cathode area (Cui, Li, Yang, & Wei, 2015; Kuang & Cheng, 2016).

## MATERIALS AND METHODS

This is an experimental research to determining the rate of corrosion (weight loss) of a metal plate on a condensing unit (Baboian, 1995). The equation used (Priest, 1992) is:

$$\text{Corrosion rate} = \frac{W.K}{A.T.D}$$

Information:

The corrosion rate = millimetres per year (mpy)

W = weight loss (mg)

A = area expanded in the corrosion environment ($cm^2$)

T = soaking time (hours)

D = density ($g/cm^3$)

K = constant of corrosion rate = 534

The experiment was conducted on the metal plate of a split air conditioner condensing unit (Panasonic). The metal plate casing of the condensing unit was removed and two sample sizes were made: 40x20x0.75mm and 200x100x0.75mm. The first sample was soaked in a solution of NaCl and the second sample was used for the atmospheric environment. The metal plate sample surface was cleaned thoroughly using sandpaper 80, 240, 600, 800 and 1000 on a flat surface flowed with water. Surface cleaning was done on the samples mechanically, chemically, or both.

Every corner of the samples was cleaned to avoid any tension concentration that leads to corrosion due to cracking. The samples must be clean of all contaminants (dust, oil and rust products). Sanding must be done very carefully to avoid the high temperature on the surface as it can affect the microstructure of the sample. Data related to weight, dimensions and serial number of the samples were recorded and the surface was photographed prior to the experiment. The metal plates were later rinsed with distilled water and ethanol to ensure it did not damage their structure. The samples were later dried and stored in a desiccator to prevent contamination and later weighed and measured. Analytical scale was used to determine the difference in weight pre-and post-corrosion. Four samples were hung in atmospheric conditions. Four other samples were immersed in the solution of NaCl with NaCl concentration of 1.5%, 2.5% and

3.5% at different times. The NaCl concentration refers to the environmental conditions that may occur in Bandung.

The samples were soaked for 30 days. Cleaning and removal of corrosive products and all materials on the surface were done carefully before measuring the final weight. Information on location, time, depth measurement, surface profile (inflated or eroded) corrosive product or scale composition (the product formed because the soil had alkaline pH reacting with soil) and operating factors (inhibitors) were collated. In order to determine the corrosion rate with the weight loss method, pickling solution was required. The pickling solution was made of 5 grams of chloride lead and 2 grams of chloride antimony dissolved in 100 mL of concentrated hydrochloric acid.

The corroded samples were then inserted into the pickling solution for about 2 minutes, then washed with water, brushed with a soft brush so that the corrosive products disappeared, rinsed with distilled water and acetone, dried and weighed again. The difference in weight before and after corrosion is the weight loss. For each metal, this treatment was repeated three times before  Then, the corrosion rate and efficiency of the inhibitor at the time variation and NaCl were determined (Van den Steen, Simillion, Dolgikh, Terryn, & Deconinck, 2016).

## RESULTS AND DISCUSSIONS

Table 1 shows the value of the corrosion rate of the two samples in four conditions and corrosion time. The four samples were tested to determine the corrosion rate in two environments: sea water and atmosphere. They represent several conditions and duration. For the sea water condition, 1.5%, 2.5% and 3.5% NaCl respectively were used (Dwilaksono, Supomo, & Pribadi, 2013). Meanwhile, the atmospheric environment is the environment of Bandung with a temperature ranging from 20 to 31°C and humidity of 80-85%.

Table 1
*Calculation of corrosion rate*

| Sample Code | Surface Area ($in^2$) | Initial Weight (g) | Final Weight (g) | Difference of Weight (g) | Corrosion Rate (mpy) |
|---|---|---|---|---|---|
| | | | NaCl 1,5% | | |
| A1 | 2.671 | 4.451 | 4.434 | 0.017 | 0.107 |
| A2 | 2.732 | 4.393 | 4.377 | 0.016 | 0.049 |
| A3 | 2.876 | 4.650 | 4.633 | 0.018 | 0.034 |
| A4 | 2.755 | 4.518 | 4.501 | 0.017 | 0.027 |
| | | | Average | 0.017 | 0,054 |
| | | | NaCl 2,5% | | |
| B1 | 2.950 | 4.797 | 4.780 | 0.017 | 0.097 |
| B2 | 2.684 | 4.371 | 4.355 | 0.016 | 0.051 |
| B3 | 3.001 | 4.894 | 4.876 | 0.018 | 0.034 |
| B4 | 2.922 | 4.743 | 4.727 | 0.016 | 0.023 |
| | | | Average | 0.017 | 0.051 |

Table 1 *(continue)*

| | | | | | |
|---|---|---|---|---|---|
| | | | NaCl 3,5% | | |
| C1 | 3.078 | 5.012 | 4.996 | 0.016 | 0.087 |
| C2 | 2.908 | 4.617 | 4.603 | 0.014 | 0.039 |
| C3 | 3.011 | 4.903 | 4.887 | 0.016 | 0.030 |
| C4 | 2.758 | 4.465 | 4.453 | 0.012 | 0.018 |
| | | | Average | 0.015 | 0.044 |
| | | | Atmospheric Environment | | |
| D1 | 63.322 | 110.042 | 109.673 | 0.370 | 0.0493 |
| D2 | 62.759 | 109.014 | 109.013 | 0.001 | 0.0001 |
| D3 | 63.399 | 110.239 | 110.242 | 0.003 | 0.0003 |
| D4 | 62.867 | 108.996 | 109.001 | 0.005 | 0.0003 |
| | | | Average | 0.095 | 0.0013 |

The metal corrosion rate (Figure 1) in the 30 day-corrosion test has the highest value on any test conditions with 1.5% NaCl. Meanwhile, the longer the corrosion test took in each of the test conditions, the lower the rate of corrosion. This is due to the formation of a layer of oxide iron $Fe_2O_3$ which can inhibit the corrosion rate. The addition of 3.5% NaCl concentration caused the corrosion rate of carbon metal to decrease (Karthikeyan, Raja, Balan, & Jeeva, 2015). This means that the greater the concentration of NaCl, the slower the rate of corrosion. This is due to increased viscosity of the solution so that the movement of ions in the solution is reduced. Consequently, the conductivity of the solution and the corrosion current density decreases.

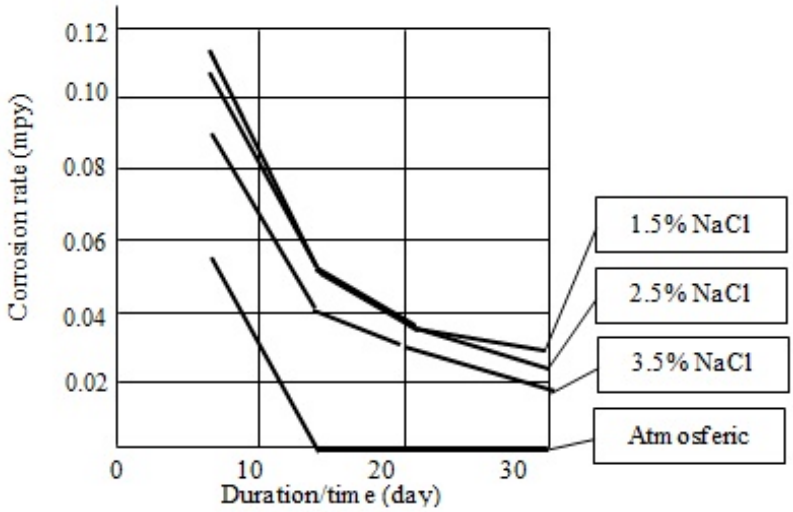


*Figure 1.* Corrosion rate based on duration in four NaCl conditions

The results show that the corrosion rate in NaCl 1.5% is higher and faster than in any other solutions (Khireche, Boughrara, Kadri, Hamadou, & Benbrahim, 2014), based on the same duration but with a different concentration of the solution. Testing at atmospheric conditions shows that the corrosion rate tends to decrease during longer periods. The value of the corrosion rate in the atmospheric conditions is smaller than in salt water environments. The corrosion rate becomes stable after reaching a certain time. This is due to the resistor of the corrosion rate and residue from the previous corrosion.

Morphological characterisation test was also done to the metal plates whereby those which had not been subject to corrosion were characterised using SEM EDS. The results were compared to carbon metal plates which had been corroded (Hadi & Jumarlis, 2013). Characterisations of the metal plates before and after preparation were obtained. The test was done to observe the surface of the metal plates, which was compared to the corroded ones.

Carbon metal plates that had been corroded were characterised using SEM EDS. Figure 2a and 2b shows the metal plates which were corroded and not corroded. The damage was significant which also saw formation ofcracks. The occurrence of corrosion cracks on the surface of the metal samples indicate. the metal plates have lost their strength and influenced the heat transfer process (Nasrazadani & Nakka, 2016). As the casings are always exposed to vibration from the compressor, the cracks caused the plates to break and chip easily.

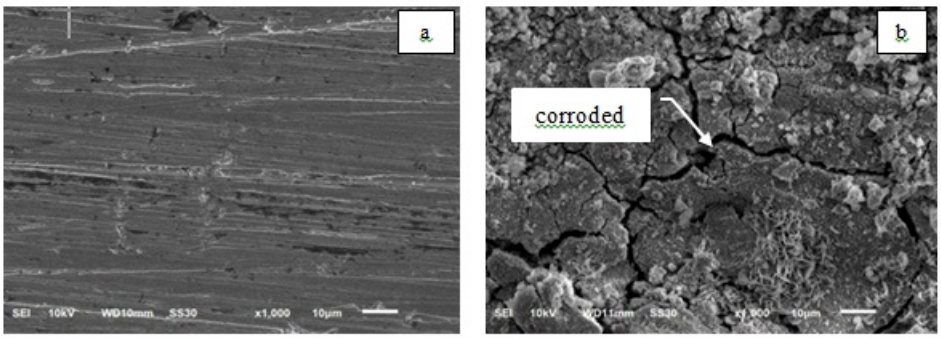


*Figure 2.* SEM images of surface before (a) and after (b) corrosion process

The results of EDS (energy dispersive x-ray spectroscopy) of the metal specimens are presented in Table 2. It was observed that there was a weight loss of 6.1% (5.7 grams) of FeO oxide compound in the initial specimens before the corrosion. At the beginning, the specimen contained 93.9% FeO. After the corrosion, it decreased to 88.2%. This suggests that Fe reacted to its aggresive environments during the test and turned into corrosion products (Finšgar & Jackson, 2015).

Table 2
*Results of metal EDS API 5L X52 M PSL 2 in the form of oxide*

| Compound | Weight pre corrosion (%) | Weight post corrosion (%) |
|---|---|---|
| C | 4,14 | 0,23 |
| FeO | 93,89 | 88,16 |
| $SiO_2$ | 0,57 | 0,71 |
| N | - | 10,40 |
| $P_2O_5$ | 0,11 | - |
| MnO | 0,95 | 0,15 |
| $SO_3$ | - | 0,34 |
| $Nb_2O_5$ | 0,20 | - |
| $Ti_2O_3$ | 0,13 | - |
| $V_2O_5$ | | 0,00 |
| Total | 100,0 | 100,0 |

The analysis using XRD was aimed to determine the types of compounds generated by the corrosion on the metal plates. Metals analysed using XRD are those which had been corroded and had the largest corrosion rate (Araban, Kahram, & Rezakhani, 2016). The XRD analysis results indicate (Figure 3) the formation of corrosive products of $FeFe_2O_4$ and FeO. Both have the highest peak at 44.6 indicating the presence of Fe as the most dominant metal compound. The two compounds have the highest corrosion rate or the most vulnerable compounds to corrosion (Zeng, Lillard, & Cong, 2016).

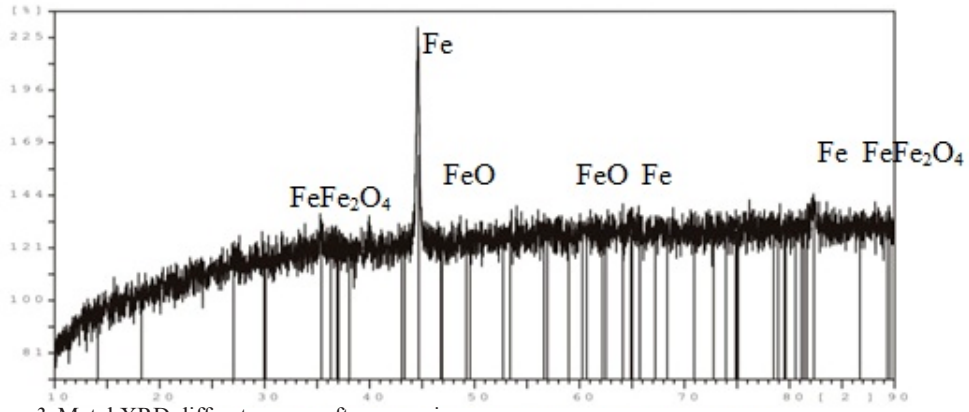


*Figure 3.* Metal XRD diffractograms after corrosion

## CONCLUSION

It can be concluded that the metal plate of the split AC casing is subject to rapid corrosions in environments with 1.5% NaCl concentrations but not in humid environments. The results of SEM EDS analysis of the damage level caused by corrosion is characterised by the presence of cracks on the surface of the samples. The compound corrosion products are $FeFe_2O_4$ and

FeO. These compounds have the highest corrosion rate or are the most vulnerable to corrosion. The corrosion rate of a condensing unit metal plate is 0.054 mpy in environments containing 1.5% NaCl. The value of the corrosion rate is acceptable because it does not quickly damage the coating of metal plates. A corrosion rate of 0.1 mpy or more will quickly damage the metal plates. Thus, it is recommended that the metal plates are cleaned and coated with anti-rust.

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# Chemical Characteristics and Sensory Properties of Biscuits using Modified Potato Flour

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## ABSTRACT

Consumer demand for composite flour-based biscuit has increased. 'Healthy biscuits' containing fibre as functional food has become a trend. This study examined the properties of biscuits made from modified potato flour. Resistant starch in modified potato flour may serve as dietary fibre and hence, the purpose of this study was to determine the chemical characteristics and sensory properties of these biscuits. Therefore, the modified potato flour was subjected to two different treatments in order to examine its properties: a) three heat treatment: boiling, steaming, and baking, b) substituting it at10, 20, 30, and 40% levels respectively. Results showed that biscuit substituted with modified potato flour was acceptable to consumers based on sensory assessment. Different heat treatment did not have an effect on biscuit taste. Biscuits made from 40% modified potato flour contains a good source of 6.49% dietary fibre, and fat, protein, ash and moisture contents of 28.5%, 9.90%, 0.02%, and 4.04% respectively.

*Keywords:* Biscuit, chemical characteristics, modified potato flour, sensory properties

## INTRODUCTION

Biscuits are usually considered unhealthy due to their high fat and high sugar content. However, traditional biscuits can be healthier source of food if they are made from modified potato flour to have fewer calories and extra nutrients with superior quality and flavour (Boobier, Baker, & Davies, 2006). This is considered functional food which can be natural, where a component has been added or where the nature of one or more food components have been modified, or any combination of these (Gibson & Williams, 2000).

Consumer demand for composite flour-based biscuit has increased. Table 1 lists the studies that focused on the properties of biscuits made from modified and combination

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of different flour. Biscuits made from blends of cowpea flour and wheat flour was acceptable to consumers as they had increased protein content (Akubor, 2003). The incorporation of buckwheat in composite flour has beneficial nutraceutical properties and its gluten-free nature has a role in preventing celiac problem (Baljeet, Ritika, & Roshan, 2010). Biscuits that contain mango peels and kernel powder are more nutritional and have antioxidant properties (Ashoush & Gadallah, 2011). Cookies made from legume flour have high protein content as well as resistant starch (Aziah & Noor, 2012). Biscuits made from oat flour, finger millet flour, pigeon pea flour and green gram flour with wheat flour meet the protein needs of humans (Serrem, de Kock, & Taylor, 2011)

Table 1
*Current reports on biscuit modifications*

| Materials and method | Results | References |
|---|---|---|
| Using 30% cowpea flour to substitute plantain flour | The Cow Pea Plantain Flour (CPF) biscuit acceptable to consumers based on the -+flavour, texture, and overall acceptability. High protein content with increased CPF in the blend. | (Akubor, 2003) |
| Using buckwheat flour to make biscuits | Biscuits made from 20% and 30% buckwheat flour acceptable to consumers. | (Baljeet et al., 2010) |
| Using mango peel powder (MPP) and mango kernel powder (MKP) to make biscuits | The antioxidant properties of biscuit made from MPP and MKP increased. Mango-flavoured biscuits were good source of nutrient using to 10% MPP and up to 40% MKP | (Ashoush & Gadallah, 2011) |
| Substituting wheat flour with legume flour (mung bean and chick pea) in cookies. | Chickpea cookies made of 50% wheat flour + 35% chickpea flour + 15% corn flour had the best flavour, crispiness and acceptability and high protein and resistant starch content. | (Aziah & Noor, 2012) |
| Mixing oat flour, finger millet flour, pigeon pea flour and green gram flour with wheat flour in different proportions (i.e. 0%, 10%, 25% and 50%) along with fenugreek leaf/ fenugreek powder to make biscuits | Biscuit acceptable to consumers and meet the needs of protein | Serrem, de Kock, & Taylor, 2011) |

Gluten-free biscuit with high-fibre has become an industry wide trend (Hosafci, 2016). Resistant starch (RS) may serve as dietary fibre and deliver a positive impact on health. However, further studies into its beneficial effects are crucial (Leszczynski, 2004). The RS has low impact on the sensory properties due to its swelling capacity, viscosity, gel formation and water-binding capacity which makes it popular in a variety of foods (Ashraf, Anjum, Nadeem, & Riaz, 2012). In general, tubers and legumes have more RS than cereals. Among the selected foods, potato showed the highest amount of RS (Chen, Liu, Qin, Mph, & Zhang, 2010). Heat-cold treatment in potato starch can result in changes in type of RS. The RS in potato was originally type 2 (ungelatinised resistant granules) transformed into type 3 (retrograded starch) which is more

resistant to digestive enzyme, so, it acts as a prebiotic (Sajilata, Singhal, & Kulkarni, 2006; Wulan, Saparianti, Widjanarko, & Kurnaeni, 2006). Therefore, heat-cold treatment can be applied to modified potato flour used in manufacturing composite flour-biscuit.

The purpose of this study was to examine chemical characteristics and sensory properties of biscuit made from wheat flour substitute, namely modified potato flour. During the experiment, potato flour was modified physically via heat treatment (boiling, steaming, and baking) and cooled. The modified potato flour was added as substitute to wheat flour and results showed that consumers liked the biscuit which had higher dietary fibre content compared with traditional biscuits. In addition, since the product was made from composite flour (modified potato flour and wheat flour), future study can examine positive health impacts of reduction in wheat flour consumption (containing gluten) and the product can be a potentially healthy biscuit and a good source of dietary fibre.

## MATERIALS AND METHODS

Materials used in this research were potato tubers obtained from a local farmer (Pangalengan, Indonesia). Wheat flour, full cream milk, refined sugar (100% sucrose) and butter were procured from local market in Bandung. Potato flour was modified physically. The research was conducted in several stages: (1) manufacture of physically modified potato flour, (2) analysis of characteristics of physically modified potato flour characteristics; (3) manufacture of biscuit made from wheat flour substitute i.e. physically modified potato flour; (4) analysis of chemical characteristics and sensory properties of biscuit.

The research method was based on split plot design. Two treatments were administered: the first consisted of three heat treatments: boiling, steaming, and baking; the second was substituting wheat flour with different proportions of modified potato flour, namely 10, 20, 30, and 40% respectively. If the calculated F value was greater than the interaction of the F value in the distribution table at the level of 5%, then Least Square design test would have been conducted. However, since there was no interaction, Duncan's multiple range test was carried out.

### Manufacturing Physically Modified Potato Flour

The first stage of this research was manufacturing physically modified potato flour using pre-heating. Potato tubers were cut into smaller size after cleaning, and then given heat treatment (boiling or steaming or baking). The potato tubers were then mashed into smaller particle and stored in the refrigerator with a temperature of 4°C for 24 hours. The potato was further dried at a temperature of 50°C until the weight became constant. It was later ground and sieved into modified potato flour.

### Manufacturing Biscuit Substituted Physically Modified Potato Flour

The biscuit was manufactured using a method proposed by Herudiyanto & Hudaya (2008). Physically modified potato flour was mixed with wheat flour at different proportions, namely 10%, 20%, 30%, 40% respectively; about 30% refined sugar (sucrose) was mixed and stirred

with 40% butter and 10% milk (based on total weight of composite flour). Later, composite flour and other ingredients were later stirred together to form a dough, then formed into the shape of biscuit and later baked at temperature of 160°C.

Chemical characteristics and sensory properties of biscuit were investigated. Analysis of chemical characteristics included moisture content, ash content, protein content, fat content and dietary fibre content. Sensory analysis was conducted using hedonic quality test for colour, taste and after taste with a scale of 1-5, where a value of 1 is very good, 2 is good, 3 is rather good, 4 is rather good, and 5 is very good.

## RESULTS AND DISCUSSIONS

### Characteristics of Physically Modified Potato Flour

Potato flour was modified physically using heat treatment. The heat treatments were boiling, steaming or baking. The characteristics of physically modified potato flour are shown in Table 2. The moisture content of modified potato flour is within the threshold levels of moisture content for wheat flour in Codex standard, not more than 15.5%. The flour which was baked had the lowest moisture content, 3.41%. This was due to the water being stripped away during baking and drying. This flour was expected to have the longest shelf life compared with the others. Ash content of modified potato flour ranged from 2.78 to 3.63 %. According to codex standard for flour, the limit for ash content depends on buyer preference. However, modified potato flour has less protein content, ranging between 1.04 and 1.11%. Thus, protein fortification in vital.

Table 2
*Characteristics of physically modified potato flour based on different methods of heat treatment*

| Characteristics of Modified Potato flour | Different methods of heat treatment | | |
|---|---|---|---|
| | Boiling | Steaming | Baking |
| Moisture content (%) | 8,87 | 8,56 | 3,41 |
| Ash content (%) | 2,78 | 3,54 | 3,63 |
| Protein content (%) | 1,04 | 1,07 | 1,11 |
| Water Solubility (%) | 11,41 | 12,79 | 13,77 |
| Water absorption capacity (%) | 139,90 | 134,95 | 135,90 |

Water Absorption Capacity (WAC) is the amount of water absorbed by the flour to achieve the desired consistency or optimal end result. The WAC of modified potato flour ranged from 134.95 to 139.90%, which means 134.95 to 139.90 lbs water is required for every 100 lbs of flour. According to Gahona, Rao, & Stanley, (2008), WAC will affect the final product attributes and the shelf life of baked products like biscuit. The water solubility of modified potato flour ranged between 11.41 and 13.77%. This was relatively higher than the solubility of cassava and sweet potato flour which ranged from 3.92 to 9. 37%. It was influenced by amylose and amylopectin characteristics (Kusumayanti, Handayani, & Santosa, 2015).

## Chemical Characteristics of Biscuit made for Physically Modified Potato Flour substitute

Moisture content

Results of analysis of variance showed that there was no association between the proportion of flour and heat treatment of modified potato flour in moisture content of biscuit. Test result of moisture content of biscuit made from physically modified potato flour is shown in Table 3.

Table 3
*Moisture content of biscuit made from physically modified potato flour substitute*

| Heat treatment of physically modified potato flour | Moisture content (%) |
|---|---|
| Boiling | 4.06[a] |
| Steaming | 3.99[a] |
| Baking | 4.02[a] |
| Substitution level of physically modified potato flour | Moisture content (%) |
| 10% | 4.00[a] |
| 20% | 4.04[a] |
| 30% | 4.02[a] |
| 40% | 4.04[a] |

*Description:* The average treatment marked with the same lowercase letters is not significantly different at the 5% significance level according to Duncan's multiple range test

According to Indonesian National Standard (2011), maximum moisture content of biscuit is 5%. Therefore, biscuit made from modified potato flour does meet quality standard. As it has a very low moisture content, it will have a high shelf life.

## Ash content

The result of analysis of variance showed that there was no association between the proportion of substitute flour and the different heat treatment in ash content of biscuit (see Table 4). Ash content is the mineral content in flour and is determined by measuring the amount of combustion residue flour on predetermined conditions. The flour's ash content varies and depends on many factors such as varieties of its raw materials (potato). Potato tubers contain little mineral, around 0.4%. (Burlingame, Mouille, & Charrondiere, 2009) Therefore, the ash content of modified potato flour is low.

Table 4
*Ash content of biscuit substituted physically modified potato flour*

| Heat treatment of physically modified potato flour | Ash content (%) |
|---|---|
| Boiling | 0.02[a] |
| Steaming | 0.02[a] |
| Baking | 0.02[a] |
| Substitution rate of physically modified potato flour | Ash content (%) |
| 10% | 0.02[a] |
| 20% | 0.02[a] |
| 30% | 0.02[a] |
| 40% | 0.02[a] |

*Description:* The average treatment marked with the same lowercase letters is not significantly different at the 5% significance level according to Duncan's multiple range test

**Protein content.** The results of analysis of variance showed that there was no association between the proportion of substituted flour and heat treatment of modified potato flour in protein content of biscuit (see Table 5). The Indonesian National Standard (2011) set minimal protein content of biscuit at 5%. The protein content of biscuit substituted with modified potato flour ranged between 9.71 and 10.09%.

Protein content of biscuit on various treatments remained unchanged. The different proportions of flour substitutes and different methods of flour modification did not affect the stability of the protein. The protein content was high enough, contributed by milk as one of the ingredients.

Table 5
*Protein content of biscuit substituted physically modified potato flour*

| Heat treatment of physically modified potato flour | Protein content (%) |
|---|---|
| Boiling | 10.09[a] |
| Steaming | 9.71[a] |
| Baking | 9.97[a] |
| Proportion of  modified potato flour | Protein content (%) |
| 10% | 9.93[a] |
| 20% | 9.95[a] |
| 30% | 9.90[a] |
| 40% | 9.90[a] |

*Description:* The average treatment marked with the same lowercase letters is not significantly different at the 5% significance level according to Duncan's multiple range test

**Fat content.** Result of analysis of variance showed that there was no interaction association between the proportion of substituted flour and different heat treatment on fat content of the biscuit (Table 6). The fat content ranged between 28.38 and 28.56%.

Table 6
*Fat content of biscuit made from modified potato flour*

| Heat treatment of physically modified potato flour | Fat content (%) |
|---|---|
| Boiling | 28.56[a] |
| Steaming | 28.51[a] |
| Baking | 28.38[a] |
| Proportion of physically modified potato flour | Fat content (%) |
| 10% | 28.43[a] |
| 20% | 28.41[a] |
| 30% | 28.55[a] |
| 40% | 28.55[a] |

*Description:* The average treatment marked with the same lowercase letters is not significantly different at the 5% significance level according to Duncan's multiple range test

Fat content of biscuit on various treatments remained unchanged. Despite difference in proportion of substituted flour and difference methods of treatment, the stability of fat was not affected. The source of fat wheat flour, modified potato flour and other ingredients such as milk, and butter.

**Dietary fibre content.** The result of analysis of variance showed that there was a significant difference between the proportion of substituted flour and different heat treatment of modified potato flour on dietary fibre content (see Table 7). Biscuit made with a proportion of modified potato flour by baking method has the highest dietary fibre content, 5.9%. It shows that baking can increase the dietary fibre content of flour. The increase in dietary fibre is due to the modified potato flour. Baking method causes a change in resistant starch (RS) from RS type 2 into RS type 3 as a result of a retrogradation process. RS type 3 is more resistant to digestive enzyme (Wulan et al., 2006).

Table 7
*Dietary fibre content of biscuit made from physically modified potato flour*

| Heat treatment of physically modified potato flour | Dietary fibre content (%) |
|---|---|
| Boiling | 3.76[a] |
| Steaming | 4.76[a] |
| Baking | 5.90[b] |
| Substitution rate of physically modified potato flour | Dietary fibre content (%) |
| 10% | 3.29[a] |
| 20% | 4.00[a] |
| 30% | 5.31[b] |
| 40% | 6.49[b] |

*Description:* The average treatment marked with the same lowercase letters is not significantly different at the 5% significance level according to Duncan's multiple range test

The higher the content of modified potato flour the higher dietary fibre of biscuit. A proportion of 30% and 40% shows significant differences in dietary fibre content (Table 7). The higher the content of modified potato flour, the more resistant the starch in the biscuit.

A food may be claimed as a source of dietary fibre if it contains 1.50-2.00 grams of fibre per serving. (Koen, Blaauw, & Wentzel-Viljoen, 2016) If we assume one serving is 35 grams, then 100 g of biscuit should contain at least 5.70 grams of fibre. Therefore, biscuits which are made from 40% modified potato flour can be claimed as a source of dietary fibre. In addition, based on the daily Dietary Recommended Allowance (RDA) of dietary fibre for women, 100 grams of biscuit made from 40% modified potato flour can supply 26% of daily fibre needs. According to RDA, the daily fibre requirement for adult women is 25 g per day (Koehler, Pareo-Tubbeh, Romero, Baumgartner, & Garry, 1997).

## Sensory Properties of Biscuit made from Substituted Modified Potato Flour

Result of analysis of variance showed that there was no association between the proportion of modified potato flour and different heat treatment in sensory properties (Table 8). Colour and taste of biscuit are important sensory attributes that affect the pleasure of eating. These attributes influence consumer choice based. The biscuit acceptable to consumers on the aspect of colour, taste and after taste with average score of panellist ranged between 2.54 and 3.75. There was no significant difference in the evaluation of colour and taste. These indicate that substitution of modified potato flour in biscuit and different heat methods of physically modified flour have no effect on sensory properties except the colour of the biscuit.

Table 8
*Effect of physically modified potato flour substitution on sensory properties of biscuit*

| Heat treatment of physically modified potato flour | Colour | Taste | After Taste |
|---|---|---|---|
| Boiling | 3.75[a] | 3.64[a] | 3.42[a] |
| Steaming | 3.71[a] | 3.61[a] | 3.41[a] |
| Baking | 1.91[b] | 2.54[a] | 2.63[a] |
| Substitution rate of physically modified potato flour | Colour | Taste | After Taste |
| 10% | 3.55[a] | 3.76[a] | 3.65[a] |
| 20% | 3.17[a] | 3.27[a] | 3.17[a] |
| 30% | 2.87[a] | 3.09[a] | 3.01[a] |
| 40% | 2.69[b] | 2.89[b] | 2.77[a] |

*Description:* The score was based on panellist. The average treatment marked with the same lowercase letters is not significantly different at the 5% significance level according to Duncan's multiple range test

Biscuits made from 40% modified potato flour that were baked had the lowest score. Thus, baking causes the colour of modified potato flour to turn brown due to enzymes. In addition, the process of caramelising sugar and flour in the dough witness a change in the colour of the biscuit to brownish yellow (Friedman, 1996). Therefore, the higher the content of modified potato flour the lower the colour score. However, proportion of the modified potato flour to the other types of flour and methods used had no significant effect on taste and after-taste of biscuit. This is inconsistent with Ashraf et al.'s findings (2012) that resistant starch has lower impact on the sensory properties of food.

## CONCLUSION

Biscuits made from modified potato flour is gaining popularity among consumers based on sensory assessment. The amount of modified potato flour and difference methods used to make biscuits had no significant effect on taste and after-taste of biscuit. Biscuits made with 40% of modified potato flour is a good source of dietary fibre (6.49%) and has a fat, protein, ash and moisture contents of 28.5%, 9.90 %, 0.02%, and 4.04% respectively.

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# Development of Android Application in Enhancing Learning in Japanese Kanji

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## ABSTRACT

This study is aimed at developing a suitable media for improving learning of Japanese kanji using an android application. The authors also examined the effectiveness of current application to learning basic Japanese. Utilising Information and Communication Technology (ICT) is not common. The media proposed in this study is also suitable for students who are learning independently. Further, this media is based on spacing effect theory, which has a huge impact in helping and improving long-term memory. Since the media uses an Android application, there is no age, grade, and level constraints. Further, the student is able to use the application wherever they are and whenever they have the time to learn. The media is also attractive, easy-to-use, and helps students to easily memorise Kanji.

*Keywords:* Android software, Kanji, Japanese character, media

## INTRODUCTION

Japanese is one of the most popular languages and widely learned as a foreign language around the world (Ryan, 2013). Japan is a powerful country that has contributed to the world in terms of its culture, language, art, design, technology, fashion and cuisine. People learn Japanese language for several reasons, namely for career and business development, intellectual stimulation, personal challenge, and cultural tolerance (Horng & Tsai, 2010).

The Japanese language has several scripts, such as Hiragana, Katakana, Romaji (Roman letters), and Kanji. (Bhatia, 1992) In daily life, those characters are used simultaneously. Students who learn Japanese as a second language in countries that uses only Roman letters find Kanji most challenging (Okuyama,

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2007). In order to learn and memorise Kanji well, a greater effort and media variation are required.

The ICT's positive contribution is also widely acknowledged in the field of education (Hennessy, Ruthven & Brindley, 2005). However, in Japanese language learning, especially Kanji, Power point or Adobe (Ukai, 1994) are the most popular media. University or school students learn Kanji using conventional methods such as dictionaries and textbook. In addition, memorising Kanji must be supported by the use of *kunyomi* and *onyomi* techniques. The *onyomi* is closer to the original Chinese language and is mostly used for nouns. One Kanji can have more than one *onyomi*. The kunyomi reading technique is used for traditional Japanese pronunciation. It is most frequently used in adjectives or verbs. Kanji can have multiple or single *onyomi* or *kunyomi* reading. The 1945 Kanji has been selected by the Japanese government as its official text. These so called "*toyo kanji*" also is also used in Japanese Language Proficiency Test (JLPT) have around 4000 readings. There are many constraints for learners as they need longer time to master the language and which often leads to boredom. Furthermore, these methods are not user friendly, especially for independent students and demotivates learning (Pizziconi, 2017).

## One way to learn Kanji effectively is via E-Learning

According to a 2013 Yahoo Mobile and Mindshare study, there were about 41.3 million smartphone users and 6 million tablet users in Indonesia, and that number predicted to increase 103.7 million and 16.2 million respectively in Indonesia in 2017. Therefore, it is crucial to develop user friendly learning applications to ensure more efficient learning of Japanese (Puspita & Fachira, 2014).

The purpose of this research was to develop an application that runs on the mobile phone operating system (Android) for learning Kanji. The Android operating system (OS) is an open source system for programmers who are beginners. Additionally, more Indonesians use Android Smartphone than IOS smartphone. This application is technology-based and mainly featured on the spacing effect to maximise the function of memorisation. Interestingly, this application can be downloaded and used independently anytime. Therefore, this paper examines the impact of the present application on student ability to grasp and attain basic Kanji reading abilities.

Many methods have been suggested to learn difficult languages, especially Kanji. According to Zhang & Takuma (2015) who examined Kanji for The Japan Kanji Aptitude Test (commonly known as Kanken), learners encountered the following problems: cost of purchasing workbooks and insufficient volume of question collected. In order to solve these problems, they developed a Kanji learning system that can automatically generate simulated *Kanken* tests based on Web search. However, this method is limited to web-based and only focused on the questions to learn *Kanken*. Nandi (2016) reported on learning kanji characters based on the combined meaning, i.e. the meaning of the basic characters (*Bushu*) with the meaning of the character-forming. However, this method is not interactive learning. Rusliani found basic kanji learning using power point, but this method uses non-interactive computer media (Rusliani, 2011).

## METHODS

### Application Development

Android applications are developed in Java programming language using Software Development Kit (SDK) which consists of a set of development tools, including the debugger (error search term), software libraries, handset-based emulator QEMU (an application in Linux emulation to run an operating system), documentation, sample code, and tutorials. Officially SDK is supported by the Integrated Development Environment (IDE) Eclipse, which uses an Android Development Tools (ADT) plugin. This 'Belajar Kanji' application can be run on Android version 4.0. The 'Belajar Kanji' application coding process is shown in Figure 1.

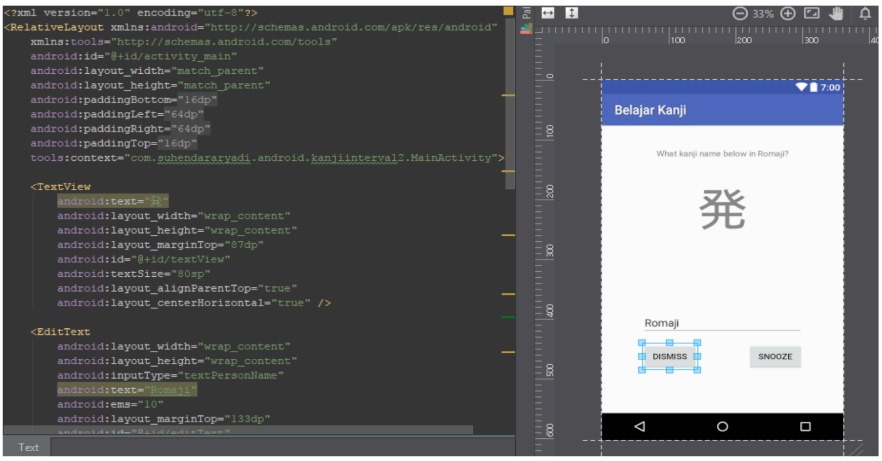


*Figure 1.* Coding process in making 'Belajar Kanji' application

The current study developed the application including the coding process (see Figure 1) of 'Belajar Kanji' within 10 months with the help of tutorials (Abdillah, 2013). This video describes how to make an application starting from finding the right video tutorial with the same case, which is how to build an alarm for Android. Then, the authors collected various materials to complete the application making, including personal computer, an Internet connection, SDK, IDE eclipse, ADT plugin, and various tips for constructing alarm applications on Android.

The next step is to create the application by following the steps of application making as indicated in the tutorial videos. After the application is constructed, the next step is to modify it, including its appearance and functions into the desired application looking at various sources (see https://github.com/; retrieved on December 25, 2016). The last step is trial and error, which is time consuming as the ultimate objective is to find the perfect application.

## RESULTS AND DISCUSSIONS

### 'Belajar Kanji' Android Application

'Belajar Kanji' is a kanji learning applications, interactive and easy to use. Everyone can use it with ease, and anytime and anywhere. This app is available on android. By applying the alarm feature, the users are always be reminded and challenged to learn kanji consistently. Figure 2 shows the photograph images of 'Belajar Kanji' application in android.

Figure 2 (a) shows when users download and install the application on the Android smartphone, it is viewed on the smartphone menu. As seen in Figure 2 (a), the application is named 'Belajar Kanji' with a logo like a *torii* (*torii* is a traditional Japanese gate most commonly found at the entrance of or within a Shinto shrine, where it symbolically marks the transition from the profane to the sacred). When the user clicks on the application, Figure 2 (b) appears, which the initial view is when the user opens the application. The name of the application, and an alarm function appears. This figure shows the basic function of the application that has alarm function as a learning tool. Figure 2 (c) shows the view of setting alarm menu before start using the application. Next, the user is able to choose several options, including Daily Repeat option and Alarm Tone.

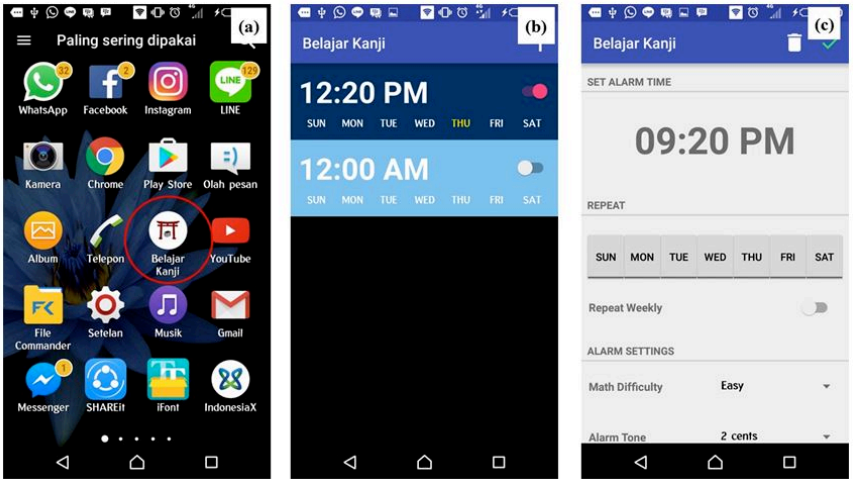


*Figure 2.* The photograph image of 'Belajar Kanji' application. Figure (a) shows the application installed on the Android smartphone (application named 'Belajar Kanji' with a logo like the one circled above), whereas figure (b) is the initial view when the user opens the application. Figure (c) shows the alarm setting before start using the application.

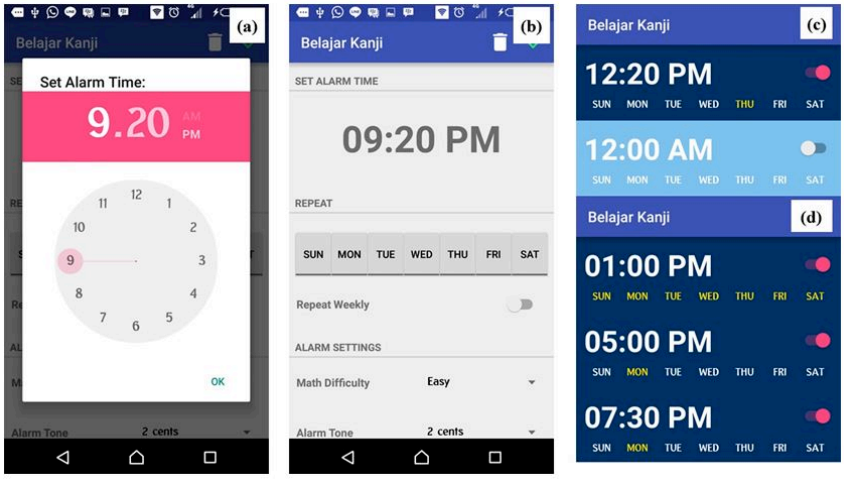


*Figure 3.* The photograph image of 'Belajar Kanji' application alarm settings. Figure (a) is the view of the time setting. Figure (b) is the option for alarm repetition (day or days). Figure (c) shows the alarm set, and figure (d) shows the alarms set on this study which include 3 sessions, at 01.00 PM, 05.00 PM, and 07.30 PM

After the user sets all options described above, the initial settings must be completed.

The next step is to set the time as shown in Figure 3 (a) – (d). Figure 3 (a) shows how to set the time, which can be done by choosing a particular time to set alarm, whereas Figure 3 (b) shows how the alarm to be set either daily or only at a particular day. After setting the alarm time and repetition, view such in Figure 3 (c) appears. The user can also create many alarms as shown in Figure 3 (d) which also indicates 3 alarms sessions per day, which are used in this study, at 01.00 PM, 05.00 PM, and 07.30 PM so that the experiment becomes more orderly and could be measured without adding variables.

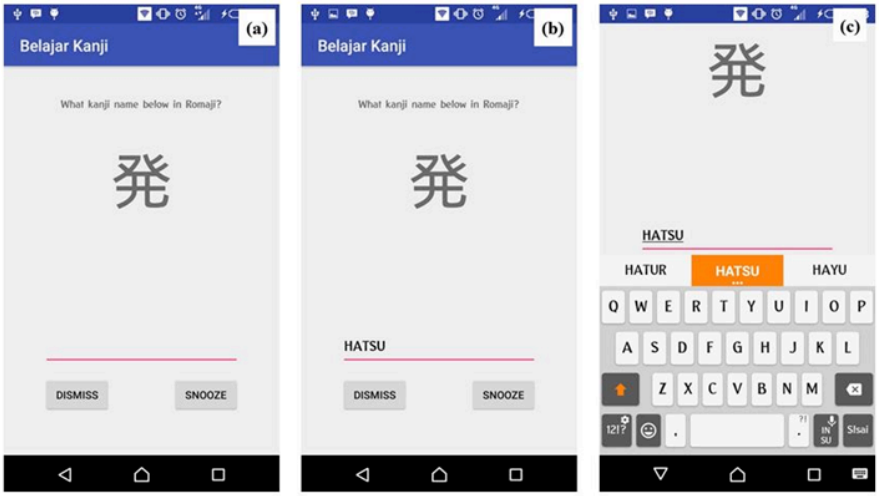


*Figure 4.* Image of 'Belajar Kanji' application operation appearance. Figure (a) is the view of Kanji when the alarm goes off. Figure (b) shows the space to write the answer (how to read) in Romaji. Figure (c) shows the image of the answer written in Kanji (HATSU)

Figure 4 (a) shows the Kanji exercise feature in 'Belajar Kanji'. Users will have to answer by writing how to read the Kanji in Romaji (Roman letters) in the available blank space as shown on Figure 4 (b). Users need to follow this rule: use capital letters for the answer (as shown in Figure 4 (c)). When they have done fulfilling the task, the 'Dismiss' and 'Snooze'button will appear as shown in Figure 4 (a). If the answer is incorrect, the Kanji will not change, and the alarm will ring or vibrate continuously. Users must erase the wrong answer and re-write the right answer. If answer is correct, the next Kanji will appear randomly and the process will be repeated 7 times per session.

The 'Belajar Kanji' uses kanji Japanese Language Proficiency Test (JLPT) database. The purpose of the JLPT is to evaluate and certify Japanese language proficiency of non-native speakers. It is the largest scale test for Japanese and used by many companies and universities to assess the Japanese language skills of applicants. There are 5 levels for the JLPT. Level 5 is entry level and Level 1 is the highest level of proficiency. The test is designed to assess reading and writing skills of applicants and also requires knowledge of vocabulary and grammar. The current application uses the standard JLPT level 5, because it is intended for novice learners as shown on Table 1.

Table 1
*Kanji list in 'Belajar Kanji'*

| Kanji | Romaji | Kanji | Romaji | Kanji | Romaji | Kanji | Romaji |
|---|---|---|---|---|---|---|---|
| 安 | AN | 会 | KAI, E | 月 | G E T S U , GATSU | 行 | KOU |
| 一 | ICHI, ITSU | 外 | GAI, GE | 見 | KEN | 高 | KOU |
| 飲 | IN | 学 | GAKU | 言 | GEN, GON | 国 | KOKU |
| 右 | U, YUU | 間 | KAN, KEN | 古 | KO | 今 | KON, KIN |
| 雨 | U | 気 | KI, KE | 五 | GO | 左 | SA |
| 駅 | EKI | 九 | KYUU, KU | 後 | GO, KOU | 三 | SAN |
| 円 | EN | 休 | KYUU | 午 | GO | 山 | SAN |
| 火 | KA | 魚 | GYO | 語 | GO | 四 | SHI |
| 花 | KA | 金 | KIN, KON | 校 | KOU | 子 | SHI, SU |
| 下 | KA, GE | 空 | KUU | 口 | KOU, KU | 耳 | JI |

## Experiments of "Belajar Kanji"

The study was based on an experiment whereby the kanji test was administered to 20 (twenty) beginner level of Japanese students in Universitas Pendidikan Indonesia, Indonesia. The students appeared puzzled when solving the tests even though they have studied Kanji. Many of the students gave up, and did not complete the test. We obtained their feedback on their ability to memorise Kanji. According to them, they did not memorise Kanji well enough,

and instead used *cramming* method on learning Kanji. *Cramming* is a method to memorize something in a short time. This method has been said to have an adverse impact on long-term memory (Dempster, 1988).

After administering the test, the students were questioned on the use of "Belajar Kanji" application. A set questionnaire containing five statements relating to the appearance and the function in the application were given to the sample. Based on the data, particularly in relation to the usefulness of the application in memorising and learning Kanji as well as the application's functions and user friendliness, the students rated them as "very good" (more than 90%). Therefore, this application can be categorised as useful and easy to be used. Most students responded that the content and features provided were useful for improving students' ability on memorising and learning Kanji.

## CONCLUSION

This study developed an Android application 'Belajar Kanji' for improving student ability to learning Japanese Kanji. The questionnaire results also showed positive responses from the students, confirming that the application was attractive, user friendly, and useful to help memorising Kanji. For example, setting the alarm at specific time (indeed, the alarm is equipped with question) will encourage the student to remember Kanji. If the student is not able to answer correctly, the alarm will not stop". In addition, since this media was made as an Android application, there is no limitation of age, grade, and level. Further, the student is able to use the application wherever and whenever they need.

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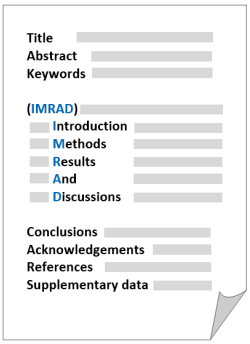


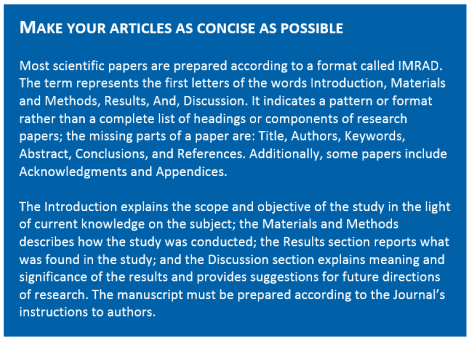


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