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Analysis and Development of Interface Design on DKI Jakarta & Tangerang'S Qlue Application based on Don Norman's 6 Design Principles

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Abstract—As government effort to embrace the social media trend, one of it by launching a mobile application called 'Qlue'. Initial study of user experince showed the result of questionnaire that was consisted of 6 questions from the six design principles from Don Norman regarding the UI of Qlue application, there are 2 things in Qlue that don't comply with six design principles from Don Norman. The 2 things are constraints and consistency. That was the reason for this research, to analyze and make a user interface for community service application which makes the usability easier based on the six design principles from Don Norman. The comparison between Qlue's user interface and the user interface was done by distributing the questionnaire that was consisted of 6 questions to the same respondents. Methodology used in this thesis is Task-Centered System Design (TCSD). Started with problem identification, analysis, UI redesign and evaluation. The result of this thesis is an UI that have a constraint which is a warning page that appeared before user finished writing a report and wanted to go back to previous page. The second result is a consistency of all report writing process and interface including buttons and icons. The conclusion of this research is that the revised proposed user interface has solved the problems that appeared on the UI of Qlue application.

Index Terms— Donald Norman, Six Design Principles, , Task-Centered System Design, TCSD, User Interface Analysis, Qlue.

I. INTRODUCTION

The large number of mobile phone users and active internet users through mobile phones is one of the opportunities that companies can use to enhance competitive advantage by developing mobile applications that provide services.

Application services that will be the primary object is an application called Qlue which provides reporting criminal acts that occurred in Indonesia to the local police station as its service. The application is integrated with the local police. Based on a report from the Central Bureau of Statistics, in 2015, their registration data revealed the number of crimes in Indonesia tends to fluctuate from year to year. In order for such criminal acts to be readily addressed by the local police force, the user may report criminal acts through this application.

Human Computer Interaction theory that match this research is six design principles from Don Norman. These principles contain standards and concepts that aim to allow users to understand the workings and usability for both a website design or a mobile application.

The questionnaire that contains the questions of Don Norman's design principles is distributed to 224 respondents (with Jakarta's population size 10 million, confidence level 90%, margin of error 5%) to find things that are inconsistent with Don Norman's 6 design principles in the Qlue application. Based on the results of the questionnaire, there are two design principles that are not met in the Qlue application; which are constraint and consistency. Constraint refers to determining ways of restricting the kind of user interaction that can take place at a given moment. While consistency is the principle that standardized the consistency of a UI visual design.

II. LITERATURE REVIEW

A. Six Design Principles

Through his book Design of Everyday Things, Donald Norman explains the guidelines for making good designs using the objects people use every day [1]. Here are 6 key guidelines proposed by Donald Norman:

1. Discoverability. Discoverability is whether user may find how to use an object by interacting with the object.

2. Affordances. Affordance is the visual attribute of an object or control that gives the user a clue of how the object or control can be used.

3. Mapping. Pressing a button or activating a control will usually trigger the system to perform some functions. There is a relationship or mapping between control and its effects.

4. Constraints. Provide limits on what an object might do.

5. Feedback. Feedback is important to help users understand how to interact with objects and what effect our actions have on the system. The purpose of the feedback is to provide confirmation to the user whether an action has been successful or not successfully done.

6. Consistency. Consistency is the key to helping users recognize and apply a pattern. A similar activity should do the same.

B. Task Centered System Design

The method used in this research is Task Centered System Design (TCSD). Figure 1 shows the steps of this study.
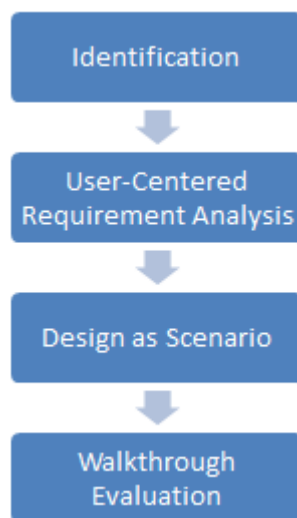
Fig 1. Study Process

Task-Centered System Design (TCSD) is a process for identifying user needs [2]. Here are the steps for doing TCSD [3]:

1. Identification; articulation of concrete description of real man doing real task

2. User-Centered Requirement analysis; use these descriptions to determine what kind of users and what tasks the system should perform

3. Design as Scenario; create a prototype display that meets those requirements

4. Walkthrough Evaluation; evaluate the view.

III.   RESEARCH METHODOLOGY

A. Task Centered System Design (TCSD)

The study began by making the UI of the application Qlue using Axure program, a leading UI building tool and then proceed with the following steps:

1. Identification; distribution of questionnaires containing questions based on six design principles from Donald Norman on the UI of existing Qlue application.

2. User-Centered Requirement Analysis; analysis of the results of the questionnaire that has been distributed and find part of Qlue application that is incompatible with six design principles of Don Norman.

3. Design as Scenario; a revised UI will be created based on the problems that have been found.

4. Walkthrough Evaluation; distributing questionnaires containing the same questions to the same respondents to get an evaluation of the UI that has been made.

B. Data Retrieval

The data used for this study was obtained by distributing questionnaires containing questions about the use of Qlue community service applications to 224 respondents. Table 1 shows the table of questions with each of the principles represented.

Table 1. Question List

Question	Principle
Can you easily find the menu you would like to access?	Discoverability
Do you know the function of a menu or symbol without any explanation stated?	Affordances
Do you have difficulty in operating the buttons?	Mapping
Does this application provide certain restrictions so that users do not make mistakes?	Constraints
Is the feedback provided by this application useful to you?	Feedback
Is the appearance of this app already consistent?	Consistency

C. New UI Creation

After obtaining the data from the questionnaire, the revised UI will be created based on the parts in the Qlue application that the respondent thinks are lacking. The new revised UI adapted to Don Norman's design principles. UI was created using Axure, it generates the HTML 5 that is deployes to a website, it

is used for user UI testing on the revised UI, testing are done through their mobile devices' browser.

IV. ANALYSIS AND DISCUSSION

A. Identification

Based on the results of the questionnaire data that has been distributed, there are 2 questions that have a percentage value indicating that the principle represented by the question is not met in the Qlue application's UI. Here are the results of data from both questions.

Apakah aplikasi Qlue ini memberikan batasan tertentu agar pengguna tidak melakukan kesalahan?
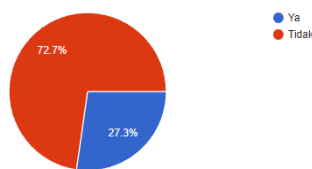
Fig 2. Data Result 1

Fig 2 shows that 27.3% of respondents responded that Qlue had given certain restrictions that prevented users from making mistakes and the rest of 72.7% responded that Qlue did not give the hints clear enough for user.

The answer to this question shows that most respondents argue that the Qlue application does not impose restrictions on the user so that the user does not make mistakes.

Apakah tampilan aplikasi ini sudah konsisten?
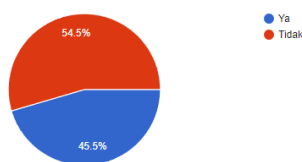
Fig 3. Data Result 2

Fig 3, showed that 45.5% responded that the Qlue application UI display was consistent. Meanwhile, 54.5% of the respondents answered the Qlue application is inconsistent.

The answer to this question shows that more than half of the respondents argue that the Qlue application UI display is inconsistent.

B. User-Centered Requirement Analysis

1. Constraints. In the existing reporting feature of the Qlue application, the user is given an error limitation when the user has pressed the post key before filling the textbox for the contents of the report details, a warning will appear that says that the contents of the report should not be empty. However, the user is not given an error limitation when the user presses the button to return to the previous page while still doing the reporting process, the user can return without any warning that the report that the user has just done will not be saved or sent.

2. Consistency. Here are the things in the Qlue app that are not consistent:

   a. The shape and color of the button in the Qlue application is inconsistent (Fig 4 and 5). Not all buttons and functions are the same.
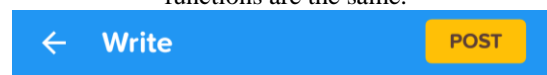
Fig 4. Inconsistent Button and Color

Fig 5. Inconsistent Button and Color

   b. The display for the three different types of reporting in the Qlue app are inconsistent even though the three pages have the same functionality as posts (Fig 6, 7 and 8).
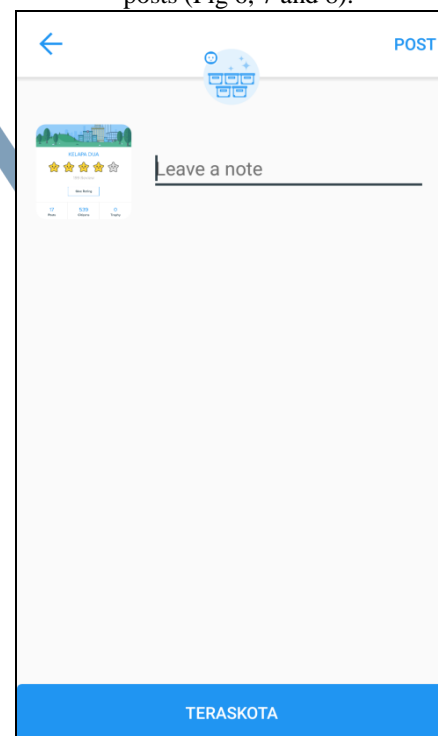
Fig 6. Inconsistent Reporting Menu
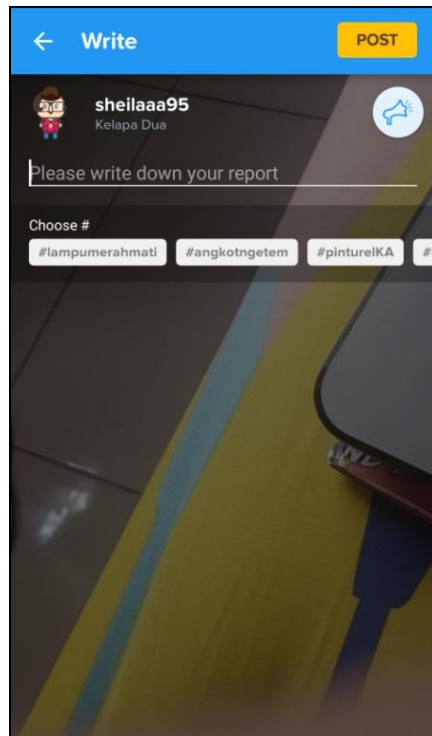
Fig 7. Inconsistent Reporting Menu
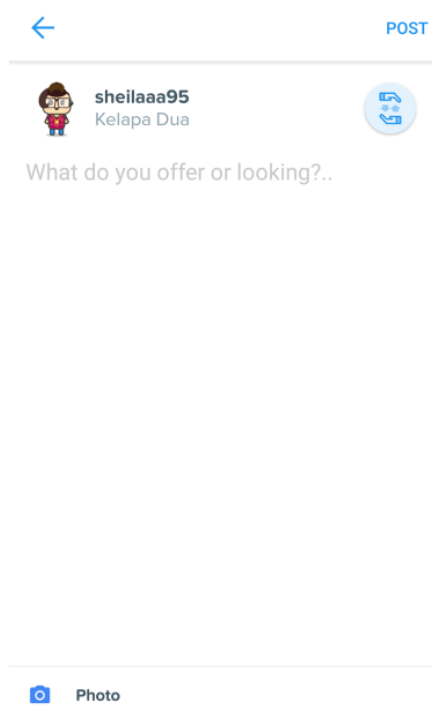
Fig 8. Inconsistent Reporting Menu

c. The feedback display given in the Qlue application is inconsistent. In the reporting menu, feedback appears on the user's mobile notification (Fig 9), when the user successfully edits the profile, the feedback will appear

with the display message box (Fig 10).
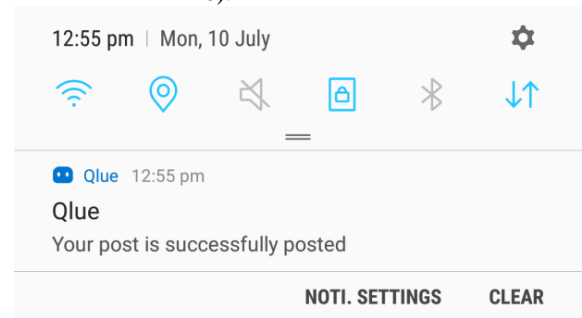
Fig 9. Inconsistent Post Success Feedback

Fig 10. Inconsistent Post Success Feedback

C. Design The Revised UI

The revised new UI is created using a program called Axure. In order for all the respondents to access this UI, the UI result created is uploaded on the website to share the finished results UI created using axshare.com. Here are a series of screen capture of the UI results on a mobile browser:

1. Constraints. Figure 11 is the display for reporting 'Report Local Issue' in the UI. If the user presses the button to return to the previous page before there is a statement that the report has been posted, a warning will appear asking whether the user will actually leave this page, because if that is the case, the report will not be saved.

Fig 14. Feedback Consistency

Fig 11. Constraints

2. Consistency. In accordance with the Qlue application, in the Report Local Issue report, users must upload photos, it is served in the new revised UI. The three warnings (Fig 12 and 13) that exist in this UI have a consistent display of red rectangle with black writing.

Fig 12. Report Consistentcy
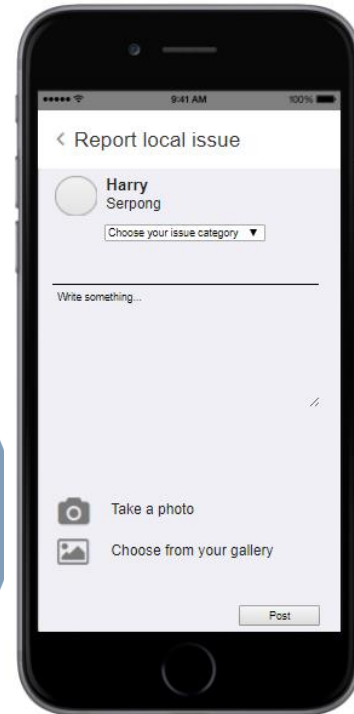
Fig 15. Post Menu Consistency (Local Issue)

Fig 13. Report Consistency

Feedback appearance on the new revised UI has a consistent look that is grey-shaped box with black writing. A feedback will appear if the user has completed an activity such as a post report (Fig 14) or has changed the profile details.
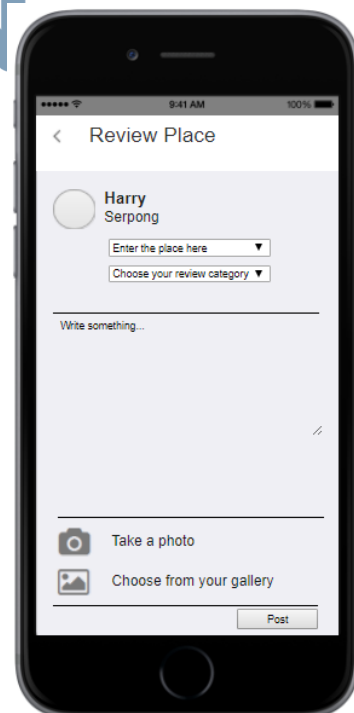
Fig 16. Post Menu Consistency (Place Review)
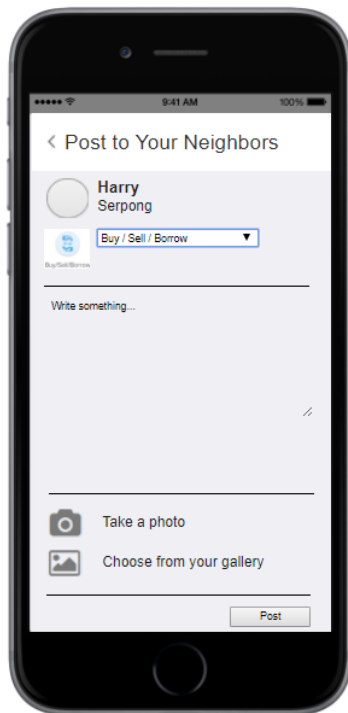
Fig 17. Post Menu Consistency (Neighborhood Report)

Three menus of these reports (Fig 15, 16 and 17) have the same function which is to post a report, although the report consists of 3 types. All three types of reports have the same consistency that all the menus for reporting are on a single page, and both include menus for uploading photos. The page to do the reporting also has the same post button display, which is a white rectangle.

D. Evaluation

To compare the UI of Qlue application with the new web-based revised UI, the questionnaire from the initial survey with the link to the web page was distributed to the the same respondents again. Here is the result of data from the questionnaire.
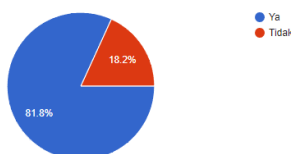
Fig 18. Data Result (Restrictions)

Fig 18 shows that 81.8% of the respondents answered that the new revised UI has given certain restrictions that prevent users from making mistakes and only the remaining 18.2% replied that the UI does not provide restrictions so that users do not make mistakes.

The answer to this question shows that most respondents argue that the new revised UI has given restrictions to the user so that users do not make mistakes.

There is a difference of 54% with the previous initial questionnaire on the percentage of the statement that the UI created has given the error limits.
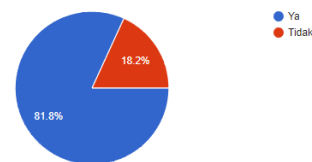
Fig 19. Data Result (Consistency)

As can be seen in Fig 19, 81.8% user responded that the new revised UI appearance was consistent. Meanwhile, 18.2% respondents answered the UI is not consistent.

There is a 36% difference with the previous questionnaire on the percentage of statements about the consistency of the UI display.

Based on the results of the questionnaire data, it concludes that the 2 problems found in the initial identification stage of constraints and consistency have been resolved with the new revised UI design.

The initial results on the questions representing the consistency principle, resulted in a 45.5% agrees that the Qlue application UI is consistent, compare to the results of similar questions against the new revised UI, achieve a higher percentage value of 81.8%.

V.   CONCLUSIONS AND RECOMMENDATIONS

A. Conclusion

The Qlue application is a part of Jakarta's Smart City program, it has a very important part of connecting the smart city systems with the community, so the user experience is very important. This study has found that the UI Design of Qlue will be much improved by creating a more consistent of three things; the reporting menu, the restrictions feature and the feedback format. As part of the research, this paper has gone even further by creating the new revised UI for a more consistent Qlue Application, and it has been proved as a preferred design by the respondents.

B. Recommendations

The developer of Qlue application must justify the limit of errors or constraints and the consistency of existing views. The limitation of this research is that it focused only on the interface design part of an application, not the whole experience (like the database configuration or the server infrastructure for a speedy application). However, for other researchers who also want to analyze the UI of an application, it is recommended to also analyze the user experience of the application. Once again, this study did not examine the back-end part of the related application, so the problem discovery process took longer and the problems found were also likely to be inaccurate because they only rely on the results of the questionnaire data. For a comparison between the selected application UI and the UI already created, it is recommended to do so with A/B Testing. With the testing method, the time spent on the problem discovery process will be less and the problems contained in a website or application will be found clearly and accurately.

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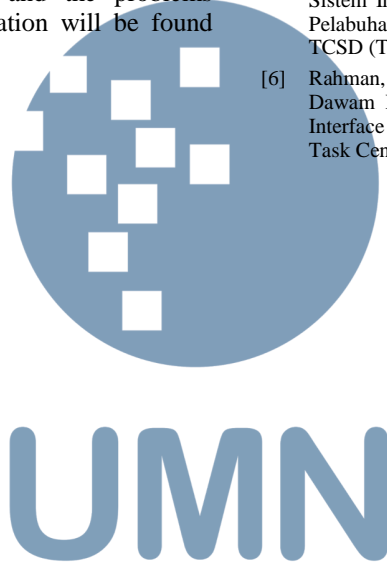
Data Visualization of Poverty Level at Provinces in Indonesia from The year 2013-2015

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Abstract—The aim of this paper is to create a data visualization that can convey information on poverty distribution of every province in Indonesia and to find a connection with education level. The method used is Eight-step data visualization and data mining methodology. Data for this research are taken from BPS from the year 2013 to 2015. Data collected after the data extracted and cleansing is 6000 records. Time needed to convert data from several publications and put it into one Excel file is 2 weeks. Tableau is chosen as tools for creating the Data Visualization. With this tools, data showed in a story dashboard which consists of 3 dashboards. The first dashboard is a mapping of poverty data onto provinces of Indonesia. The second dashboard is a mapping and distribution of education levels on cities and counties in Indonesia. The third dashboard is showing a ranking of areas with the highest percentage level of a citizen of education lower than elementary school in Indonesia. Based on the User Acceptance Test to BPS staff, authors have been able to produce the Story required, and interactive. As a conclusion from Data Visualization has been made, high poverty in certain areas not immediately is directly proportional to the level of education.

Index Terms— Dashboard, Data Visualization, poverty, Tableau.

I.   INTRODUCTION

According to the BPS report on 2017, Indonesia is a country that has a land area of 1.913.579 square kilometers which consists of 17.504 islands. Albeit the size that it has, equity in Indonesia has not been going on well. An article from 2017 by Directorate-General of Disadvantage Area Development mentioned that developments have always been focused on Java Island. It is one of the causes of poverty in other parts of the country.

One of the main focus of Indonesia government in this term (2014-2019) is to minimize the gap between regions in every part of the country. According to Minister of Finance Sri Mulyani Indrawati, this can be done by developing infrastructures in underdeveloped regions or regions that have a high level of poverty on record.

The problem with this large country, the government needs more time to decide which region should become their priority for development. A decentralized governing system Indonesia uses means coordination between central government and regional government is needed in the form of information regarding poverty level or social economic conditions of each region.

With the advanced technology we have right now, it is easy to get such information because the data are open to everyone, such as data from www.data.go.id and www.bps.go.id. Unfortunately, data for the public from BPS is in the publication format (PDF), not in another format such as spreadsheet or text format.

By having open data, information should be easier to obtain and faster to be used to solve poverty problems. Nevertheless, these data are still in the format of publications, in numbers and could only become a meaningful information if managed properly. One of the techniques that can be used in order to convey information better is in the form of data visualization.

To make information regarding these poverty data easier to understand by ordinary people, authors want to create a data visualization that can display poverty data and its relationship with the education level of each province in Indonesia. It aimed to help parties that need a mapping of poverty distribution in Indonesia.

Data used for the visualization are obtained from www.bps.go.id and ranged from the year 2013 to 2015.

The formulation of the problems are as followed:

- How to design a dataset of poverty data needed for data visualization?

- How to build a data visualization dashboard that can be used to analyze poverty of all provinces in Indonesia.

II. LITERATURE REVIEW

A. Data Visualization

Data visualization is a technique to transform data or information into visual matter. [1] Usage of data visualization could make data or information that we have become clearer in order to be communicated to others [2].

The goal of data visualization is to get insight from graphics or images interactively, into many aspects that related to some processes that we are interested in. [3].

B. Dashboard

The dashboard is a visual display of important information that is needed to reach a goal, arranged on a single screen so the information can be seen at a glance [4].

C. Database

The database is a collection of related data. The database is designed, developed and filled with data for a specific purpose for a specific group of users [5].

The database is a computer structure that is divided and integrated which stores collection of data from end-user that consists of raw facts and metadata (data of data), where the end-user data are integrated and arranged [6].

D. Data Warehouse

Data Warehouse is a collection of subject-oriented, integrated, always changing, and non-volatile data. The purpose of a data warehouse is to integrate big-sized corporate data into a storage where the user can easily run the query, produce reports, and analyze [7].

As [7] said, some of the benefits of using data warehouse are as follows:

- High return on investment
- Competitive advantages
- Increasing productivity from decision makers

E. Data Mining

Data mining is a process of gathering valid and understandable information from a big database and using it for taking crucial business decisions [7].

F. Data Cleaning

Data cleaning, known also as data cleansing or data scrubbing, is a process of detecting and cleaning errors and inconsistency from data in order to increase the quality of data that are going to be stored in database or data warehouse [8].

G. Extract, Transform, Load (ETL)

Perta Extract, transform, and load (ETL) process is an essential process in data warehouse development.

As told by the name, this process is divided into three phases, as follows according to [9]:

1. Extract. In this phase, data were extracted from various sources. This phase is quite a challenging aspect because accuracy in extracting data is needed. The goal of this phase is to get data from various sources in order to be combined into a single format that can be used for data transformation.

2. Transform. In this phase, the transformation of data from the original format into a format that can be used for the data warehouse is commenced. There are many ways to do so, such as:

    a. Taking some columns from data

    b. Interpret encoded values

    c. Encode independent data

    d. Calculate new values

    e. Sorting

    f. Combining data from multiple sources

    g. Divide columns into more new columns

    h. Aggregation

    i. Validation of simple or complex data

3. Load. Loading data to final storage (usually a data warehouse). Data can be loaded with various ways such as bulk loading using DBMS software or sequential loading by inserting data each row at a time. Bulk loading is usually recommended because loading data sequentially takes longer time in the process of parsing the statement that is inserted in the query..

H. Poverty Gap Index (P1)

Poverty Gap Index is an average measure of expenditure gap each poor resident has against the poverty line. The higher the index, the further average expenditure of poor resident from the poverty line [10].

I. Poverty Severity Index (P2)

Poverty Severity Index gives illustration regarding the distribution of expenditure among poor residents. The higher the index, the level of inequality of the poor residents' expenditure is higher [10].

J. Poverty Line

The poverty line is a sum of Food Poverty Line and Non-Food Poverty Line. Residents that have expenditure per capita per month lower than the poverty line are categorized as poor residents.

- The Food Poverty Line is a value of minimum food expenditure which is equal to 2100 kilocalories per capita per day.

- The Non-Food Poverty Line is a minimum requirement for housing, clothes, education, and healthcare [10].

III. RESEARCH METHODOLOGY

The method used in this research is eight-step data visualization and data mining methodology, famous with the name Visual Data Mining project. This method is chosen because it fits with data visualization development process which consists of data mining process and extracts, transforms, load (ETL) process [11].
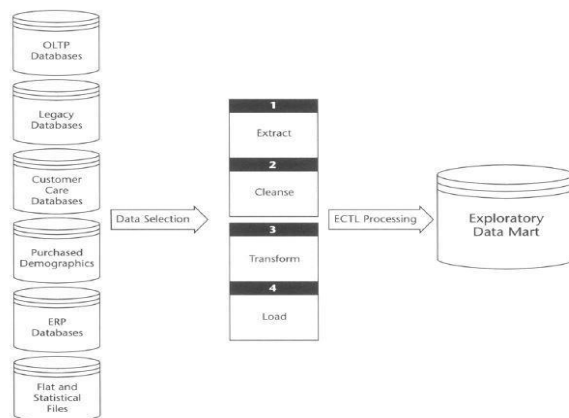
Fig 1. Eight-step Data Visualization and Data Mining Methodology

This method is divided into three phases, as follows:

1. Project Planning Phase
   a. Justify and Plan the Project
   b. Identify the Top Business Questions
2. Data Preparation Phase
   a. Choose the Data Set
   b. Transform the Data Set
   c. Verify the Data Set

3. Data Analysis Phase
   a. Choose the Visualization or Mining Tool
   b. Analyze the Visualization or Mining Model
   c. Verify and Present the Visualization or Mining Model

IV. RESULTS

This section consists of results in every phase which are conducted using the eight-step data visualization and data mining methodology.

1. Project Planning Phase

   a. Justify and Plan the Project. In this research, a proof-of-concept scope is selected, which means the goal of data visualization is to give value to decision-makers. This visualization can be a reference for governments or related parties to understand poverty condition in Indonesia. The goal is to create a mapping of poverty and educational level data to analyze the relationship between both data.

   b. Identify the Top Business Questions. The top business question that is identified and is going to be answered in this research is if there any relationship between poverty level and education level in a region.

2. Data Preparation Phase

   a. Choose the Data Set. Data are chosen by doing a process of extracting (first part of ETL process). Data are gathered from publications published by BPS in PDF format.

   b. Transform the Data Set. After getting data needed for visualization, the next step is to convert publications in PDF format into Microsoft Excel spreadsheet (XLS). After converting, a process of cleaning data is done by taking only needed columns of a data set and arranging various records into one spreadsheet. After that, we can import this data to Tableau software database, and make some changes into regional data in a spreadsheet. Regional data in the spreadsheet are still "string" types in Tableau, so it

needed to be changed into the geographic role in Tableau software.

c. Verify the Data Set. This activity is to make sure the data set is already well transformed and can be used for visualization. Verification of errors is done here. One of the errors found is where there are record mistakes when a region in 2015 publications don't exist in 2013 and 2014 publications. The solution is to add those missing regions into the 2013 and 2014 data and move cities accordingly as the latest data. There are also some missing regional data that are not detected in Tableau software during the transformation process of regional data geographical role. In order to fill this unknown data, we have to input regional coordinates (longitude and latitude). To find the coordinates, a supplementary tool is used from the website www.mapcoordinates.net/en which uses Google Maps as base map.

3. Data Analysis Phase

a. Choosing the visualization or data mining tool. The tool used to create a data visualization is Tableau visualization software. The reason of using Tableau is because it has some advantages against another tool like Microsoft PowerBI, as summarized in Table 1.

Table 1. Comparison of Tools

Comparisons	Tableau	Power BI
Visualization Data Limits	Unlimited	3500 data
Calculations	Built-in Calculations	Syntax
Compare Several Categories	Yes	No
Customize Pop-Up Content	Yes	No
Offline Iterations	Yes	No
Story from Multiple Dashboards	Yes	No

b. Analysed the visualization or data mining model. There are three dashboards created as a result, the first is a mapping of poverty data in provinces of Indonesia. The second dashboard is a mapping and distribution of education levels on cities and counties in Indonesia. The third dashboard is showing a

ranking of areas with the highest percentage level of poverty in Indonesia and a ranking of areas with the highest percentage level of citizen with education lower than elementary school in Indonesia.

All three dashboards can filter its data according to area or year, and also can be clicked in maps or bars to filter or highlight single area.

From analysing dashboard number three, we can also conclude that Deiyai regency in Papua province has the highest poverty level in 2013 with 45.93%, but the regency with lowest education level is Nduga regency with 91.86% of its residents have not or do not pass elementary school.
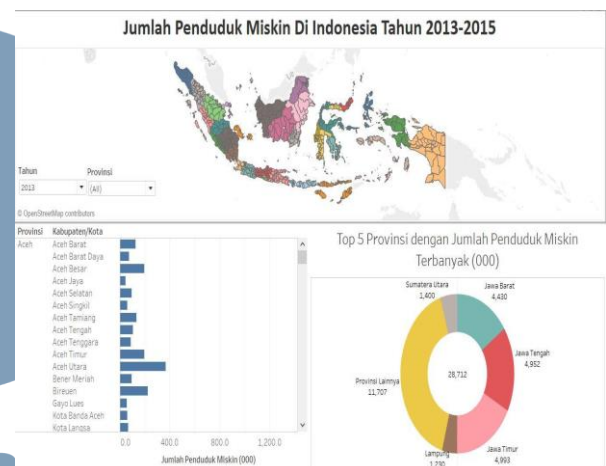
Fig 2. First dashboard
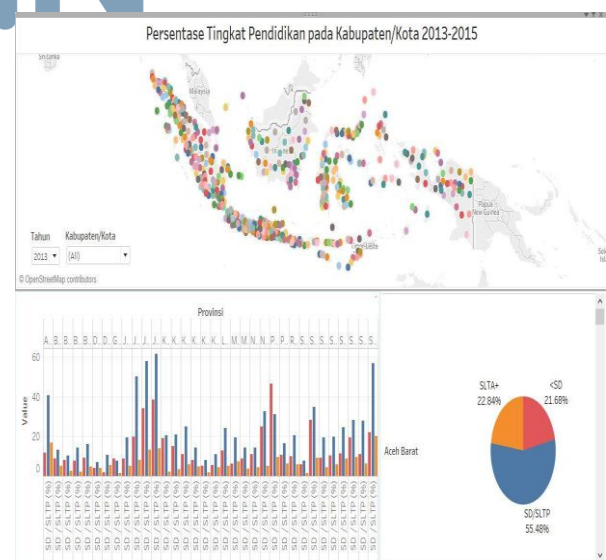
Fig 3. Second dashboard

Another finding is the Southwest Maluku regency, ranked 24 in highest poverty, is actually ranked 481 out of 511 regencies and cities in Indonesia in low education, which means it has a high education with a rate of not passing elementary school of 7.42%. Although the percentage of each area is of course not the same (considering the number of residents in each area is different and the 100% of the level is not the same).

From this finding, we can see that education level can influence poverty level in some areas but not directly influence it, there are so many other factors that we can put into the equation such as a number of residents, infrastructure conditions that influence goods and services access to the certain area.
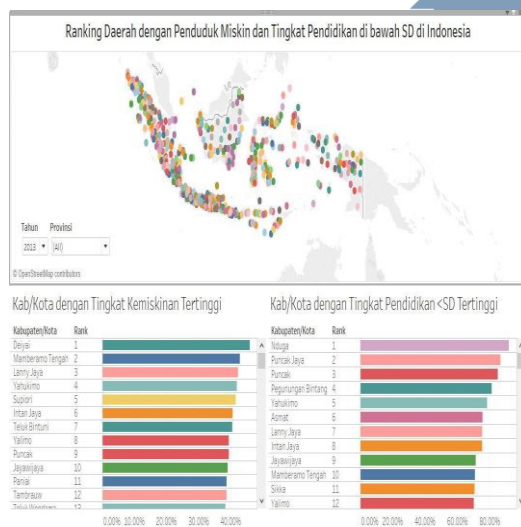
Fig 4. Third dashboard

c. Verifying and presenting the visualization or mining model. After the visualization is created, a final verification process is conducted to make sure the visualization has already represented the true value of the data. The verification is done by taking samples of some data in the visualization and match them with the raw data from the publications. A story dashboard is created in order to accommodate the three dashboards in one functional display. User acceptance test is also conducted by reviewing the visualization to a staff of BPS. The visualization has been uploaded to Tableau Public website and can be seen online.

V. CONCLUSION

The data visualization created can display poverty and educational data interactively using data set that was transformed into Microsoft Excel spreadsheet, from numerical and statistical publications of BPS which were PDF documents before. Data visualization is done using Tableau software to create maps, bars, pie charts, which then combined into a story dashboard consists of three dashboards that show poverty data, education level, and ranking of regions per category.

Data visualization also give information that education level is one of the factors that influence poverty level in certain regions, however, it doesn't have a direct influence. Factors such as a number of residents' difference in each region, infrastructure that helps goods and services' access that influence economy also must be taken into the equation when analyzing factors and cause of poverty in certain regions.

Data visualization that has been created can be used as a reference for research and development to anyone that needed it in order to raise the welfare of residents from the underdeveloped regions.

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New Traders' Mood when using Trading Online Application in Universitas Multimedia Nusantara

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Abstract—**trading online have a brief history of success all due to Internet. However, beginners find some difficulties to make profit. One of the reasons is their moods. This study is focused to explore their moods. Some moods are found has relation with the trading online. Avoiding loss in trading online, some moods should be controlled first before they start trading.**

Index Terms— **Trading Online, Foreign Exchange.**

I. INTRODUCTION

The online commerce application is conducting stock transactions on the internet through various websites. For years, emerging companies have a brief success story due to the Internet. The online transaction processes of finance, including the purchase and sale of bonds, stocks and other investments, all come under online commerce [1].

A previous study shows that some moods impact on judgement accuracy and trading performance. Moods are divided into good, neutral, and bad moods. Traders in a neutral and bad mood can obtain more profits than traders in a good mood. Pleasant mood can reduce the accuracy of judgement, whilst unpleasant mood can increase the judgement accuracy. This problem occurs because traders in a pleasant mood review less information and make quicker decision [2].

This study examines user usability on trading online application on their moods. Moods refer to feelings that tend to be less intense than emotions and that often (though not always) lack a contextual stimulus. Most experts believe that emotions are more fleeting than moods. For example, if someone is rude to you, you will feel angry. That intense feeling or anger probably comes and goes fairly quickly, maybe even in a matter of seconds. When you are in a bad mood, you can feel bad for several hours [3].

User Moods are divided into four quadrants as shown on Fig 1, from Low Arousal to High Arousal, and from Displeasure to Pleasure. UWIST Mood Adjective Checklist (UMACL) is applied in this study [4]. The list contains some moods as followings: Hedonic Tone: Pleased, Cheerful, Optimistic,

Contented, Satisfied, Happy, Low-spirited, Dissatisfied, Gloomy, Depressed, Sad, and Sorry. Anger Items: Impatient, Annoyed, Angry, Irritated, and Grouchy. Tense Arousal Items: Stirred Up, Fearful, Anxious, Jittery, Tense, Stressed, Nervous, Calm, Restful, Relaxed, Unconcerned, Composed, Self-controlled, Peaceful, and Comfortable. Energetic Arousal: Active, Energetic, Industrious, Alert, Fortunate, Vigorous, Bright, Idle, Sleepy, Dull, Unenterprising, Quite, Sluggish, Tired, and Passive.

Users' moods become interesting for some previous Human Computer Interaction researchers. Rooij and Jones argued that there is a connection between moods and creativity in Human computer Interaction Study [5]. Visuri, Sarsenbayeva, Goncalves, Karapanos, and Jones found that users' moods have an association with the use of smartphone applications [6].
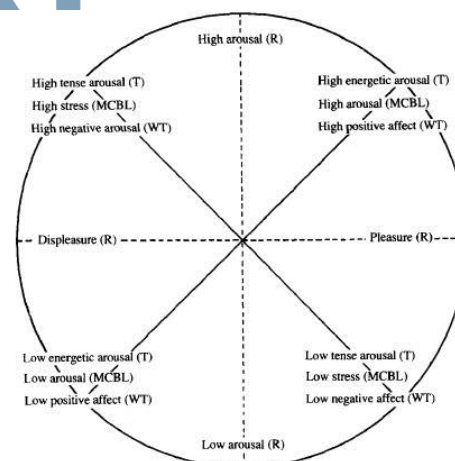
Fig 1. Structural Model of Moods [4]

For many traders, especially the less experienced, trading is marked by significant and persistent emotional responses to successes and setbacks. It is relevant to note the distinction between mood and emotion, since both were relevant to traders. Mood can be understood as a relatively diffuse emotional climate which persists over time and not anchored to specific

situations or cognitions. On the other hand, emotions typically have particular objects and increase behavioral response tendencies relevant to those objects [7]. Mood can influence the result of trading because decision making and risk taking can be influenced by mood on investors' trading behavior [8].

This study is focused on the exploration about new traders' moods before and after trading online session. So the problems that occur are followings:

1. Which moods do significantly change before and after trading session?

2. Which moods do significantly change before and after trading session for traders who make profits?

3. Which moods do significantly change before and after trading session for losing traders?

4. Which moods do significantly correlated with the trading performance?

The purpose of this research is to find an important mood to consider for new traders to start trading online. By knowing the mood, new traders can maintain some mood before trading so that it can reduce the money lost after trading online.

II. METHODOLOGY

A. Data Collection Methods

25 new traders are randomly selected. Traders bring their smartphones. They are asked to download and install the trading software on their smartphones. Before trading, step by step how to trade online is explained using trading software to each trader for about 15 minutes. The software used in the study is iqoption. It is popular binary option trading software in Indonesia.
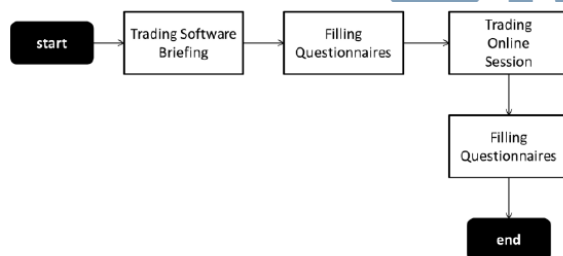
Fig 2. Data collection flow of process

To measure the moods of each Trader, a questionnaire is filled before and after the trading session. 5 Likert scales are applied in the Questionnaires from 5 that refer strongly agreed to 1 that refers strongly disagreeing. The questions are developed from UMACL list of moods.

Total trading online session is 30 minutes in the same room. The initial capital is $1000. There is no training about trading strategy to win. Traders can use their own strategy to win.

B. Data Analysis Methods

25 students answer the same questions on the questionnaire Q1 before trading session as well as on questionnaire Q2 after trading session. Each questionnaire contains all UMACL moods. Those answers are processed by using SPSS to find some moods that are significantly different before and after trading session. Questionnaire are validated by using SPPS, bivariate-correlation-Pearson, two-tailed, $p=0.05$. The Reliability test shows Alpha Cronbach=0.8.

Afterwards, both Q1 and Q2 are split according to the result of trading session, either win or lose money. For the winners, SPSS are applied to find some moods that are significantly different before and after trading session. So do the unlucky traders.

Finally, answers from Q1 and Q2 are processed to find their correlation with the trading performance by using SPSS.

III. DISCUSSION

Data is gathered from 25 students who are selected as new Traders by using simple random sampling in Universitas Multimedia Nusantara. 34% of them are females and 66% are males. Their ages are between 18 and 22 as shown on Fig 3. These traders have never been trading before.

First we look at traders' mood before trading. The largest mean is found on Peaceful since the Traders have not started the trading session yet. However, the largest variance is found on stressed. It may happen because some Traders take it easily, but some others take it too serious.

On the other hand, from the result of descriptive statistics after trading, Traders are found pleased with mean=4.080, standard deviation=1.038, and variance 1.077. Most Beginners look happy when trading online for the first time. While other mood items are under 4. In addition, biggest variance is shown on stirred up and fortunate. Stirred up has mean=2.4, standard deviation=1.472, and variance=2.167. This is their first time to try a new experience so those new traders can feel stirred up. Fortunate has mean 3.0 and the same standard deviation and variance. At the time of trading at a certain time they win but o the other time they can loss too. The variance of fortunate becomes big because some Traders make profits and others are unlucky.
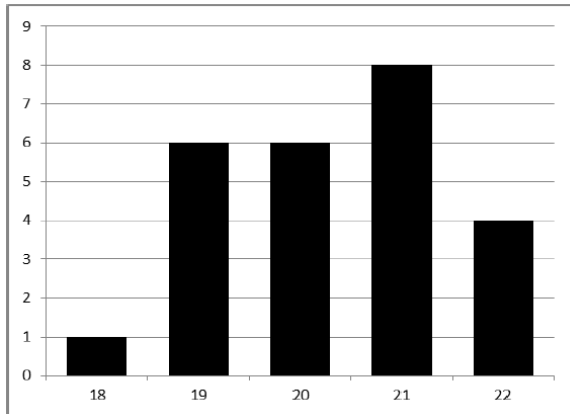
Fig 3. Traders' Ages

A. Moods that significantly change before and after trading session

Moods before and after trading session are compared to find which moods have changed significantly by using Wilcoxon Signed Ranks Test. From this test, we find that pleased, depressed, dull, quite, sluggish, tired, and peaceful changes significantly.
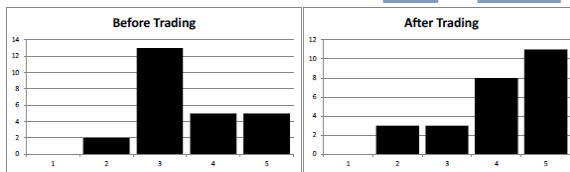
Fig 4. Pleased before and after trading
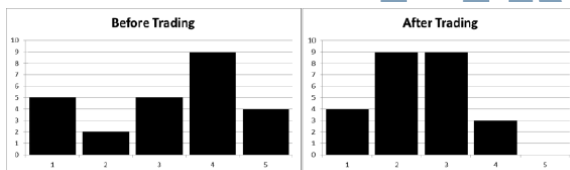
Fig 5. Depressed before and after trading

Most Traders are more pleased after trading as the right chart is skewed to the right side (Fig 4). Either they win or lose; trading online is a fun and exciting activity for them. As the trading activity pleases them, the depression is reduced significantly (Fig 5).
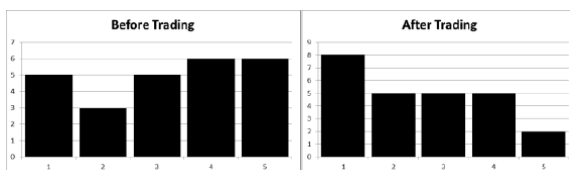
Fig 6. Dull before and after trading
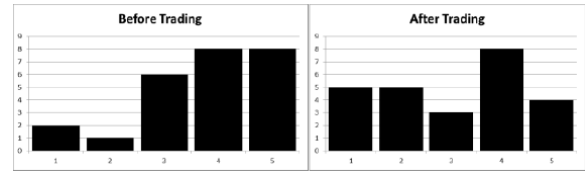
Fig 7. Quite before and after trading
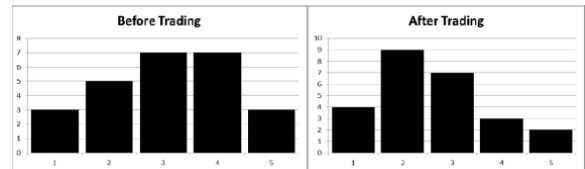
Fig 8. Sluggish before and after trading
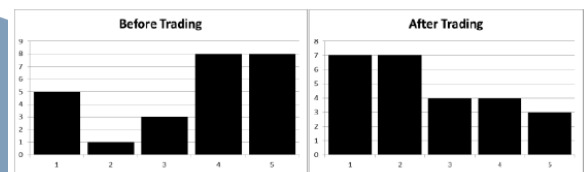
Fig 9. Tired before and after trading
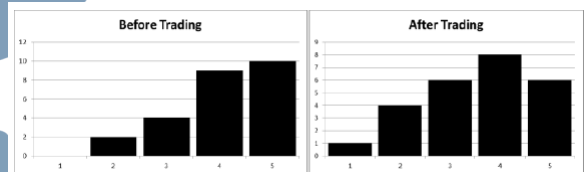
Fig 10. Peaceful before and after trading

As trading online is an excited activity, during trading session, Traders made noises so that moods of dull (Fig 6) are decreased, more traders become not quite (Fig 7), and sluggish (Fig 8) are also decreased significantly. This excitement also gives Traders some influences to reduce their feel of tired significantly (Fig 9). However, Traders' moods of peaceful change because influences of the trading results, which are win or loss (Fig 10).

B. Moods that significantly change before and after trading session for traders who make profits

Here, we focus to explain significant changes on the winners' mood. As shown on table I above, there are five mood that are significantly change which are pleased, active, energetic, vigorous, and sluggish.

Table 1. Winning Traders' Moods

Mood	N	XBT	XAT	SBT	SAT	Neg Rank	Pos. Rank	Ties	Z	Asymp Sig.
Pleased	11	3.546	4.273	1.036	1.009	0	6	5	-2.271	0.023
Actived	11	3	3.909	1.414	1.221	1	7	3	-2.124	0.034
Energetic	11	2.636	3.636	1.748	1.433	0	6	5	-2.232	0.026
Vigorous	11	2.546	3.364	1.368	1.286	1	7	3	-2.111	0.035
Sluggish	11	3.182	2.364	1.328	1.027	7	0	4	-2.46	0.014

The positive ranks are increased on pleased, active, energetic, and vigorous. So the winners look more pleased, active, energetic, and vigorous after trading. But winners become less sluggish after trading. All positive moods such as pleased, active, energetic, and vigorous are changed to positive rank after trading and negative mood such as sluggish is changed negatively. In other words, to make a better result on trading online, traders should increase their positive moods and reduce their negative moods when they are trading.

C. Moods that significantly change before and after trading session for losing traders?

Table 2. Losing Traders' Moods

Mood	N	XBT	XAT	SBT	SAT	Neg Rank	Pos. Rank	Ties	Z	Asymp Sig.
Self Controlled	14	3.6429	2.939	1.008	0.616	7	2	5	-1.997	0.046
Peaceful	14	4.214	3.286	0.802	1.069	8	1	5	-2.323	0.02
Sleepy	14	3.7857	2.714	1.424	1.267	10	3	1	-2.03	0.042
Quite	14	3.857	3.143	1.099	1.512	9	2	3	-2.178	0.029
Dull	14	3.5	2.786	1.605	1.311	9	2	3	-2.178	0.029
Tired	14	3.571	2.643	1.399	1.277	9	2	3	-2.292	0.022

Here, we focus to explain significant mood changes from losing Traders. As shown on the table above, some moods significantly changes for losing traders which are selfcontrolled, peaceful, sleepy, quite, dull, and tired.

Positive moods such as self-controlled and peaceful are not increased. Losing money makes new Traders untighten their self-controlled and their peaceful mood become reduced. However, negative moods such as sleepy, quite, dull, and tired are reduced too. Losing traders keep trying to make their money back. Subsequently, chasing money makes them not sleepy, not quite, not dull, and not tired.

Winning Traders made changes more on positive moods rather than negative moods. The direction is also correct. The positive moods are increased significantly, and the negative mood is reduced significantly. However, losing traders made changes more negative moods rather than positive moods. The direction is not entirely correct. Not only negative moods are reduced significantly, but some positive moods are also reduced.

D. Moods that significantly correlated with the trading performance?

In this section, we discuss about the moods that havecorrelation with trading results. As shown on Table 3, there are four moods involved here, which are unconcerned, selfcontrolled, unenterprising, and sluggish.

Table 3. Correlated Moods with Trading Performance

Mood	Correlation
Unconcerned	$Y = 5643.231 - 657.872X$
Self-Controlled	$Y = 5643.231 - 1009.035X$
Unenterprising	$Y = 5643.231 + 692.224X$
Sluggish	$Y = 5643.231 + 941.589X$

Negative correlations are shown on Unconcerned and selfcontrolled. To won the trading online, Traders must reduce their unconcerned during the trading session. Concentration here is very important to be kept in better condition.

It is also strongly suggested for them to untighten strong control to themselves. If the traders are too tight in their selfcontrol, they will only make a small number of actions.

Positive regressions are shown on unenterprising. To win on trading online, they must increase their unenterprising so they can find more opportunities to win.

In addition, sluggish is quite interesting here because it is shown on significant changes of losing traders but it also have positive correlation with trading result. However, the direction is different. Loser Traders tend to reduce their mood of sluggish. But winners increase their mood of sluggish. To put a Buying or Selling order in trading only should not in rush. Even though the self-controlled are reduced, but the traders must be very sure to make the order.

IV. Summary

Generally, new traders bring their moods when they use trading online. Their moods consist of good moods and bad moods. New Traders must level up their positive moods and at the same time control their bad moods. Positive moods that are suggested to be managed include pleased and peaceful, active, energetic, vigorous, self-controlled. Whilst some negative moods that are suggested to be managed including depressed, dull, quite, sluggish, tired, sleepy, unconcerned, and unenterprising.

If the trading results can be ignored, we find that the trading online is a fun activity for new Traders. The number of positive moods that occur is less than bad moods. It enlarges some good moods significantly. Traders become more pleased and peaceful after trading since they enjoy their new experience trying the trading application. In addition, this activity can reduce some bad moods. The moods of depression, dull, quite, sluggish, and tired are significantly decreased.

Furthermore, if we connect the changes of Traders' moods with their trading results, there are only two types of results, either they make some profits or lose their money. There are some differences of mood changes between these two results.

For new Traders who win the trading session, the positive moods increase significantly whilst negative moods decrease significantly. New Traders become

more pleased, active, energetic, vigorous, but less sluggish.

For new traders who lose money at trading session, more bad moods change significantly rather than good moods. Both positive and negative moods are reduced. Bad moods that change significantly include sleepy, quite, dull, and tired. The positive moods that occur here are self-controlled and peaceful.

And finally, we find that some moods have a correlation with trading results including unconcerned, self-controlled, unenterprising, and sluggish. To win the trading session, new traders must reduce their unconcerned and self-controlled moods whilst they also must increase unenterprising and sluggish moods.

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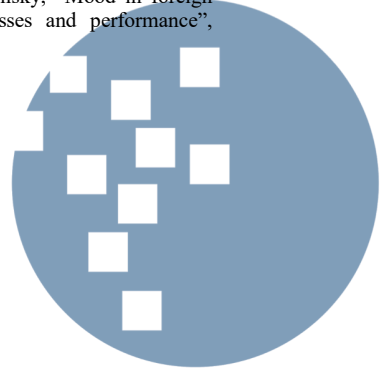
COBIT 5.0: Capability Level of Information Technology Directorate General of Treasury

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Abstract—**Information system is one of the most important things that can help every companies to improve the performance of their company. The Directorate Generate of the Treasury is one of the government agencies that already use information systems to support their performance to handle the entire transaction of state budgeting and also they provides information systems to serve their users. That system must have a priority of the security and reliability. To ensure that the system has both of the priority, it is necessary to holding of the information systems auditing to ensure that capability level of their governance. This research using framework of COBIT 5.0 and doing measurements with Capability Level. EDM 01 (Ensure Governance Framework Setting and Maintenance) and EDM 02 (Ensure Benefits Delivery) are the two main processes of that government needs to do an audit, because they want to make sure that the system can running well and can deliver every benefits to their users. Based on the measurements that have been done using a capability level, both of the main processes are stalled on level 4 and could not reach the level of target on level 5 because there are some activities that cannot going well and can be inhibit the others process to reach their goals.**

Index Terms— **Capability Level, COBIT 5.0, Information Systems, Information Systems Auditing, IT Governance.**

I. INTRODUCTION

In modern era, there are several progress at the development of the information technology that have some function or feature that getting better. There are several companies use information systems to assist the company in achieving their goals, and helps to improve the performance of the processes that exists at the company [1]. Therefore, the information system have a priority of the security and reliability. To ensure that the system has both of the priority, it is necessary to holding of the information systems auditing to ensure that capability level of their government. This research used framework of COBIT 5.0 and doing measurements with the Capability Level of their governance, that framework issued by ISACA in 2012 is COBIT 5.0. The framework is appropriate to be able to ensure the IT governance of information technology at the Directorate Generate of the Treasury.

Directorate of Treasury is one of the government agencies that deal with the every activities and transactions carried out by the State. The Directorate using information systems to support their performance. Information systems are handled by the IT section that called with the Directorate of Information Systems and Treasury Technology, where the directorate ensure the system that always running well and always available when their users want to use, and also to manage the entire State Treasury activities. Based on the importance of the information system, then the government want to do the auditing of the information systems to take the measurement of the information technology governance to ensure that their systems can running well without inhibit the performance of some of the business processes at their government.

The main purpose the problems in this study:

1. How capability level of information and technology governance on the Directorate General of the Treasury using framework of the COBIT5.0?

2. How does the recommendation over the results of the measurement capability level has been done of the technology and information Directorate General of the Treasury?

II. LITERATURE REVIEW

A. IT Governance

IT Governance under the Information Technology Governance Institute (ITGI) is part of corporate governance and comprises of leadership, organizational structure and IT governance processes and IT objectives. IT governance is the responsibility of the board of directors (BOD) and executive management [2].

In other words, we can say that IT Governance is an interrelated organizational structure and process for

managing and controlling the company by adding value to the use of technology in it [2].

B. Audit

Audit is a systematic and objective process to ensure the level of submission between the assignment and predefined criteria, the results of the assignment will be communicated to the interested parties [3].

C. Information System Auditing

Information System Auditing is an an evaluation of how the suitably level of between information systems that has been designed and implemented effectively, efficiently, and economically, as well as adequate assets of security mechanisms, and ensuring adequate integrity [4].

D. COBIT 5.0

COBIT or known Control Objective for Information and RelatedTechnology is one of the frameworks that can run an audit information system in detail and depth, an information systems auditor requires a framework that is used to perform an audit on a company with a complex data[5].

COBIT is a framework that used for the audit of information technology created by ISACA (Information Systems Audit and Control Association) and published in 1996 which emphasizes the areas of audit, then in 1998 are published COBIT version 2 that highlight the phase control. In 2000 released COBIT 3.0-oriented management, and in 2005 released COBIT 4.0 which led to IT Governance.

In 2007 COBIT released version 4.1, and in 2012 the most released version COBIT new IE version 5.0 more leads to governance and management for the company's IT assets.

5 five principles that belonging to COBIT 5.0, are:

1. Meeting Stakeholder Needs—It is critical to define and link enterprise goals and IT-related goals to best support stakeholder needs.

2. Covering the Enterprise End to End— Companies must shift from managing IT as a cost to managing IT as an asset, and business managers must take on the accountability for governing and managing IT-related assets within their own functions.

3. Applying a Single Integrated Framework— Using a single, integrated governance framework can help organizations deliver optimum value from their IT assets and resources.

4. Enabling a Holistic Approach—Governance of enterprise IT (GEIT) requires a holistic approach that takes into account many components, also known as enablers. Enablers influence whether something will work.

COBIT 5 features seven enablers for improving GEIT, including principles, policies and frameworks; processes; culture; information and people.

5. Separating Governance From Management— Governance processes ensure goals are achieved by evaluating stakeholder needs, setting direction through prioritization and decision making; and monitoring performance, compliance and progress. Based on the results from governance activities, business and IT management then plan, build, run and monitor activities to ensure alignment with the direction that was set.
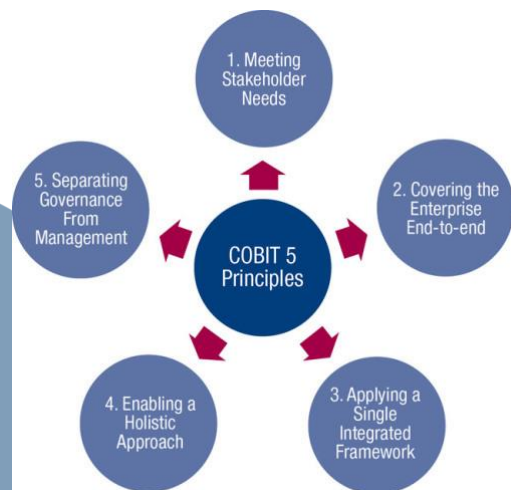
Fig 1. COBIT 5.0 Principles

E. Capability Model

On the COBIT 5.0 is no longer using the Maturity Level as on the COBIT 4. But updated into Capability Model that is based on the ISO/IEC 15504. ISO 15504-2 that describes a measurement to be able to do an assessment of the ability of the processes of COBIT framework that defined into six levels that start from a scale of 0 – 5 [6].

III. RESEARCH METHODOLOGY

To conduct this study, this research used multiple research methods to help resolve some of the problems that exist, such methods-are:

A. COBIT 5.0

The first method is the COBIT 5.0 framework. COBIT 5.0 is a framework used to make measurements of management and governance of information technology management in the company to achieve its objectives. This research uses this framework as it provides a complete framework and can help companies achieve their desired target, benefits and provide an assessment through good corporate governance and management in information technology.

The stages of information system auditing performed, are:

1. Determine the purposes and problems of the company.

2. Conduct analysis on some of the existing problems with the guidelines provided by COBIT 5.0.

3. Determination of priorities against 37 kinds of processes that exist on COBIT 5.0.

4. Collecting some data of some processes that have become priorities to be auditing.

5. Perform a measurement or assessment of the level of capability against the results obtained from the data collection.

6. Specify the target against the level of capability is desired by the company.

7. Provide recommendations over the results have been found in research and data collection that already done.

B. The Stages of Information System Auditing

The next method are using stages of the Information System Auditing according to Hermawan [7], there are four stages in the stage of the Information System Auditing, are:

1. The Stages of Planning. The first stage is the planning stages, at this stage this research determines the objects that will be do the information system auditing, determine the purpose of the audit process of information system, and perform the identification and analysis of the process – the process in accordance with the vision - mission of that company's.

2. The Stages of Preparation. The second stage is the preparation stages, at this stage this research do the collection of information to be processed and analyzed. The first step is provide Enterprise Goals to be sorted based on interests and vision – mission owned by the company. The next step is doing mapping against the results of Enterprise Goals to IT Related Goals. The last step is doing the mapping of the process that contained in COBIT 5.0 required by the company to do an audit.

3. The Stages of Implementation. The third stage is the implementation stages. Data collecting technique is done by using qualitative data method where this research did environmental observation and observation document that owned by company and adjusted with document which have become standard or provision from COBIT 5.0, then using interview and giving questionnaire to IT division in that company. By doing data collection techniques, this research analyzed

the level of information technology governance capabilities in that company.

4. The Stages of Reporting. The last stage is the reporting stages, at this stage this research evaluate the data that have been obtained from the previous stage. The results will be show with the form of a report containing the findings of the audit activities of the information system that have been conducted and contains recommendations on the results. The document will be given to related parties that can be given as a review and references so that IT governance of that company can improve better.

IV. RESULTS AND DISCUSSIONS

The result of the analysis and discussion against the four stages of information system auditing performed, are:

A. The Stages of Planning

The object on this research is the Director General of Treasury is engaged in public service. This research conducted an audit of the IT Division in the Directorate that called Directorate of information systems and technology of Treasury. Directorate of information systems and technology of Treasury became one of Directorate General of Treasury subdirektorat since 2015. Directorate General of Treasury itself has been established since 2004 where that directorate is engaged in the implementation every activities of the State from that budget, the management of State Treasury, the management of state property, provides a useful system to help serve its users, and so on.

That government provide huge influence against the State Treasury transactions and also to provide services to their users. Therefore it is very important the IT Division in a company to help ensure the system they have in order to be able to walk to the maximum without any obstacles that can interfere with the process of the performance of that company. Based on the importance of the system, certainly the role of the security and reliability of the information system needs to be able to preventing the occurrence of gaps or issues on performance at the company.

Based on the importance of the role of the second well against information systems or information technology governance exists, then this research wanted to do the measurement capabilities of information technology governance in the Directorate General of the Treasury so that audit of information systems can help to find the possibility of gaps in the system or that governance, and also can fix it if found some gap or obstacle which resulted will be inhibit processes or business process in the company.

In this study used of COBIT framework 5.0 and have one domain became the main focus of the existing COBIT 5.0 i.e. Evaluate, Direct, and Monitor

(EDM) 01 and 02 is about Setting and Maintenance as well as the delivery of the benefits of the business.

B. The Stages of Preparation

To measure the level of capability of the IT management and governance, and needs for data collections to be processed into a source of information. The following is the steps undertaken to get a data that want to be processed, are:

1. Determine the purpose of the Directorate General of Treasury.

2. Analyze of IT Related Goals based on COBIT 5.0 are in accordance with the vision and mission of the company.

3. Choose the main process that is needed by the company in order to did audit of information system for it governance at the company and can evolve to be better.

The 37 kinds of processes that exist in the COBIT framework 5.0, are:

Table 1. Processes of COBIT 5.0

No	Process	Description
1	EDM01	*Ensure Governance Framework Setting and Maintenance*
2	EDM02	*Ensure Benefits Delivery*
3	EDM03	*Ensure Risk Optimisation*
4	EDM04	*Ensure Resource Optimisation*
5	EDM05	*Ensure Stakeholder Transparency*
6	APO01	*Manage the IT Management Framework*
7	APO02	*Manage Strategy*
8	APO03	*Manage Enterprise Architecture*
9	APO04	*Manage Innovation*
10	APO05	*Manage Portfolio*
11	APO06	*Manage Budget and Costs*
12	APO07	*Manage Human Resources*
13	APO08	*Manage Relationships*
14	APO09	*Manage Service Agreements*
15	APO10	*Manage Suppliers*
16	APO11	*Manage Quality*
17	APO12	*Manage Risk*
18	APO13	*Manage Security*
19	BAI01	*Manage Programs and Projects*
20	BAI02	*Manage Requirements Definition*
21	BAI03	*Manage Solutions Identification and Build*
22	BAI04	*Manage Availability and Capacity*
23	BAI05	*Manage Organizational*

No	Process	Description
		Change Enablement
24	BAI06	*Manage Changes*
25	BAI07	*Manage Change Acceptance and Transitioning*
26	BAI08	*Manage Knowledge*
27	BAI09	*Manage Assets*
28	BAI10	*Manage Configuration*
29	DSS01	*Manage Operations*
30	DSS02	*Manage Service Request and Incidents*
31	DSS03	*Manage Problems*
32	DSS04	*Manage Continuity*
33	DSS05	*Manage Security Services*
34	DSS06	*Manage Business Process Controls*
35	MEA01	*Monitor, Evaluate, and Assess Performance and Conformance*
36	MEA02	*Monitor, Evaluate, and Assess the System of Internal Control*
37	MEA03	*Monitor, Evaluate, and Assess Compliance With External Requirements*

Based on 37 kinds of process that given to the IT Division to be determined that will be the main focus to did the audit of information systems, so the head of the Sub Directorate choose two main process, EDM01 (Ensure Governance Framework Setting and Maintenance) and EDM02 (Ensure Benefits Delivery) because the company provides an information systems major that can be influential of Treasury transactions against the country and they giving service to the community and the users that access it, then these companies would like to audit of the two main process that already choosen with the head of the Sub Directorat IT. After getting two main processes, this research did interviews and giving the questionnaire that refers of the two main processes that already chosen before.

C. The Stages of Implementation

On the stage of implementation requires the evaluation of evidence of data originating from three different kinds of data collection i.e. observation, interviews, and questionnaires. The explanation of the three kinds of the data collection that have been performed, are:

1. Observation

This research did the two stages of observation. The first stage is the observation of the environment, in which visit and conduct the observation of the situation and working space of the IT Division. The workspace of IT Division can be said very comfortable, nice, orderly, and has highly security. At the workspace, there are six main monitor in the front

that is used to monitor the operations of the system they have. The IT Directorate has a very highly security where the employees working there had to go through two stages. First stages, they using fingerprints and the second stages, they did the tapping using employees card, so the others will not be able to enter to the working space if they do not have the employees card.

The second stage is document observations, where this research do some adjustment the documents that government have with that have become standards refers to document the Process Assessment Model (PAM) on COBIT 5.0 are as follows:

Table 2. Observation Documents

No	Guidelines of Document COBIT 5.0
EDM01 *Ensure Governance Framework Setting and Maintenance*	
1	*Constitution/bylaws/statues of organization*
2	*Governance/decision-making model*
3	*Regulations*
4	*Business Environment Trends*
5	*Communications of changed compliance requirements*
6	*Obligations*
7	*Audit Reports*
8	*Performance Reports*
9	*Status and results of actions*
10	*Results of internal control monitoring and reviews*
11	*Results of benchmarking and other evaluations*
12	*Results of reviews of self-assessments*
13	*Assurance review scope*
14	*Compliance confirmations*
15	*Compliance assurance reports*
16	*Reports of non-compliance issues and root causes*
17	*Enterprise governance guiding principles*
18	*Decision-making model*
19	***Author****ity Levels*
20	*Enterprise governance communications*
21	*Reward System Approach*
22	*Feedback on governance effectiveness and performance*
EDM02 *Ensure Benefits Delivery*	
1	*Strategic road map*
2	*Investment return expectations*
3	*Selected programs with return on investment (ROI) milestones.*
4	*Benefit results and related communications*
5	*State-gate review results*
6	*Investment portfolio performance reports*
7	*Evaluation of strategic alignment*
8	*Evaluation of investment and services portfolio*
9	*Investment types and criteria*

No	Guidelines of Document COBIT 5.0
10	*Requirements for stage-gate reviews*
11	*Feedback on portfolio and programmed performance*
12	*Actions to improve value delivery*

Based on the list of the documents on the table 2, Directorate General of the Treasury have all documents that comply with the standard of COBIT 5.0. Documents – documents for the main process EDM01 and EDM02 are a document about the valid work contracts and documents made by PPK (The Makers of Commitment Officials that signed by the Centre, document Standard Operating Procedures that are used as a guide to do the whole existing activities, the document that describes the requirements that are set up when there is a change of regulatory or compliance with the both of internal and external, the document that contains all about reports of information systems auditing that have been conducted before, the document that contains about Performance Report their of employees in which the results of review against self-assessments and made every 3 months and adjusted with Major of Performance Indicators document (IKU) to do the assessment, document about non-disclosure agreement to be used when a company wants to do cooperation with vendors or third parties in accordance with the standards provided in the Assessment Process (PAM) in COBIT 5.0.

2. Interview

The interview that have been done located at the Directorate of Information Systems and Technology of Treasury, Central Jakarta. This research do an interview with Mr. M. Ali Hanafiah, as the head of Sub Directorate of Information Systems and Technology of Treasury. That interview was talking about Setting and Maintenance and how to perform the delivery of benefits to the user. There is some topic of discussion is obtained from the results of this interview, are:

a. Directorate of Information System and Technology of Treasury making the accuracy of content and timing to carried out their task.

b. Directorate of Information System and Technology of Treasury Always did a satisfaction survey to their stakeholders, the survey is doing yearly.

c. Directorate of Information System and Technology of Treasury did some training for their new employees who will work in their company.

d. When the want to create a project, the IT division has some kind of initiative, because they want to see if there is a potential for their

business process. But on the other hand they also receive input, if there is a command from the owner or stakeholders. But before the owner requested or the bet of a program or system, the IT may be modified by the initiative and may some process may be appropriate with the others process. And if there is a redundancy process, the IT will do a process that is done only once.

e. They have Service Level Agreement document that they will used to fix it the errors or bug.

f. If they are going to make a project, they have lacking of the human resources, not about the capacity but because the system or project that will be created is too large enough so that will takes a specific skill. Therefore they did with involving the third parties by hire the consultants.

3. Questionnaire

This research using the guidelines of COBIT 5.0 to create a questionnaire that will be given to the company. This research gave that questionnaire with the question or statement in accordance with two main processes that have been selected before. The questionnaire consists of 5 levels, which is at level 1 contains a more specific question about while at level 2 to 5 contain a more general question. The questionnaire can be rise to the next level if they get the median value $\geq$ 85%. But if $\leq$ 85% the questionnaire just stop on that level. So it can be said that the last level is the level of capability level of it governance against both of the two main processes that they selected earlier with the IT Division of the company.

D. The Stages of Reporting
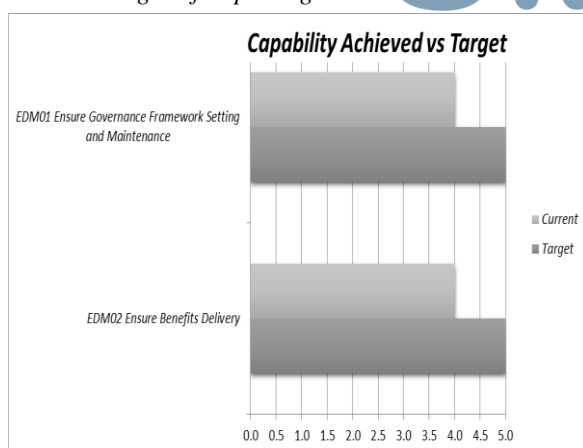
Fig 2. Capability Achieved vs Target

Figure 2 showing about the graph of against the achievement of the it governance capability level obtained with the target that was made by the Directorate. In Figure 2 it can be said that it

governance that available on the Directorate of information systems and technology, Treasury, Ministry of Finance has not yet been able to reach the desired target i.e. level 5. The final value achieved by these companies reached only at level 4 for the both of two main processes i.e., Evaluate, Direct, and Monitor (EDM01 and EDM02) with the results against each process i.e. 84.88% and 84.69%, where those results prove that there is still some gap of the activity on the both of the processes that have not been run with maximum. Some of the activities that becomes a barrier so that can be inhibit the performance of the both of these processes, are:

a. Lack of the information processing that is required to support the operations of the process of Setting and Maintenance and delivery of benefits.

b. Lack of a the timetable unmeasured determination process for Setting and Maintenance.

c. Lack of the supervisory restriction on performance Settings and Maintenance.

d. Lack of the identification and determination against the procedure and frequency of assessment in accordance with the assessment process and the purpose of the process of delivering the benefits of the business.

e. Lack of doing a reset when there are many things that are not desired in the process of Setting and Maintenance.

V. CONCLUSIONS

Based on the results of the evaluation of the measured level of capability of human resources governance and TI on the Directorate of Information Systems and Technology of Treasury, Ministry of Finance of Jakarta using framework of COBIT 5.0 and using two main processes are EDM01 (Ensure Governance Framework Setting and Maintenance) and EDM02 (Ensure Benefits Delivery), then that has been generated is the process of EDM01 stopped at level 04 with the value is in 84.88% and the process of EDM02 stopped at level 04 with the value is in 84.69%. EDM01 and EDM02 is in the Largely Achieved on level 4 and called the Predictabel Process. Based on the information, the company is running a process that is always done with monitoring, measured, and predicted to reach a desired goals.

Based on the results of the data collection can be said that EDM01 (Ensure Governance Framework Setting and Maintenance) and EDM02 (Ensure Benefits Delivery) can not be reached at level 5 because the company lack of setting the information needed to support the process of Setting and Maintenance, lack of supervisory restriction on performance processes of Setting and Maintenance, and companies less to identified against the procedure

and frequency of assessment in accordance with the assessment process and the goal of delivering the benefits of the business. Recommendations for the some gap are it will be better if the company set the informations that they need before doing the process of Setting and Maintenance because if the information needed is less, it will be inhibited in achieving the desired goals, the company should set limits of the supervision to oversee the performance of the Setting and Maintenance, and the company should to do the identification of procedures as well as the frequency of the assessment process delivery of the benefits.

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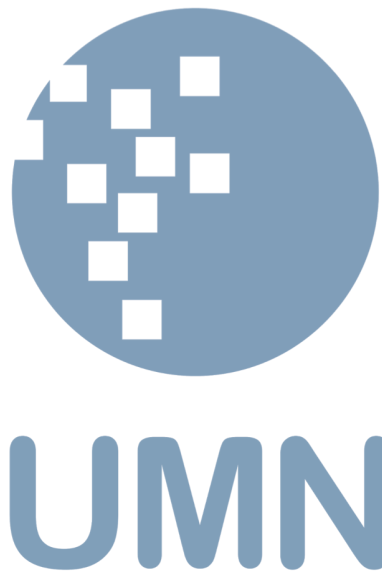
Design and Development of Computer Specification Recommendation System Based on User Budget With Genetic Algorithm

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Abstract—**There are a lot of things that must be considered when determining specifications of computer components to make sure those components chose are working compatible. According to a survey conducted to 78 respondents, about 72.5% of the respondents prefer to buy a built-up computer. The reason is because of a lack of knowledge of computer components and how to assemble computer properly. This research aimed to develop a recommendation system that able to give recommendation of buying computer based on compatible components to be assembled, with the available budget, so that people who do not know computer components can also buy a assembled computer. The Genetic Algorithm was chosen for making this recommendation system because this Algorithm gives more alternative solutions through the process of crossover and mutation compared to the Greedy Algorithm which doesn't produce a solution by trying all alternative solution nor Exhaustive Search on Brute Force Algorithm which takes a long time to find optimum solution. The recommendation system of computer components specifications based on the budget available has been successfully developed using Genetic Algorithm and achieved 75.75% user satisfaction.**

Index Terms— **Computer Components, Genetic Algorithm, Greedy Algorithm, Recommendation System.**

I. INTRODUCTION

According to International Data Corporation (IDC), in 2016, overall sales of personal computer in Indonesia reached 2 million units. This indicates the need for computers is still quite a lot in Indonesia, especially for office and gaming needs.

In general there are two types of computer sold in computer stores, the built-up computers and the assembled computers. The built-up computers are computers directly made by the manufacturers of the computers, while the assembled computers are computers assembled by technicians base on buyer's request.

Based on a preliminary survey, about 72.5% of respondents who prefer to buy built-up computers reasoned they bought the computers because they don't know computer components. While 86.8% of the the respondents who prefer to buy assembled computers reasoned they bought the computer because they could adjust the price of the computer based on their budget.

The preliminary survey conclude that people bought built-up computers because they don't know computer components well. If there is a recommendation system able to give components specification of compatible computers based on their budget, they would buy an assembled computer so they can adjust the price of the computer base on their budget, and they no longer need to know computer components.

Researches related to the this problem has been done by some other researchers. Imbar in 2013 [1] select the specification of computer components based on the budget of the buyer. However, the research based on Greedy Algorithm produced sub-optimum solution because the algorithm did not operate thoroughly against all available alternative solutions.

Another research conducted by Haryanty in 2012 [2] using Genetic Algorithm with Roulette Wheel selection method and the result was producing combination of products optimal to buyer's budget. However, this research only used five computer components i.e processor, motherboard, memory (RAM), graphics card and hard disk; and did not check the compatibility of RAM according to the motherboard used.

This research used Genetic Algorithm to make improvement from the previous research by using seven computer component products and used Tournament Selection for the selection method which has an advantage in convergence speed compared to proportionate roulette wheel. It is expected to help people when buying assembled computer with the various of computer components and the incomprehension of computer components compatibility.

II. METHODOLOGY

A. Genetic Algorithm

Genetic algorithms (GAs) are search methods based on principles of natural selection and genetics.

GAs encode the decision variables of a search problem into finite-length strings of alphabets of certain cardinality. The strings which are candidate solutions to the search problem are referred to as chromosomes, the alphabets are referred to as genes and the values of genes are called alleles. For example, in a problem such as the traveling salesman problem, a chromosome represents a route, and a gene may represent a city. To evolve good solutions and to implement natural selection, measure to distinguish good solutions from bad solutions is needed. The measure could be an objective function that is a mathematical model or a computer simulation, or it can be a subjective function where humans choose better solutions over worse ones. The fitness measure must determine a candidate solution's relative fitness, which will subsequently be used by the GA to guide the evolution of good solutions [1].

Another important concept of GAs is the notion of population. Unlike traditional search methods, genetic algorithms rely on a population of candidate solutions. The population size, which is usually a user-specified parameter, is one of the important factors affecting the scalability and performance of genetic algorithms. For example, small population sizes might lead to premature convergence and yield substandard solutions. On the other hand, large population sizes lead to unnecessary expenditure of valuable computational time.

Once the problem is encoded in a chromosomal manner and a fitness measure for discriminating good solutions from bad ones has been chosen, the algorithm start evolving solutions using the following steps:

1. Initialization. The initial population of candidate solutions is usually generated randomly across the search space. However, domain-specific knowledge or other information can be easily incorporated.

2. Evaluation. Once the population is initialized or an offspring population is created, the fitness values of the candidate solutions are evaluated.

3. Selection. Selection allocates more copies of those solutions with higher fitness values and thus imposes the survival of the fittest mechanism on the candidate solutions. The main idea of selection is to prefer better solutions to worse ones, and many selection procedures have been proposed to accomplish this idea, including roulette-wheel selection, stochastic universal selection, ranking selection and tournament selection.

4. Recombination. Recombination combines parts of two or more parental solutions to create new, possibly better solutions (i.e. offspring). There are many ways of accomplishing this (some of which are discussed in the next section), and competent performance depends on a properly designed recombination mechanism. The offspring under recombination will not be identical to any particular parent and will instead combine parental traits in a novel manner (Goldberg, 2002).

5. Mutation. While recombination operates on two or more parental chromosomes, mutation locally but randomly modifies a solution. Again, there are many variations of mutation, but it usually involves one or more changes being made to an individual's trait or traits. In other words, mutation performs a random walk in the vicinity of a candidate solution.

6. Replacement. The offspring population created by selection, recombination, and mutation replaces the original parental population. Many replacement techniques such as elitist replacement, generation-wise replacement and steady-state replacement methods are used in GAs.

B. Tournament Selection

GAs uses a selection mechanism to select individuals from the population to insert into a mating pool. Individuals from the mating pool are used to generate new offspring, with the resulting offspring forming the basis of the next generation. A selection mechanism in GA is simply a process that favors the selection of better individuals in the population for the mating pool. The selection pressure is the degree to which the better individuals are favored: the higher the selection pressure, the more the better individuals are favored. This selection pressure drives the GA to improve the population fitness over succeeding generations. The convergence rate of a GA is largely determined by the selection pressure, with higher selection pressures resulting in higher convergence rates. However, if the selection pressure is too low, the convergence rate will be slow, and the GA will unnecessarily take longer to find the optimal solution. If the selection pressure is too high, there is an increased chance of the GA prematurely converging to an incorrect (suboptimal) solution.

Tournament selection provides selection pressure by holding a tournament among "s" competitors, with "s" being the tournament size. The winner of the tournament is the individual with the highest fitness of the "s" tournament competitors. The winner is then inserted into the mating pool. The mating pool, being comprised of tournament winners, has a higher average fitness than the average population fitness. This fitness difference provides the selection pressure,

which drives the GA to improve the fitness of each succeeding generation. Increased selection pressure can be provided by simply increasing the tournament size "s", as the winner from a larger tournament will, on average, have a higher fitness than the winner of a smaller tournament [2].

C. Uniform Crossover

Uniform crossover do not fragment the chromosomes for recombination. Each gene in offspring is created by copying it from the parent chosen according to the corresponding bit in the binary crossover mask of same length as the length of the parent chromosomes. If the bit in crossover mask is 1, then the resultant gene is copied from the first parent and if the bit in crossover mask is 0, then the resultant gene is copied from the second parent. A new crossover mask is generated arbitrarily for each pair of parent chromosomes. The quantity of crossover point is not fixed initially. So, the offspring have a mixture of genes from both the parents [3].

D. Uniform Mutation

The mutation operator randomly selects a position in the chromosome and changes the corresponding allele, thereby modifying information. The need for mutation comes from the fact that as the less fit members of successive generations are discarded; some aspects of genetic material could be lost forever. By performing occasional random changes in the chromosomes, GAs ensure that new parts of the search space are reached, which reproduction and crossover alone couldn't fully guarantee [4]. Uniform Mutation can be done using the following steps [5]. Choose one gene randomly. Replace the value of a chosen gene with a uniform random value selected between the user specified upper and lower bounds for that gene.

III. SYSTEM MODELING

A. Use Case Diagram

Use case diagrams are usually referred to as behavior diagrams used to describe a set of actions (use cases) that some system or systems (subject) should or can perform in collaboration with one or more external users of the system (actors). Each use case should provide some observable and valuable result to the actors or other stakeholders of the system. Fig 1 shows the Use Case Diagram of the application.
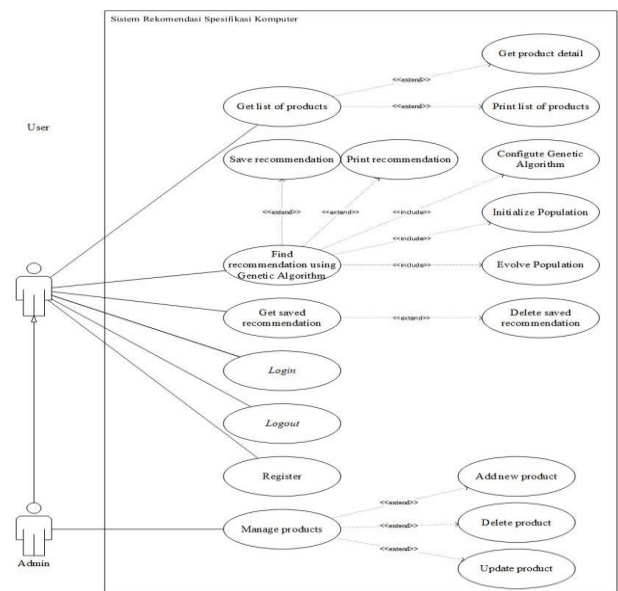
Fig 1. Use Case Diagram

B. Class Diagram

Class Diagram is UML structure diagram which shows structure of the designed system at the level of classes and interfaces, shows their features, constraints and relationships - associations, generalizations, dependencies, etc. Fig 2 shows the Class Diagram of the application.
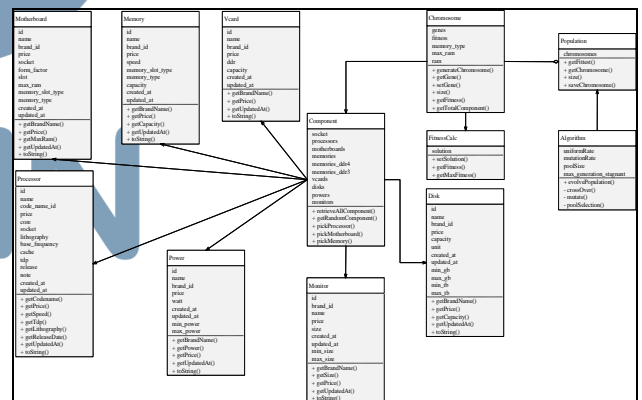
Fig 2. Class Diagram

IV. IMPLEMENTATION AND EXPERIMENT RESULTS

The system is built on a website platform using PHP, Bulma CSS framework, DataTables, and AngularJS. User will get recommendation of computer components base on their budget by using the following steps.

1. Defining the computer component that will be used. By the default, user will use all components.

2. Filter product by its minimum specification

3. Define budget.

A. Computer Specification Recommendation System

Users can define the computer components that will be used for getting a recommendation.
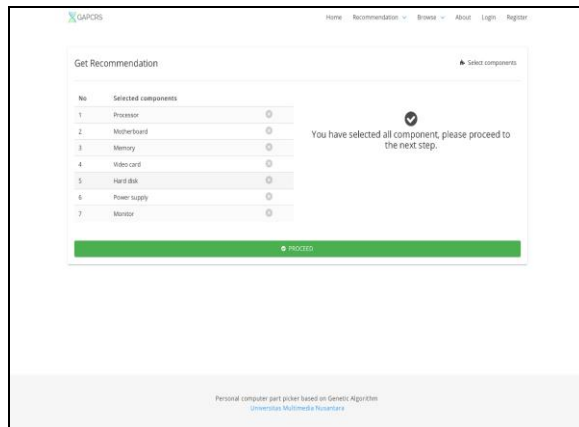
Fig 3. Defining Components

After user has defined the components, he/she will define the minimum specification of products for each component.
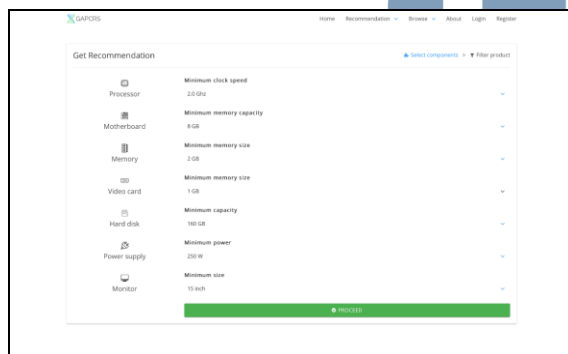
Fig 4. Defining Minimum Specification of Products

On the next page shown all of the components and their minimum specification of products. User will input budget and waiting until the Algorithm has found the solution. In Figure 3 the user has input IDR 3,500,000 to the budget.
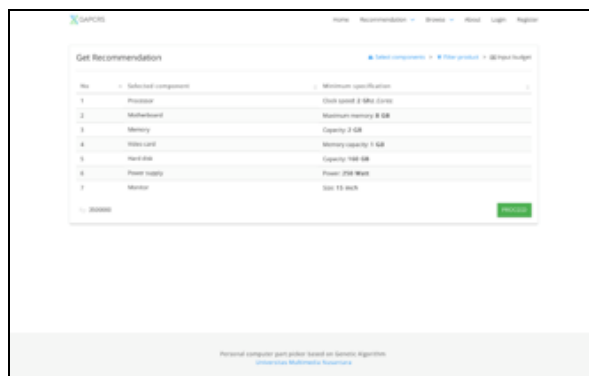
Fig 5. Input Budget

The combination of computer components will be show after the algorithm has found solution. The compatibility for each component have been checked automatically by the application so user don't have to worry about compatibility issues.
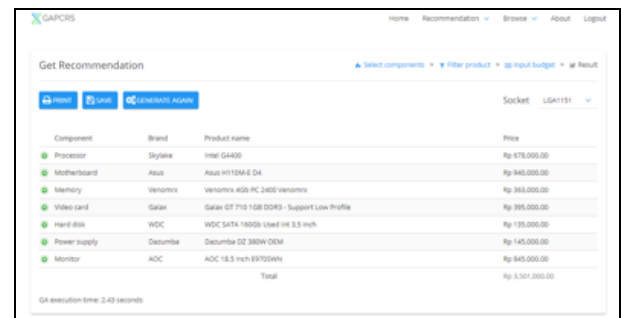
Fig 6. GA Result

B. Testing

Testing has been conducted by giving input IDR 3,500,000 to budget which is the worst case for the algorithm. The test used different population size and was performed for 30 times for each population size and processor's socket. The test set mutation rate and crossover rate 0.05 and 0.6 respectively. It is observed that the optimal values for mutation probability (0.001) and single point crossover with probability (0.6) with population size (50-100) as suggested by DeJong (1975) have been used in many GA implementations. Mutation probability above 0.05 is in general harmful for the optimal performance of Gas [6].

Table 1. Amount of Data Used in the Test

Component Name	Total Products
Processor (LGA 1151)	**17**
Processor (LGA 1150)	**17**
Processor(LGA 1155)	**25**
Motherboard	352
Memory	296
Video Card	458
Hard Disk	43
Power Supply	286
Monitor	252

Table 2. Test Result by Using 10 Population Size

Socket	Average Time	Average Generation	Average Difference
1151	0.626	502.7	Rp 10,500.00
1155	0.321666667	311.2333333	Rp 1,833.33
1150	0.414333333	323.9	Rp 2,400.00
Mean	0.454	379.277778	Rp 4,911.11

Table 3. Test Result by Using 30 Population Size

Socket	Average Time	Average Generation	Average Difference

Socket	Average Time	Average Generation	Average Difference
1151	1.049666667	326.3	Rp 2,600.00
1155	0.64	190.466667	Rp 866.67
1150	0.763	180.766667	Rp 800.00
Mean	0.81755556	232.511111	Rp 1,422.22

Table 4. Test Result by Using 50 Population Size

Socket	Average Time	Average Generation	Average Difference
1151	1.585	282.4	Rp 1,500.00
1155	0.824	136.5	Rp 666.67
1150	1.117666667	204.0666667	Rp 1,333.33
Mean	1.17555556	207.655556	Rp 1,166.67

Table 5. Test Result by Using 60 Population Size

Socket	Average Time	Average Generation	Average Difference
1151	1.80533333	270.233333	Rp 1,566.67
1155	1.097666667	155.4666667	Rp 966.67
1150	3.057	160.9	Rp 700.00
Mean	1.98666667	195.533333	Rp 1,077.78

Table 6. Test Result by Using 80 Population Size

Socket	Average Time	Average Generation	Average Difference
1151	1.99766667	224.233333	Rp 1,533.33
1155	1.68133333	183.033333	Rp 900.00
1150	1.36633333	153.8	Rp 600.00
Mean	1.68177778	187.022222	Rp 1,011.11

Table 7. Test Result by Using 100 Population Size

Socket	Average Time	Average Generation	Average Difference
1151	1.894	170.2	Rp 2,533.33
1155	1.594	137.9	Rp 466.67
1150	1.56266667	141.2	Rp 800.00
Mean	1.68355556	149.766667	Rp 1,266.67

C. Software Quality

Software quality questionnaire was filled by 33 respondents. The questionnaire questions were made based on EUCS model. By using Pearson Product-Moment Correlation, it was obtained that all the questions are valid, and by using Alpha Cronbach formula, it was obtained the questionnaire's reliability of 0.78 which can be considered as adequate [7]. The score for software quality is 75.75% which is considered good.

V. CONCLUSION AND FUTURE WORKS

Computer specification recommendation system using Genetic Algorithm has been successfully designed and developed. The score for software quality is 75.75% which is considered good.

Based on the experiments that have been carried out the most efficient population size in terms of time and the difference between budget and recommendation is 50. Larger population size will make the result is more accurate than smaller population size but it will take a longer time to find solution.

In order to improve the application, it is suggested that the application may provide a picture to each product and use different algorithm that has been mentioned before for crossover process, mutation process, and selection process to make the application works more efficient than before.

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The Design of Mobile Indoor Robot Guidance System

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Abstract—**The mobile indoor robot guidance system is a mobile robot which can assist users to find the desired position or location indoor or inside particular shed where Global Position System (GPS) failed to perform. Robot guidance system has many features in order to make the system useful for all of the users. The type of user who can make use of this system is mostly the disabled user and the user which is unfamiliar with the environment or the map. There is also potential usage inside the shopping mall or the big office spaces with the capability of displaying the advertisement during guidance process. This work deploys robot guidance system using geo-magnetic and Wifi methods for Indoor Positioning System (IPS). Although DC motors can generate interference to the magnetic sensor, the proper shields are adequate for the system. The metal shields for the DC motor can minimize the deviation from 6.41n T or about 16.74% for non-shielding motors to 2.86 n T or about 10.56%. Based on this research, mobile indoor robot guidance system can be implemented using various methods of IPS including geo-magnetic.**

Index Terms—**mobile robot, indoor positioning system (IPS), Wifi multilateration, geo-magnetic positioning, disabled user**

I. INTRODUCTION

The mobile indoor robot guidance system is a mobile robot which can assist users to find the desired position or location indoor or inside particular shed where Global Position System (GPS) failed to perform. Unlike the GPS assisted positioning/ guidance, indoor guidance system has unique parameters especially for non-expert user [1, 2]. This system has to work under an invisible path and narrow area of movement unlike the road assistance GPS. The non-expert users can find the desired position faster with minimal learning curve. This kind of system will be useful to be used in large shopping malls, factories, offices and public places. This system will also give better accessibility support for the physically disabled people. Another benefit from indoor navigation system for disabled people is for giving the abilities to be independent. The system helps to make their lives easy without any external aid [3].

There are several applications for Indoor Positioning System developed for smartphone users. Not all users can easily use the system. Elderly and disabled person might face difficulties when using smartphone-based indoor positioning system. To resolve this issue, robot guidance is needed to assist them for direction and telling them where they are.

This system needs Indoor Positioning System (IPS) to update their location. There are several choices in implementing an indoor positioning system, such as magnetic [4, 5, 10], wireless fidelity (WiFi) [6], Bluetooth [7, 8], and radio-frequency identification (RFID) [9]. Bluetooth solution is not easy to implement as they require additional beacon. Same goes for RFID which needs Wireless RFID Reader or gates. Whereas magnetic and WiFi based systems doesn't require additional infrastructure.

II. ROBOT GUIDANCE SYSTEM

Robot guidance system has many features in order to make the system useful for all of the users [1]. The type of user who can make use of this system is mostly the disabled user and the user which is unfamiliar with the environment or the map. The mobile indoor robot guidance system will give direct and easy guidance unlike the navigation using GPS and maps. This system can give direct guidance the same as guidance given by human or hospitality staff. There is also potential usage inside the shopping mall or the big office spaces with the capability of displaying the advertisement during guidance process.

A. Location Point

Robot guidance system should be aware of its position via indoor positioning system. Enhanced GPS positioning will not perform well in most of the building especially in the basement. This system is designed to know the indoor location based on the latitude and longitude reference. The use of latitude and longitude will give the advantage in software design to use common library developed for basic earth navigation. There are many methods to be used

for indoor positioning system. This research use Earth's magnetic field and WiFi to determine the latitude and longitude which represent the robot position on the map.

B. Units Location Name and Waypoint

Robot guidance not only work based on the latitude and longitude position. In order to interact with its user, the robot must have an idea of the location name it is located at and destination to guide users. Location name is known by comparing the distance between robot's position and the closest locations in the database. This referencing procedure help the user to simplify the position information. The same methods also applied to the location finding. The user is allowed to specify the waypoint to the target position. The waypoint can use the closest location to the predefined position in the database.

C. Location Information by Voice

The user interface / experience can be upgraded by giving the capability to receive location information by voice. This feature can be added using existing voice processing function provided by the operating system or additional voice processing function. This function is usually paired by voice command function. In this system, the voice command function can be beneficial for the visually impaired user to give command on where the user wants to go.

III. MOBILE INDOOR ROBOT GUIDANCE SYSTEM DESIGN

A. Database Design

This research use SQLite for database software. The database is divided into two groups. The first group is used for the geo magnetic fingerprinting while the second group for the positioning. The first group store geo magnetic fingerprints and RSS value of the access point (AP). Magnetic value use float data type while robotLat and robotLong use the same data type as latitude and longitude. The data structure for the first group can be found in Fig 1.
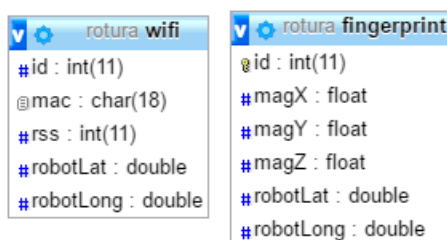
Fig. 1. Data structure for the first group

For the second group, MAC address use char 18 data type (delimiter included). RSS designed to use integer data type to represent the value of 0 to -110 dBm. AP table is being used for storing the detail

reference of each Access Point. Comparison table is added to link between position generated in geo magnetic method and Wifi method. Placeinfo is added to store the name of the location. The data structure for the second group can be found in Fig 2
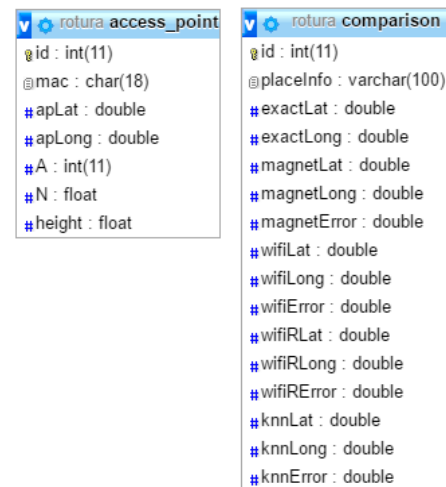
Fig. 2. Data structure for the second group

B. Software Design

The flow chart for the software can be found in Fig 3. The robot movement is based on the list of orders. When robot is on, robot will look for the wireless connection that has been set. After that, it will turn on web server that will send first position data to the main server. The main server will calculate data from robot and give command to robot. After robot receive that command, robot will move as instructed, recalculate position, and answer it with new data.
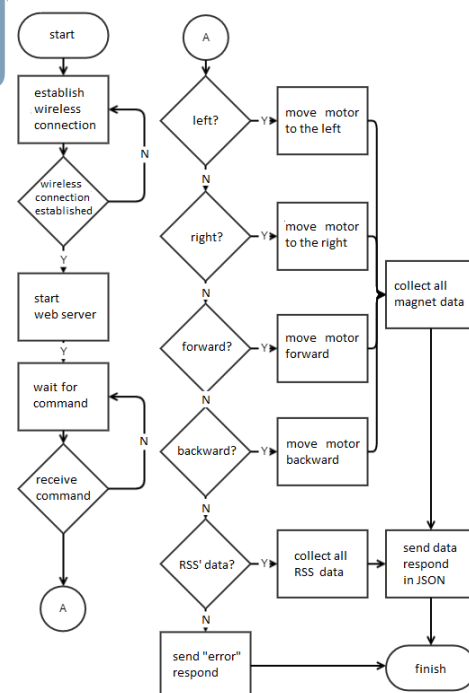
Fig. 3. Flow chart for Mobile Indoor Robot Guidance System

accuracy of the magnetic sensor, so the DC motors need to be isolated. Table I shows the difference in
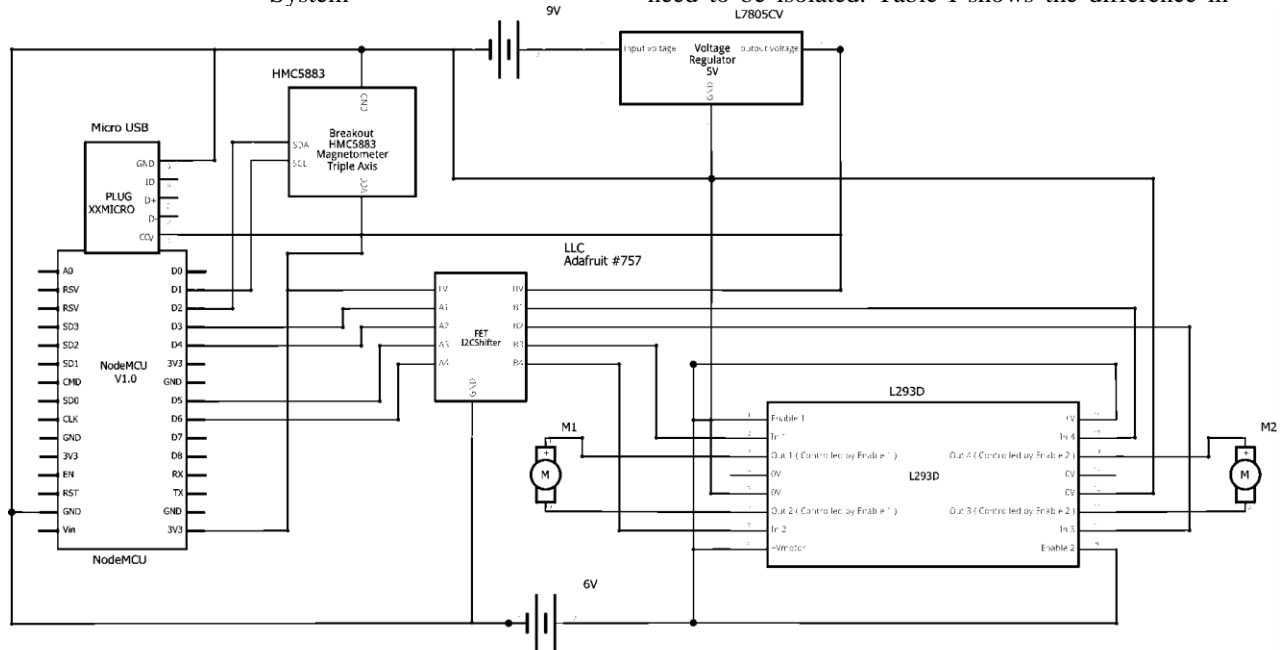
Fig 4. Schematic Diagram for Mobile Indoor Robot Guidance System

C. Hardware Design

Robot's hardware consists of the components as follows:

- ESP8266 NodeMCU
- GY-273 HMC5883L Module / digital compass
- DC motor and gearbox
- H-Bridge Motor Driver L293D
- Logic Level Converter (LLC) and regulator L7805CV
- Power supply/battery

The schematic can be found in Fig 4.

IV. THE IMPLEMENTATION, RESULT AND DISCUSSION

A. Earth's Magnetic Field

Magnet has three orthogonal strength (X, Y, and Z), total field strength (F), and two angles (D and I) [11]. X, Y, and Z component are being used to build fingerprint data. The robot compare sensor readings with the fingerprint to determine location.

The constraint of using earth's magnetic field is the magnetic field interference from robot part. This research also measures the effect of the usage of DC motors to the reading in magnetic sensor. The magnetic field from DC motors can affect the

TABLE I. DC MOTOR EFFECT AGAINTS HC5883L SENSOR READING

| Point/ Location	Magnetic Compo-nent	Motors (nT)	Without Motors (nT)	Diff (nT)
A	X	53.27	47.18	6.09
	Y	-13.64	-12.18	1.46
B	X	54.45	45.91	8.54
	Y	-10.27	-14.27	4
C	X	50.91	43.27	7.64
	Y	-29	-35.27	6.27
D	X	53.27	44.36	8.91
	Y	-29.55	-32.18	2.63
E	X	-23.55	-31	7.45
	Y	-69.18	-60.27	8.91
F	X	-25.36	-33.45	8.09
	Y	-67.16	-60.27	6.89
			AVG	6.41

Then the proper metal shields are installed in the DC motors to minimize the effect of interference. Table II shows the sensor readings between robots that used DC motors equipped with shield and without motors. It had an average difference result of 2.86nT or about 10.56%.

B. Wireless Fidelity

Robot also use received signal strength from WiFi to determine location points with multilateration [12, 13]. In Multilateration, access point (AP) location point is very important, because multilateration is calculated based on the position of three or more detected AP as in Fig. 5.

C. Mapping

This research uses 32 points of references for making sure that the results are correct. These points are considered as geo referencing for this research. The positions of the points are shown in Fig 6 and 7.

TABLE II. DC MOTOR WITH SHIELD AGAINTS HC5883L SENSOR READING

Point/ Locati on	Magnetic Compo- nent	Motor (nT)	Without Motor (nT)	Diff (nT)
A	X	30.27	28.73	1.55
	Y	16.82	20.91	4.09
B	X	27.91	26.82	1.09
	Y	26.09	29.09	3
C	X	24.55	23.36	1.18
	Y	30.82	37.09	6.27
D	X	26.45	24.27	2.18
	Y	36.09	39.64	3.55
E	X	19.55	16.55	3
	Y	30.36	34.36	4
F	X	22.55	22.36	0.18
	Y	17.45	21.73	4.27
			AVG	2.86

Comparing the result of the magnetic IPS and Wifi multilateration IPS can be done directly by compare the average error rate of each mapped position. The magnetic IPS generates less error rate which is 4.08m with the standard deviation of 4.68m. The WiFi IPS generates the data which have the error rate of 10.7m with the standard deviation of 6.26m. This result shows that the interference from the DC motor can be minimized and still perform better than the use of WiFi in positioning.
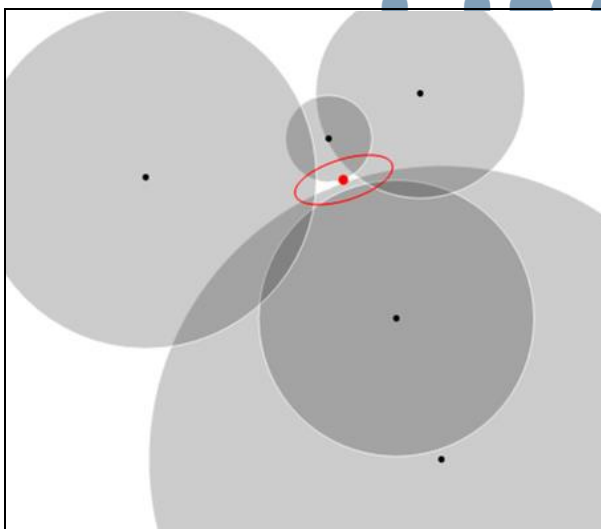
Fig. 5. Multilateration [14]

The data then compared to the geo referencing and then converted to distance in meter. The value of 1m is equal to 0.0000091 degrees in latitude and longitude.

V. ADDITIONAL FEATURES

Some features can be added to make the mobile indoor positioning system performs better.

A. Obstacle Avoidance

Robot equipped with ultrasonic sensor (HCSR04) to avoid obstacle in all of the edges of the robot. Robot will find another path if it finds obstacle that block the way.

Fig. 6. Points of references

Fig. 7. Points of references in the building area

B. Recalculate Position and Route

The robot is able to store the latitude and longitude of current location and latitude and longitude of the destination. When the robot moves, system can recalculate the route to the destination. This approach can minimize the dependency to the preset waypoint data in the system.

VI. CONCLUSION

The mobile indoor robot guidance system is a mobile robot which can assist users to find the desired

position or location indoor or inside particular shed where Global Position System (GPS) failed to perform. Robot guidance system has many features in order to make the system useful for all of the users including the disabled users. Robot can be implemented using various methods of IPS. At this work, both magnetic and WiFi are used for guidance. The proper metal shields are installed in the DC motors to minimize the effect of interference. This approach can minimize the deviation from 6.41nT or about 16.74% to 2.86nT or about 10.56%.

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Creating A Web-Based Online Flashcard for Korean Vocabulary Memorization

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Abstract— **The Korean language is one of the most enthused language these days, mainly caused by the Hallyu wave. In traditional language learning techniques, flashcards are often used to help memorize simple syllables. Nowadays, online flashcards are used as a replacement for the traditional flashcards, which are proven to be more effective in many ways. However, the lack of use of appropriate methods to learn a new language will result in slower learning process. Therefore, by implementing a suitable method such as the Leitner method to an online flashcard will improve the learning process. The Leitner method sets aside the questions that can be answered easily and allows users to focus on questions that cannot be recalled consistently by distributing a set of questions in five different sections. Every question that can be answered by the user is moved to the next compartment, where the question will be repeated after a specified period of time. System usability scale is used to measure the usability of the application. This application has been successfully designed and built using the Leitner method to give the user the suitable interval of time for learning with flashcards and achieved a system usability scale score of 82,5.**

Index Terms— **Leitner, Online flashcard, Laravel, Korean language.**

I. FOREWORD

To start learning a new foreign language, focusing on learning simple vocabularies is considered as a good way to learn blocks of sentences in order to improve skills of speaking in Korean [1]. One of the traditional ways to memorize vocabularies in a foreign language is to learn and repeat the characters periodically and see the visuals of the meaning of the foreign language so that it can be easily absorbed and remembered by using traditional flashcards [2].

In this era where technology has penetrated almost in all areas of the learning process, manual flashcards are no longer widely used. While technology was not superior, flashcards are used as a common practice to study by writing facts to be learned on a set of cards, which users see each card, think about the answer, then flip the card and take the next card. However, reviewing questions in manual flashcards is not effective because there are no specific guidelines to

decide when to review a particular question, and the learning process will consume more time [3].

Therefore, by applying the appropriate method such as the Leitner method to online flashcards can enhance the learning process. By using Leitner, if a question cannot be recalled by the user, the question will be repeated more frequently so that the question can be remembered faster. This method sets easily recalled questions aside from the difficult questions and allows users to focus on questions that can not be answered consistently [4].

Similar studies done by Agustyan Hidayat in "Design and Develop Spaced Repetition Software to Remember Japanese Characters using SM-2 Algorithm Based on IOS" and Jeremiah Daniel de la Rouviere in "Chinese Radicals in Spaced Repetition Systems: A Pilot Study on the Acquisition of Chinese Characters by Students Learning Chinese as a Foreign Language" by implementing the SuperMemo-2 algorithm. The difference between SuperMemo-2 algorithm and the Leitner method lies in the element determining the lag time for repetition [5]. The Leitner method uses a fixed variable to determine the lag time for the next repetition, whereas the SuperMemo-2 algorithm performs calculations made based on the performance of the user [6]. SuperMemo-2 may be able to boost learning efficiency, however the complexity of the calculations to determine the lag interval is considered too complicated and are more prone to errors when the scheduling is implemented into an application [7].

II. THEORETICAL BASIS

A. Korean Language

The Korean language is considered as one of the most enthused foreign language. Hallyu wave refers to the phenomenon of Korean entertainment and culture that are becoming more popular in the world with music, drama and film. The term was first coined by the Chinese media in the late 1990s to describe the increase in the popularity of Korean pop culture in China that boosts enthusiasm of the Korean language [8], but the cost to learn the Korean Language is fairly

costly, therefore some people have difficulties to learn words in Korean [9].

The Korean language has been around for thousands of years. Initially, they used Chinese characters to write the Korean language, called Hanja (한자). Hanja is not widely used to write in Korean anymore, but is still used in traditional and formal writings [10]. The words in the Korean language is represented by Hangul. Hangul is a phonemic writing system that consists of letters for consonants and vowels. Unlike the general phonetic writing systems such as Roman alphabet, Hangul is uniquely designed to combine consonants and vowels into units of syllables. Therefore, we can say that Hangul has something in common with syllabic writing systems [11].

B. Online Flashcard

According to Merriam-Webster, a flashcard is a card bearing words, numbers, or pictures that is briefly displayed usually as a learning aid. Flashcards are usually made using paper / cardboard and contains small text and images. There are eight main principles to make a good traditional flashcard [2].

1. The use of images. Studies revealed that the memory for pictures and simple texts are higher than the use of explanations using individual images [12]. The information presented orally and in writing are more memorable because the information presented with pictures can be ambiguous.

2. Create more flashcards to explain a scecific meaning. In order to maximize the learning outcome, create more flashcards using different explanations.

3. Use one question to explain one answer. If there is more than one answer to a question in a flashcard, the latter answers are easily forgotten than the first answer.

4. Prioritize the understanding. Users do not have to answer the same questions as those listed on a flashcard. If the user is able to answer with the synonyms of a certain answer, then the user has successfully answered the question.

5. Avoid the use of antonyms. The use of antonyms to explain questions are more prone to mistakes in recalling the correct answer.

6. Use straightforward and direct questions. Try to avoid a lengthy explanation and explain questions in short words that are easier to remember.

7. Use easy explanations. For explanations of a definition of a certain word, avoid sentences that are difficult to understand. Use annotations that can be remembered and understood easily.

8. Prevent the use of corections to study grammar To learn grammar, avoid using questions that ask the user to search for errors in a sentence as it will result in recollecting the wrong word.

The main advantage of learning using flashcars are direct feedbacks to find out if the answer right or wrong, and learning in small blocks so that learning process becomes effortless.

Flashcards are used as a common practice to write facts to learn at a set of cards, in which users see each card, think about the answer, then turn the card over and take the next card. But reviewing all the questions in a flashcard without a proper reference is considered less favorable because there are no guidelines to decide when to further review a particular question. Another problem is that the easy questions are repeated as often as difficult questions, resulting in the lack of reviewing difficult questions, and the learning process becomes less optimal because the time needed to learn takes up more time [3].

Online flashcards are designed to simulate traditional flashcards where two sections on the screen represent the front and the rear side of a flashcard [13]. The front side of the flashcard are questions in the form of texts, and the rear side of the flashcard are answers of the questions written on the front side. Online flashcards are designed to facilitate learning without the need to carry physical cards for studying a specific subject, which can help improve learning efficiency, accessibility and more interactivity, making the learning process stimulating. There are five main reasons to use online flashcards [14].

1. Easy access. Online flashcards can be accessed by using tablet PCs and smartphones, which are reachable compared to traditional flashcards.

2. Images can be added easily. Images can be found easily with the access of internet, so the drawing ability does not affect the image quality in a flashcard.

3. Reducing the use of paper. The use of online flashcards can help reduce paper usage and help save the environment.

4. Flashcards can be shared easily. Flashcard can be shared easily to others by sharing among social media.

5. Saves time. Online flashcards are made easier and more accessible, so that the time used to revise flashcard be maximum and learning outcomes can be improved.

C. Spaced Repetition System

According to Rehana Mubarak in the publication entitled "Spacing Effect and Mnemonic Strategies: A

Theory-Based Approach to e-Learning", the process of learning can be more effective if the informations are repeated in different intervals, where difficultly recalled questions are repeated in a shorter time interval and easily recalled questions reviewed again in a Moment [15].

Ebbinghaus concludes that a person is able to remember 100 percent of an information upon receiving the question. Thereon, the information is forgotten promptly. In merely 20 minutes, 42 percent of what has been learned are forgotten, and in 24 hours, 67 percent of the information is lost from memory. In the end, after a month, a person is only able to remember 21 percent from the information that has been memorized [16]. The forgetting curve shows a decrease of retention in the long run, where information will be lost if it is not recalled again [17].

Spaced repetition system is a learning technique used by combining the interval of interval time between repetition of the previously learned material to develop a psychological spacing effect into codes that can be implemented in an application. Spaced repetition are commonly used ina contect where a person needs to study a large amount of information and make sure the informations can retained in the memory. Spaced repetition system is suitable to use in terms of learning vocabulary in a foreign language [18].

D. Leitner method

The Leitner Method was developed by Sebastian Leitner in the 1970s with the aim to improve the efficiency and effectiveness of learning. The traditional Leitner method divides questions into five different compartments. The main process of the Leitner method can be described in Fig 1 below.
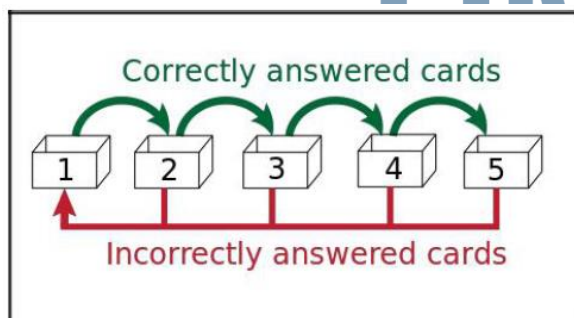

Fig 1. The Leitner Method [3]

All flashcards starts from the first deck (Stack 1) is regarded as a question that was never reviewed, and it is assumed that the question in the first stack is the hardest, so that these questions need to be addressed in a short time so that the answers are easier to remember. When reviewing the flashcards, all correct answers will be moved to the next deck, because the answers were considered easier to remember by the user. This process is repeated until the last deck, and if there are questions that are not recalled by the user, the

flashcard is moved back to the first compartment, since the question is considered to be forgotten and needs to be reviewed again in a short period of time so that the answers can be remembered easily. The key to the efficiency and effectiveness of the Leitner system is that a card that is in the lowest deck would be more frequently reviewed than the cards that are in the highest deck. This method sets aside the questions that can be answered easily and allows users to focus on questions that cannot be answered consistently [4].

The main concept in the Leitner method is to study the information within a specified time. At the beginning of the learning process, all the flashcards start from level 1. The Leitner Schedule used for this application is a loop within 16 days to determine how often to repeat the information in a different box for five different compartments [19].

Table 1. Standard time settings for the Leitner method

Level	Time required for the next occurence
1	0 days
2	1 day
3	3 days
4	7 days
5	15 days

Table 2. Utilization of determining the level for 16 days

Day	Level	Day	Level
	1,2	9	1,2
2	1,3	10	1,3
3	1,2	11	1,2
4	1,4	12	1, 5
5	1,2	13	1,2,4
6	1,3	14	1,3
7	1,2	15	1,2
8	1	16	1

Table 1 is the default setting for the Leitner method, and the utilization of determining the level for sixteen (16) days are shown in Table 2 [19]. The use of the Leitner method has many advantages. The Leitner method users can learn words in a short time unit and are able to study according to the user's memory. The main advantage of this method is that users are able to focus on flashcards that are more difficult to remember, which results is a reduction in the amount of time it takes to learn a subject. This method will provide maximum learning results if the learning process is done every day and interspersed

with a short break after studying for 45 to 60 minutes [20].

E. System Usability Scale

System Usability Scale (SUS) is a series of questions to the questionnaire prepared by John Brooke in 1986 to collect data to evaluate a wide range of products and services, including hardware, software, mobile devices, websites and applications and other media [21]. SUS is part of the ISO 9241 standard, which ISO defines usability [22]. SUS consists of ten questions in a questionnaire with five answer options to respondents that varies from strongly agree to strongly disagree and are represented in the form of the numbers one through five [23]. SUS has become the industry standard, with more than 1300 references in articles and publications. The main benefit of using SUS to scale usability of an application is that the scale of response is easily understood by the participants of the questionnaire, and also that it can be used in small samples with reliable results. SUS results can distinguish between systems that can be used and cannot be used [24]. Calculation of votes for the SUS is as follows [25].

1. Odd-numbered items: subtract one from the user response.

2. Even-numbered items: subtract the user responses from 5 points

3. Add up the converted responses for each user and multiply that total by 2.5. This converts the range of possible values from 0 to 100 instead of from 0 to 40.

Based on the results from 500 different evaluation studied by Jeff Sauro, the average value for SUS is 68 points. If the value is more than 80.3 points, then the system is considered as an excellent system. If the value of SUS is higher than 68, then the system is considered above average. If the value of SUS below 51, then the system is not considered good enough and less in accordance with the standard and changes in the system are necessary to increase the value of the SUS [26]. One advantage of using SUS as a measurement of the degree of usefulness of the application is the minimum amount to get the SUS points is relatively small, with fifteen users [27].

III. SYSTEM DESIGN AND ANALYSIS

The following are the research method implemented in this paper.

1. Literature review, a process in which a study of sources such as journals, reports, applications, web pages, or articles that have been published by other researchers about Leither, flashcards, online flashcards, spaced repetition systems, and others are studied.

2. Application design, a process in which the application algorighms are designed to ease the app making process.

3. Application implementation, a process which implements the algorithm and design that was made in the code to build a web-based online flashcard application.

4. Survey, a process which conducts a survey to ensure product quality from the user's perspective so that the application can be used as a medium of learning the Korean language which are interactive and easy to use.

5. Create reports, a process in which a report is made to summarize the process of creating the application as well as the conclusions of the research.

A. Flowchart

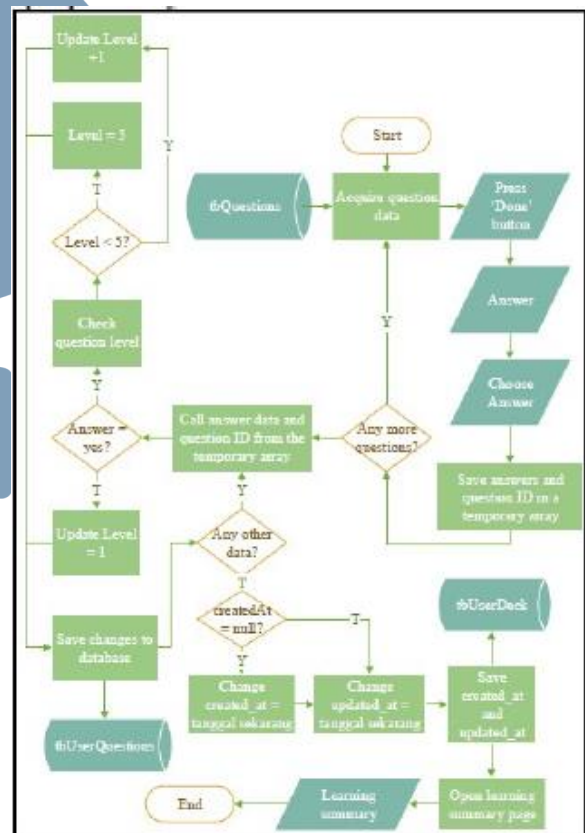Fig 2 shows the flowchart used to determine the level by implementing the Leitner method.

Fig 2. Leitner learning process

B. Entity Relationship Diagram

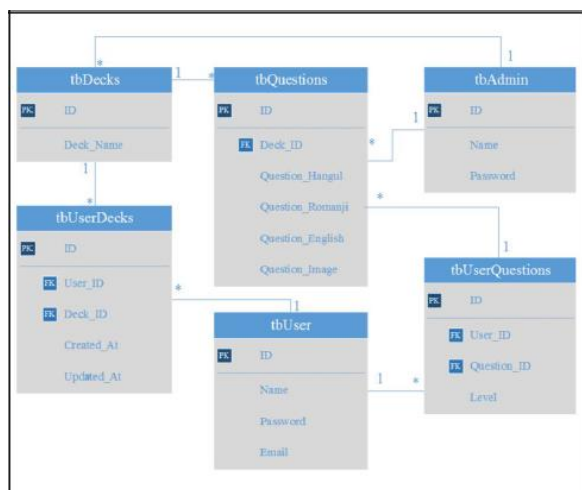Fig 3 shows the Entity Relationship Diagram created for the application.

Fig 3. Flashcard application ERD

IV. TESTING AND IMPLEMENTATION

Application testings are commenced so that the application made is in accordance to the main purpose of making this application.

This test measures the user satisfaction levels when using this application to learn the Korean language. The questions used in this application is according to the System Usabilty Scale (SUS) and the results are taken from five different respondents to obtain an average value for the application. Table 3 shows the calculation results with SUS for the first version of the application from a perspective of five users.

Table 3. First respondents results

Question no.	Respondents				
	P1	P2	P3	P4	P5
Q1	3	5	4	3	4
Q2	2	3	3	2	3
Q3	4	4	4	4	4
Q4	2	3	5	3	3
Q5	4	5	4	3	4
Q6	4	4	1	3	2
Q7	5	3	1	4	5
Q8	1	1	1	1	2
Q9	4	3	3	3	4
Q10	5	5	4	4	3
SUS score	65	60	60	60	70
Average SUS score	63,0				

As a result of low average yield score from the five respondents who have used the application for the first time, the application received an unsatisfacory value of SUS of 63.0 points, therefore a few changes were made for the application. Tutorials were added before the learning process begin to ensure users understand how to learn the application properly. Table 4 shows the calculation results with SUS for the second version of the application from a perspective of five users.

Table 4. Second respondents results

Question no.	Respondents				
	P1	P2	P3	P4	P5
Q1	4	5	4	3	4
Q2	2	2	2	2	2
Q3	4	4	5	4	4
Q4	2	2	5	3	2
Q5	4	3	5	3	4
Q6	1	2	1	2	2
Q7	4	4	5	5	5
Q8	2	1	1	1	2
Q9	4	4	4	4	4
Q10	3	2	3	2	2
SUS score	75	77,5	77,5	72,5	77,5
Average SUS score	76,0				

Based on the average yield of the five respondents who have used the application for the second time, the SUS value obtained is quite satisfying. The SUS score obtained for the second version of the application is 76.0 points. Some minor changes in the application is made again to boost the value of SUS. The changes made are modifications to the application's layout for an orderly interface, adding links to the learning progress page after each category is completed, and the addition of the 'About', 'Credits' and 'Help' menus for an explanation regarding the application and the addition of the 'Tutorial' menu on the category selection page.

Table 5 shows the calculation results with SUS for the third version of the application from a perspective of five users.

Table 5. Third respondents results

Question no.	Respondents				
	P1	P2	P3	P4	P5
Q1	4	5	4	4	4
Q2	2	2	2	2	2
Q3	5	4	5	4	4
Q4	2	2	2	1	1
Q5	5	4	4	4	4
Q6	1	1	1	1	1
Q7	5	5	5	5	5
Q8	1	1	1	1	2
Q9	5	4	3	5	5
Q10	2	2	1	1	1
SUS score	90	85	85	90	87,5
Average SUS score	87,5				

Based on the average yield of the five respondents, the SUS value obtained is satisfying. The SUS score obtained for the third version of the application is 87.5 points.

V. CONCLUSION AND FUTURE WORKS

The final conclusion is that the web-based application used to memorize the Korean language was successfully designed by implementing the Leitner method. The application has been successfully constructed by implementing the Leitner method to determine the repetition interval for each questions. The application has managed to produce a dynamic interval where each users can obtain a different learning interval so that the application can adapt according to each users and has obtained a satisfying system usability scale score of 87,5 points. Further suggestions for the inprovement of the application is to improve the learning system in terms of an addition to the learning features to determine the learning process when a user skips a day of learning so that the learning process corresponds to the Leitner method by adding the questions from the skipped days to the day the user opens the application. improvements can also be made to enhance the user interface so that the learning process can be more appealing and can help motivate the learning process by using the application. In addition, a sound output can also be added to each flashcards to learn the pronounciation of each words.

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Maximal Overlap Discrete Wavelet Transform, Graph Theory And Backpropagation Neural Network In Stock Market Forecasting

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Abstract—The aim of this paper is to get high accuracy of stock market forecasting in order to produce signals that will affect the decision making in the trading itself. Several experiments by using different methodologies have been performed to answer the stock market forecasting issues. A traditional linear model, like autoregressive integrated moving average (ARIMA) has been used, but the result is not satisfactory because it is not suitable for model financial series. Yet experts are likely observed another approach by using artificial neural networks. Artificial neural network (ANN) are found to be more effective in realizing the input-output mapping and could estimate any continuous function which given an arbitrarily desired accuracy. In details, in this paper will use maximal overlap discrete wavelet transform (MODWT) and graph theory to distinguish and determine between low and high frequencies, which in this case acted as fundamental and technical prediction of stock market trading. After processed dataset is formed, then we will advance to the next level of the training process to generate the final result that is the buy or sell signals given from information whether the stock price will go up or down.

Index Terms—stock market, forecasting, maximal overlap wavelet transform, artificial neural network, graph theory, backpropagation

I. INTRODUCTION

Forecasting stock market has been a hot topic in the last decades. It has been investigated, researched and experimented by researchers and professionals. A large number of methods for computing and stock predictions have been performed to solve the challenges [1]. The main issues of the forecasting are that the flow of the stocks hard to follow due to high volatility clustering and chaotic properties of stock market prices.

Several experiments by using different methodologies have been performed to answer the stock market forecasting issues. A traditional linear model, like autoregressive integrated moving average (ARIMA) has been used, but the results are not satisfactory because it is not suited to model financial series. Yet experts are likely observing another approach by using artificial neural networks. Artificial neural network (ANN) are found effective in realizing the input-output mapping and can estimate any continuous function which given an arbitrarily desired accuracy. One of the ANN model proposed is back propagation algorithm (BP) [2], however this model also met two obstacles like low convergence rate and instability. On the other hand, another method yet to be observed is multi resolution analysis techniques like wavelet transform. It would likely give an unusual effects performed by wavelet processed data on the performance of numerical algorithms used to train the back-propagation algorithm.

The purpose of this paper is to aim for a high accuracy of stock market forecasting in order to produce signals that will affect the decision making in the trading itself. The paper is likely will combine several methods experimented before by another researchers to give processed data from raw data to be trained by artificial neural networks method. In details, we will use Maximal Overlap Discrete Wavelet Transform (MODWT) and graph theory to distinguish and determine between low and high frequencies, which in this case acted as fundamental and technical prediction of stock market trading. After processed dataset is formed, then we will advance to the next level of the training process to generate the final result that is the buy or sell signals given from information whether the stock price will go up or down. While the main contributions of this paper are:

- Combining MODWT and Graph theory in the preprocessing stage to extract stock features by using low and high frequencies as the representation of short and long term trend.

- Using backpropagation neural network to train the dataset produced by the combining algorithm to achieve the desirable decision output (buy or sell output)

II. RELATED WORKS

Stock prediction is one of the most important issues in finance, various techniques have been adopted by researcher to predict the stock price.

Maximal Overlap Discrete Wavelet Transform have been implemented for decomposing the financial time series data [2,6,5,8,9] and to examine the effectiveness of high-frequency coefficients obtained from wavelet transforms in the prediction of stock prices, artificial neural networks (NN) were adopted [1,3,4].

Various kinds of wavelets are available such as the Haar,Mexican Hat, Morlet and Daubechies Wavelets [7]. In this paper, the Moving Average Discrete Wavelet Transform (MODWT) method were applied to decomposed the original signal.

III. METHODOLOGY

First of all the data collection will be conducted from online website, then the data will be processed through the attributes selection. Then after the attributes selection the data will be placed under wavelet transform to extract the features of the data. The next step that will be done is process the extracted features with the graph theory to get the strong correlation to give another attribute to the datasets. The last method is to train the complete datasets of training and test them with the testing datasets.
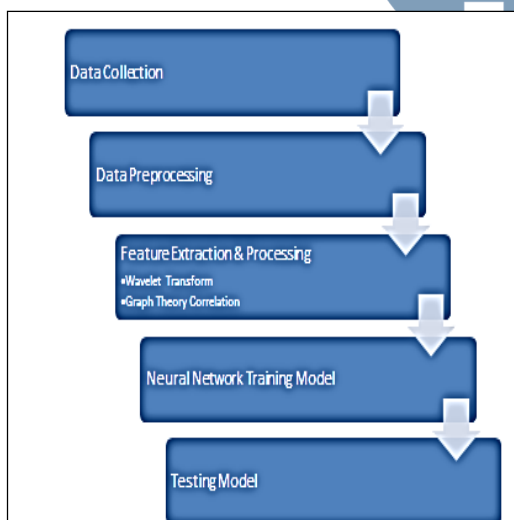

Figure 1. Methodology

1. Data Collection. Data Collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes. The goal for all data collection is to capture quality evidence that then translates to rich data analysis and allows the building of a convincing and credible answer to questions that have been posed.

The first step in this research is the data collection. In this stage, we carefully choose what types of data set will be used for the experiments.

The data of the stock market are varies and it contains a lot of types, there are Composite Index, Blue Chip stocks, and also common stocks. Besides that the other thing that we have to be concerned about is the marketplace itself, like American, European, and Asian, and other markets.

In these experiments the data sets collection selected is combination of Composite Index and Asian market. The main reason of the selection is that because the volatility of stock price movement for the Composite Index in Asian market is relatively stable so that will reduced the error possibilities produced.

We collect the data of Indonesian Stock Market Exchange (code: JKSE) from the online website. The data will conduct data from January 2010 until March 2015.

Table 1. The Data of Indonesian Stock Market Exchange

Date	Open	High	Low	Close	Volume
Apr 16, 2014	4,883.49	4,893.54	4,870.61	4,873.01	4,263,442,400
Apr 15, 2014	4,872.30	4,893.23	4,863.01	4,870.21	4,069,120,000

The data contained variables of daily Date, Open, Close, Volume, Low, and High Prices can be seen in Table 2.

Table 1. Data Row Attributes

Name	Description
Open	Price when market open
Close	Price when market close
Volume	Stock market volume traded
High	Price when market reach the highest of the day
Low	Price when market reach the lowest of the day
Date	Time when the stock market movement occurred

2. Data Pre Processing. The next step is the data preprocessing stage. In this stage the attributes will be selected according to the usage in the forecasting model. In this experiment we process the normalization for some attributes, like Open and Volume in order to scale a fall within a small and specified range. The normalization used is normalization by min-max normalization (-1 and 1) because in wavelet transformation, the result will be more satisfactory if the range contained positive and negative values. And for the attribute construction, new attributes necessary are

constructed from the given one. For example in this experiment we add V_conv, δ , dim1, dim2, and dim3 to support the training and testing data set for the forecasting of stock market price. From the data pre-processing procedures we understand that the selection of attributes is depended on how the attributes affect the outcome of the model. In this case the main attributes (*Open, Close, Volume, High, Low* and *Date*) are still not sufficient to give the expected results outcome. Hence the dataset will be transformed into another form which will be used in the next stage (Date, Open, Close, V_conv, and δ(%)). Where we can get the attribute δ,

$$\delta(\%) = \frac{Close - Open}{Open} * 100$$

Another attribute that we attained is the Volume Converted (V_{conv}), where $V_{conv} = Volume$ for positive values of $\delta(\%)$ and $V_{conv} = -(Volume)$ for negative values of $\delta(\%)$.

3. Wavelet Transform. Wavelet is a wave with amplitude begins at zero, increases and then decreases back to zero. Wavelet is very powerful for signal processing because it is constructed to have specific properties.

   In this experiment, the wavelet transform used is Moving Average Discrete Wavelet Transform (MODWT). The using of this wavelet because MODWT is a wavelet transform algorithm that could overcome the lack of translation-invariance of discrete wavelet transforms.

   The mother wavelet used is Daub4. The Haar wavelet has the advantage of very good time localization but the frequency resolution is minimal and not smooth. From the Haar wavelet we can see that the wavelet transform is equivalent to a filtering process with two filters, which divide the time series into wavelet part, which extracts the detail and the smoothed part. Daubechies discovered other filter coefficients. The simplest set has only 4 coefficients which famously known as Daub4. The selection of Daub4 is because it can extract the detail and the smoothed part, which cannot be done by Haar.

   The datasets used for the training data and testing data are 2^n (to be precised 1024 dataset for training data and 32 set for testing).

   The goal of this wavelet transform is to extract the features from the Open price and transform them into dimensions (dim), which then will be used for additional attributes for the final data set.

4. Graph Theory Correlation. The applicability of the graph theory is in determining of the three most significant attributes from MODWT dimensions. The three attributes attained by giving threshold for every wavelet dimension data set by observing the minimum and maximum value of every dimension and δ from the data set. After receiving the three significant dimensions referred as dim1, dim2, and dim3 we then proceed to the next stage.

5. Neural Network Training Model. In this neural network training we will train datasets from the training datasets supervisedly to be compared then with the testing datasets. The training datasets consists of several attributes like *Open, Target (Close), δ, V_{con}, dim1, dim2 and dim3*.
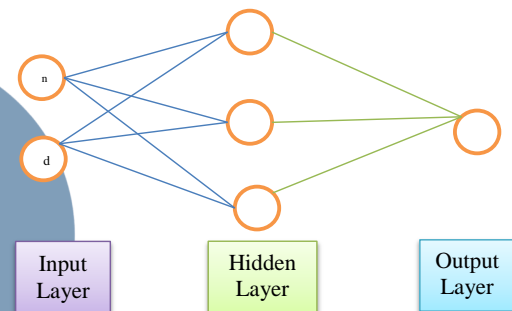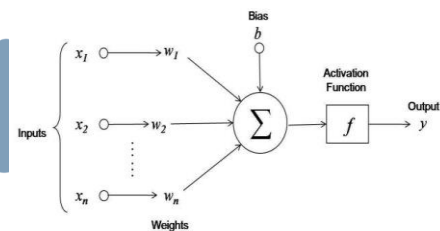

Figure 2. BPNN Scheme

Figure 3. Activation Function Scheme

For the neural network training that will be used is back propagation. The back propagation neural networks are feed-forward neural networks with one of more hidden layers that capable of approximating any continuous function up to certain accuracy with only one hidden layer. BPNN consists of three layers, named input layer (used to correspond to the problem's input variable), hidden layer (used to capture the non-linear relationships among the variables) and output layer (used to provide the predicted values). Relationship between the output *y(t)* and the input *x(t)* is given:

$$y(t) = w(0) + \sum_{j=1}^{u} w(j) . f\left(w(0,j) + \sum_{i=1}^{v} w(i,j).x(t) \right)$$

Activation Function scheme can be seen in Figure 3 with the activation functions for the output layer used are the sigmoid and hyperbolic functions. The objective function to minimize is the sum of the squares of the differences between the desirable output $y_d(t)$ and the predicted output $y_p(t)$. The training of the network is performed with the steepest descent algorithm, as follows:

$$\Delta w(k) = -\alpha(k)g(k) + m\Delta w(k-1)$$

Where $\Delta w(k)$ is the vector of weight changes, $g(k)$ is the current gradient, $\alpha(k)$ is the learning rate that determines the length of the weight update, and m is the momentum parameter that allows escaping from small local minimal on the error surface and avoids having oscillations reduce the sensitivity of the network to fast changes in the error surface.

The parameter for the neural network is that training cycles 10000 epoch, learning rate 0.2, momentum 0.3, and error epsilon 10^{-5}.
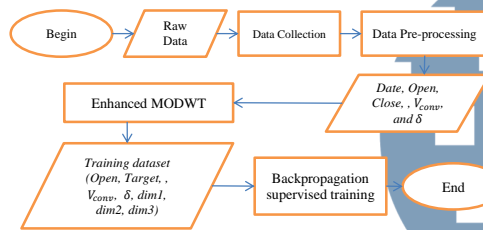

Figure 4. Training Model Flowchart

6. Testing Model. The testing of the model is by comparing the data results of the applied model of backpropagation's prediction results with the original data. The experiments consist of several kinds of data testing combination, using full portion of the same data with the training data, partial portion, and completely new data.

The prediction results then will be matched with the real data and then calculated for the errors. To test the performance of the model, the complete model will be compared with another model of discrete wavelet (DWT) transform with Haar transform model and using Backpropagation Neural Network (BPNN) for the forecasting.
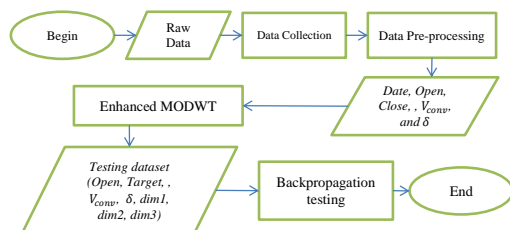

Figure 5. Testing Model Flowchart

IV. RESEARCH RESULT

A. Experiment with JKSE (Asian Market Composite Index)

The data used for the datasets are Indonesian stock exchange (JKSE) data vary from 2010 until 2015. To be exact, 1024 datasets will be used for the training and 32 datasets for the testing.

1. Data collection and Pre-processing. Since the data used for the dataset is data series then data JKSE from range 2010 until 2015 are collected. The select of JKSE data is because the JKSE movements are relatively stable with approximate changes 0.026%.
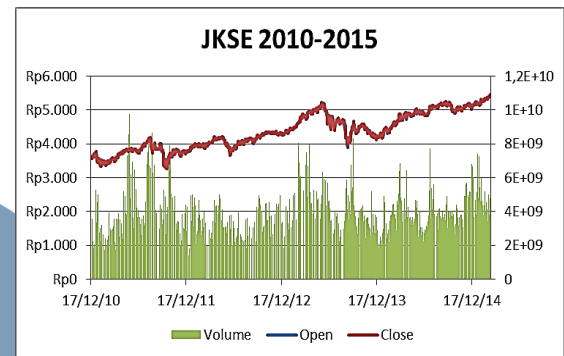

Figure 6. JKSE 2010 – 2015

Total dataset that will be used are 1024 in total for the training data and 32 dataset for testing. For the testing, here will be 3 scenarios:

a. Full training dataset

In this scenario all the dataset used are taken from the training set. In total there are 32 dataset used which exactly the same from the training dataset. It is expected that the accuracy of the forecasting will be high because there are already data template and target given for the testing data.

b. Half training and new dataset

For this second scenario, 32 dataset will be used for the testing which is half of the data (50%) taken from the training data and half others are new dataset. From this scenario it is expected that there would be high accuracy and less error even though the results may not be as good as the first scenario.

c. Full new dataset

In this third scenario, we will do extremely different dataset from the first and second testing dataset where all the dataset used are completely new which never computed in the training experiment before. From this experiment it is expected that although the accuracy from this experiment may be less than other two previous experiments, it still give out a good result, which still have high accuracy and better than experiments worked with any other methods ever.

1. MODWT and Graph Theory

From the data processing then the experiment moved to process MODWT and Graph Theory. In this stage 1024 training dataset and 32 testing dataset will be conducted. The processing is using Open, Close, V_conv, and δ(%) variables which furthermore the Open variable is gone through normalization with threshold between -1 to 1. The results from the MODWT and graph theory led to the dimensions, dataset output, and attributes (Dim1, Dim2 Dim3) as shown in Table 3.

Table 3. Training and Testing Dataset

No.	Results	Training Dataset	Testing Dataset
1	Dimensions	11 Dimensions of low and high frequencies	6 Dimensions of low and high frequencies
2	Dataset output	1024 dataset	32 dataset
3	Dim1 (compatibility)	99.8%	69%
4	Dim2 (compatibility)	99.8%	69%
5	Dim3 (compatibility)	100%	63%

Table 4. Training Dataset for JKSE

Open	Target	V_{conv}	δ	dim1	dim2	dim3
3571.46	3581.56	0	0.003	1	1	1
3589.15	3568.81	-3577988800	-0.006	1	0	1
3569.46	3637.45	2553375000	0.019	1	0	1
3637.69	3611.53	-2244739000	-0.005	1	1	1
3621.63	3625.27	-1978708400	-0.003	1	1	1

Table 5. Testing Dataset for JKSE

Open	V_{conv}	δ	dim1	dim2	dim3
5217.2	-6397240000	-.0110	1	1	1
5180.43	5418008800	.0016	1	0	1
5182.01	-4481017600	-.0065	1	0	1
5152.16	-4347921600	.0000	1	1	0
5154.37	4581389600	.0023	1	1	1

2. Backpropagation

From the supervised training which using sigmoid activation, the results of the weight of every node in hidden layer by applying 10000 times training cycle (epoch). Several combinations of learning rate and momentum have been performed from 0.1 for the learning rate and 0.1 for the momentum until 0.9 for the learning rate and 0.9 for the momentum. The best combination for data learning is 0.1 and momentum 0.3. The result of the training model as follows in Table 5.

Table 5. BPNN Weighting Result

Weight	Node 1	Node 2	Node 3	Node 4	Node 5
Volume	-0.022	0.088	0.008	0.047	-0.052
Delta (δ)	-0.043	0.290	-0.061	-0.090	0.402
Dim1	-0.036	-0.042	-0.023	-0.022	0.027
Dim2	-0.217	-0.260	-0.143	-0.268	-0.390
Dim3	-0.211	-0.246	-0.162	-0.314	-0.460
Open	-0.684	0.646	-0.631	-0.798	0.812
Bias	-0.210	-0.226	-0.219	-0.388	-0.399

And for the output results also displayed as follows in Table 6.

Table 6. Regression Result

Regression	Node 1	Node 2	Node 3	Node 4	Node 5	Threshold
(Linear)	-1.013	1.430	-0.809	-1.699	1.735	0.188

In the visualization will be displayed as follow in Figure 7.
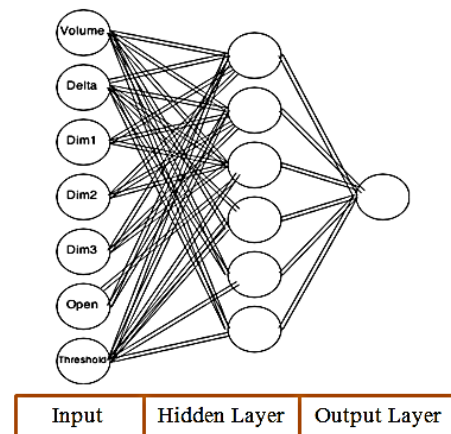

Figure 7. BPNN for JKSE Model

3. Final Results (accuracy and error)

The aim of the experiments is to predict the upcoming n+1 Open Price of the JKSE Index. From several data testing combination, using full portion of the same data with the training data, partial portion, and completely new data, the results from this research experiments versus DWT-BPNN algorithm as follows in Table 7 and Figure 8.

Table 7. Error Result of Enhanced MODWT– BPNN

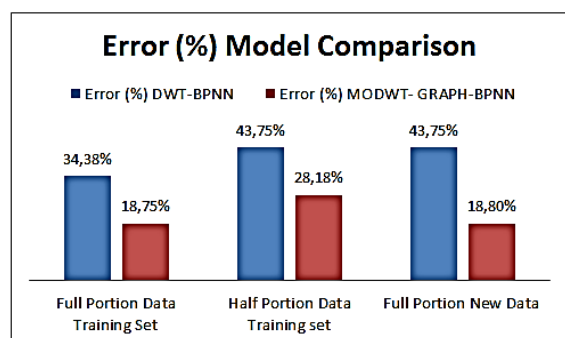| Data Testing	Error (%) DWT-BPNN	Error (%) MODWT-GRAPH-BPNN
Full Portion Data Training Set (32 sets)	34.38%	18.75%
Half Portion Data Training set (16 sets new data, 16 sets training data)	43.75%	28.18%
Full Portion New Data (32 sets)	43.75%	18.8%

Figure 8. Error Model Comparison for JKSE

From these experiments it is showed the results that by using DWT-BPNN the best result is by using full portion data of training set. This result is seemingly very possible because by using the exactly the same testing data with the training data, the pattern of the dataset is already determined so that resulting smaller error percentage in testing stage. The error for the real testing data (completely new data) is 43.75%, which is about 9.37% higher than the training-testing data's error, which is 34.38%.

On the other side of the model applied by using MODWT, Graph theory and BPNN resulting that the error percentage conducted by using full portion training data as the testing data is the smallest, which showed 18.75%. It is not much differ in number with the experiment by using the full portion new dataset, which give error percentage about 18.8%. This diversity occurred by only 0.5% higher for the new testing dataset. The anomaly occurred in half portion data training set which in this case gave the largest error percentage, which showed 28.18%.

From this experiment by using JKSE dataset, it showed that in all testing dataset MODWT-Graph-BPNN performed better than DWT-BPNN.

V. CONCLUSION

The results of this experiment stated that there are several major attributes that are significant to the computation of the model, such as Open, Target, V_conv, δ, dim1, dim2, and dim3.

It is also stated that the model of combined Enhanced MODWT-BPNN performed well for the JKSE stock index and performed best when the testing datasets are all new datasets. It performed less error than if the new dataset are combined with existing (training) datasets which the error showed 28.18% for combined datasets and 18.8% for the pure new datasets.

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Development of Medical Record With Extreme Programming SDLC

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Abstract— The XP model (eXtreme Programming) is used for the development of medical record applications. Because for project development requires rapid adaptation to changes that occur during the development of the application. XP is also suitable for fewer team members and is in the same location. Software development should be well planned, so that the software obtained quality and in accordance with the needs of users. The successful development of this software with XP can be avoided existence of patchwork in application development. Step by step research methods for medical record software are Planning, design, coding, testing and software upgrades. Studies conducted in this study include: literature study, interviews, observation, and document examination. Next do an analysis of the created application, and check the document to get an idea of the system created. This is done as an analysis and system design done by the author. The correct framework at the time of the application development bridge between the developer side and the user side, so that the developed application can be completed on time. XP focuses more on software development and system design with CRC (Classroom Responsibility Collaborator). CRC creators must be thorough and consider CRC interrelationships with each other. The XP framework that every step always involves users, programmers, and parts of the test so that the applications created can be completed in a timely manner and in accordance with the needs of users.

Index Terms— CRC (Class Responsibility Collaborator), eXtreme Programming (XP), Medical Record, System.

I. INTRODUCTION

Software Development Life Cycle (SDLC) is a strategy of constructing or maintaining software systems [1], [2]. Software methodologies like Waterfall, Vee-Methodology and Rational Unified Process (RUP) are called traditional software development methodologies and these are classified as heavyweight methodologies [1], [3]. Now six techniques that are recognized as agile development strategies, which are: Agile Crystal methodologies, agile dynamic software development methodology, feature-driven development method, lean software development, scrum, extreme programming.[1], [4]

The system developed is very diverse, from desktop applications to web-based applications. Applications developed by application developers, Searching and opening jobs. Like Bill Gates with his Microsoft company, Mark Zuckerberg with Facebook's social network creation, Larry Page and Google's creator Sergy Brin, and still many people who are successful with IT [5]. Most IT companies, even IS businesses are lead by non-technical people. Xtreme Programming (XP) so popular because to develop are software engineering centric [6].

There are some organizational units that require different applications and then developed based on their respective styles and platforms. The thing that will happen is the organization will have some kind of information system that is not integrated. As a result, the leader will be difficult to obtain the information he needs if the information is sourced from various existing information systems [7]. XP breaks down a project into sub-projects, each including planning, development, integration, testing and delivery [4], [8]. They rely on planning, with the understanding that everything is uncertain, to guide the rapid development of flexible systems of high value [4], [8], [9].

XP is best suited for project development that requires rapid adaptation to changes that occur during application development. XP is also suitable for fewer team members and is in the same location in software development [10]. The selection of appropriate system development frameworks will have a significant impact on software development, so there is no crisis of software.

II. THEORIES

A. Analysis and Design System

In designing the system can use a non object approach and object-oriented [11]. To design system on the framework XP can use CRC (Class Responsibility Collaborator), see Fig 1.

DOCTOR	
Superclasses	: -
Subclasses	: -
Responsibilities:	**Collaborators:**
-IdDoctor	-Schedule
-Name	-Patient
-Sex	-Drug
-Address	-Cost
-Save	
-Edit	
-Delete	

Fig 1. Class Responsibility Collaborator

CRC [10]. In developing the applications, can use the concept of object oriented. The four main points on the concept of object-oriented programming are: Abstraction, Encapsulation, Inheritance, Polymorphism [11].

B. eXtreme Programming (XP)

XP is a package of several practices and ideas, most of which are not new. The combination and packaging of all of these is, however, new [12], [13]. Extreme Programming was in fact targeted especially at small co-located teams developing non-critical products. It has been suggested that the early adopters of agile methods have been small high-tech product companies [12], [14]. Currently, however, it has already been proven at many companies of all different sizes and industries worldwide [12]. XP provides a list of simple, specific, and seemingly naïve principles and values that guide the software development process throughout the main four phases of software development: planning, coding, designing, and testing.

XP provides a list of simple, specific, and seemingly naïve principles and values that guide the software development process throughout the main four phases of software development: planning, coding, designing, and testing (see Fig 2).
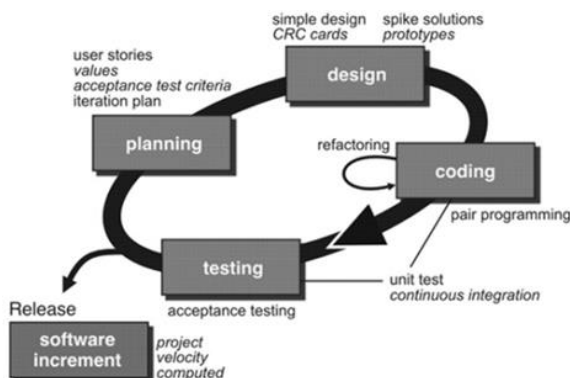

Fig 2. XP Methodology

Software Development Life Cycle is a process to develop software. This process is divided into some phases such asRequirement Analysis, Design, Coding, Testing, Installation and Maintenance. All these activities are carried out in different ways as per the client"s need. Each way is known as a Software Development Life Cycle Model. Every system must go through these phases whether it is small scale or large scale [15], [16], [17].

Planning, at this stage begins with an understanding of the business proceses of the application, defines the output, the features that exist in the application, the functionality of the application created, the timing and cost of application development, and the application development flow. Design, at this stage emphasizes simple application design, tools for designing at this stage can use CRC cards (Class Responsibility Collaborator). CRC is used for mapping classes that will be used in use case diagrams, class diagrams, and object diagrams, Coding, the main thing in developing apliksi using XP is pair programming (in making programs involving two or more programmers). Testing, at this stage focuses on testing the features that exist in the application so that no errors and applications made in accordance with business processes on the client.

Selection of the SDLC framework is Important, because the success of the software can't be separated from the framework. XP provides a paradigm of flexibility between users and developers in accommodating software requirements spesifications to suit the users wishes, and the time required too tight.

C. Medical Record

The medical record (MR) by definition is a "collection of data on a patient including a history, statement of current problem, diagnosis and the treatment procedures [18]. MR is referred to as managing patient medical records electronically from a variety of sources. It deals with patient treatment, diagnosis, laboratory test, imaging, history, prescription and allergies that can be accessed from various sites within the organization with the protection of security and patient privacy [19], [20], [21], [22].

III. RESEARCH METHODS

XP put more emphasis on software engineering pratices than project management. XP put more emphasis on the engineers than the project managers. The authors argue that XP deserves to be discussed in this paper because some books have not discussed in detail and comprehensive, and its innovation in the development of software. Authors in this paper act is project manager, and do something development, like: step by step of Research Methods see figure 4.

From Figure 4 can be seen this research method is divided into five stages according to the XP framework consisting of five parts are:

1. Step I Planning, At this stage on the XP model. Research conducted at the planning stage are: user stories, understanding the business process, defining the output of the application, features In the application, the function of the application, the determination of the time and cost of the application, the flow of application development.

2. Step II Design. The XP methodology emphasizes simple system design, focusing more on programming and program testing. This is because XP takes short time, so with CRC card is enough to represent the system design in this research.

3. Step III Coding. In the Coding stage, the research included are create a database, Create a program, Create a user guide.

4. Step IV Testing. Testing in software environment with full database.

5. Step V Software Increment. In the software increment stage is a research for the release of applications made to the user.

The contribution of this paper is to generate an blueprint of application development with the XP. XP is different from other SDLC is because XP do mapping in detail and comprehensive.
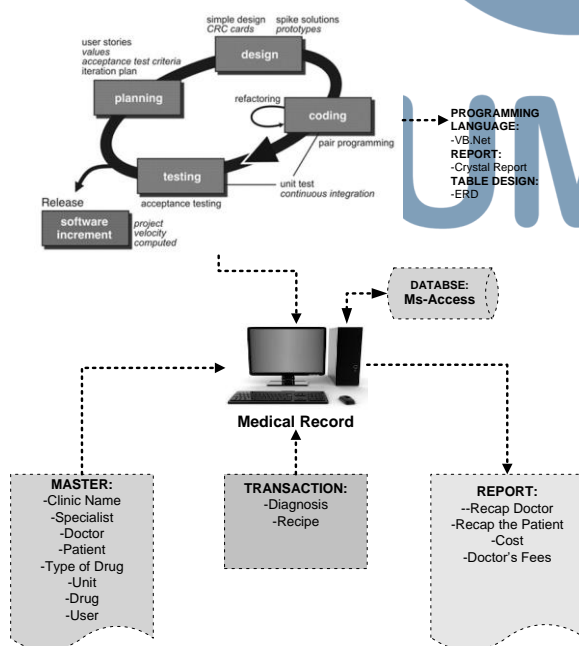
Fig 4. Step by Step of Research Methods

IV. RESULT AND ANALYSIS

A. Requirement

Requirement for applications to help today's work is needed, such as computerized medical records applications, personnel and payroll applications, accounting applications, and more.

B. Mapping of Application

Table 1. Mapping File Master-Report Transaction

No	Explanation
Master File	
1	Clinic Name
2	Specialist
3	Doctor
4	Patient
5	Type of Drug
6	Unit
7	Drug
8	User
Diagnosis	
1	Diagnosis
2	Recipe
Report	
1	Recap Doctor
2	Recap the Patient
3	Cost
4	Doctor's Fee

Mapping to be used for many details in the applications so that it is easier for project managers to bring agility in to the company. A lot of organization doing right now is just continuous build not continuous integration. The description of the application made in this research is: determine the master file, transaction file, then report file (see table. 1). Mapping of applications include are master file, diagnosis and report..

C. Cycle of Application Medical Record

Cycle of application Medical Record in the application created as in Fig 5.

Fig 5. Cycle of Aplications

Included entering master data, the transaction includes the patient's diagnosis by the physician, the admin section copies the prescriptions made by the doctor, and makes the report.
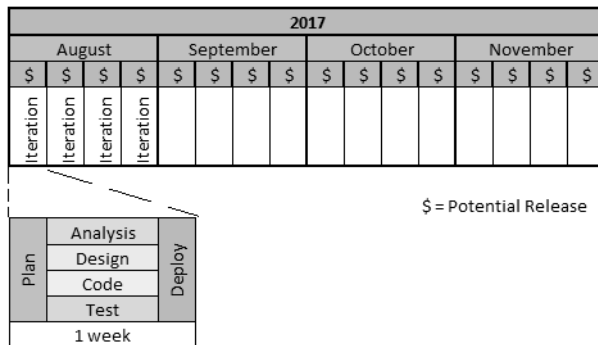
D. Schedule Development

Fig 6. Life Cycle and Schedule Development

To get an overview of the blueprint of medical record application development, the application creation framework is mapped from the selection of system development methodology, system design tools, database used, programming language used, entity connectivity, master file, transaction file, file report. Life cycle and application development schedule with XP methodology as in Fig 6.

E. Planning

Every activity on application development, developers create documentation. The following documentation Understanding Business Context through user stories.

Table 2. User Stories

User Stories
User input master data, such as: Clinic Name, Specialist, Doctor, Patient, Type of Drug, Unit, Drug, Use. Doctor do diagnosed to patiens, Result of diagnosed enter to system (Recipe). Recipes made in the insert into the system. From system can print: Recap Doctor, Recap the Patient, Cost, Doctor's Fee.

Here is the documentation of output mapping on medical record application.

Table 3. Output Application

No	Output	Explanation
1	Recap Doctor	Recap and Print Doctor.
2	Recap the Patient	Recap and Print Patient.
3	Cost	Recap and Print Drug.
4	Doctor's Fee	Print cost Doctor.

F. Design

In the design phase, CRC and Prototype mapping is done, the design of this system using CRC because to create applications with object-oriented kosep. Each CRC will be a class on the concept of object-oriented programming.

Table 4. Design CRC and Mapping of Class

No	CRC Design	Class Mapping
1	Login	clsLogin
2	ClinicClinicName	clsClinicName

3	Specialist	clsSpecialist
4	Doctor	clsDoctor
5	Patient	clsPatient
6	Type of Drug	clsTypeOfDrug
7	Unit	clsUnit
8	Drug	clsDrug
9	User	clsUser
10	Diagnosed	clsDiagnosis
11	Recipe	clsRecipe
12	RecapDoctor	clsRecapDoctor
13	Recap the Patient	clsRecapThePatient
14	Cost	clsCost
15	Doctor's Fee	clsDoctorFee

Example of CRC can see Fig 7.

Fig 7. Mapping of CRC

The mapping of prototype of medical record application in this research is CRC mapping result that has been made on CRC design. In Figure 6 shows a prototype in the application.

Fig 8. Mapping Prototype

Due to the limitations in this paper, only one sample of master physician prototype designs is shown.

G. Coding

In the coding stage of the activities undertaken are: create a database and create programs. The following table mapping the needs of the tables used in the application, see Table 5.

Table 5. Mapping of tables in database

No	Tabel Name	Description
1	tblSpecialist	To Save data spesialis
2	tblDoctor	To Save data doctor
3	tblPatient	To Save data patient
4	tblDiagnosed	To Save data diagnosed
5	tblClinicName	To Save data clinic
6	tblDrug	To Save data drug
7	tblUnit	To Save data unit
8	tblTypeOfDrug	To Save data type of drug
9	tblHRecipe	To Save data copy of recipe
10	tblDRecipe	To Save data detail copy of recipe
11	tblUser	To Save data user

The following table mapping user interface on the application, see table 6. Include in mapping are form name and description, like: login, clinic name, user, recipe, Etc.

Table 6. Mapping userinterface

No	Form Name	Description
1	frmLogin	For login to application
2	frmClinicName	For logs clinic Name
3	frmSpecialist	For logs specialist
4	frmDoctor	For logs doctor
5	frmPatient	For logs patient
6	frmTypeOfDrug	For logs type of drug
7	frmUnit	For logs unit drug
8	frmDrug	For logs drug
9	frmUser	For logs user
10	frmDiagnosed	For logs doctor of diagonose
11	frmRecipe	For logs recipe
12	frmRecapDoktor	For Print recap of doctor
13	frmRecapThePatient	For Print recap of patient
14	frmCost	For Print cost
15	frmDoctorFee	For Print fee of doctor

Here's the mapped design table documentation, see Fig 9.

DOCUMENT NAME	: DESIGN TABEL	
Name of Application	: Medical Record	
Activities	: Design tabel	
During	: 21/08/2017 until 05/09/2017	
No	Table	Description
1		Example of table spesialist.
2		Example of table doctor.
…	….	etc

Fig 9. Documentation Table

Here is the documentation of making the coding that has been mapped on the user interface, see Fig 10.

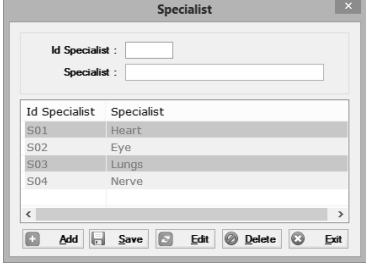| DOCUMENT NAME	: CODING TO USER INTERFACE	
Name of Application	: Medical Record	
Activities	: Design user Interface	
During	: 06/09/2017 until 24/11/2017	
No	Design User Interface	Description
1		Example of user interface spesialist.
2		Example of user interface doctor.
3		Example of report recap doctor

Fig 10. Documentation of Coding

H. Testing

In XP, testing with white box on each module is done simultaneously when creating the program, each module is completed directly made white box testing. Here are the mapping of test results of each module, see table 7. Due to the limitations in this paper, there are only a few examples of table design and user interface.

Table 7. Mapping result of testing with white box

DOCUMENT NAME	: UNIT TESTING		
Name of Application	: Medical Record		
Activities	: Testing With White Box		
During	: 06/09/2017 until 24/11/2017		
No	Module of Testing	According Business Proces	
		Yes	Not Yet
File			
1	Login	√	-
Master			
2	Clinic Name	√	-
3	Specialist	√	-
4	Doctor	√	-
5	Patient	√	-

6	Type of Drug	√	-
7	Unit	√	-
8	Drug	√	-
9	User	√	-
Transaction			
10	Diagnosed	√	-
11	Recipe	√	-
Report			
12	Recap Doctor	√	-
13	Recap the Patient	√	-
14	Cost	√	-
15	Doctor's Fee	√	-

Table 8. Mapping result testing with black box

DOCUMENT NAME	: UNIT TESTING	
Name of Application	: Medical Record	
Activities	: Testing With Black Box	
During	: 25/11/2017 until 30/11/2017	

No	Module of Testing	According Business Process	
		Yes	Yes
File			
1	Login	√	-
Master			
2	Clinic Name	√	-
3	Specialist	√	-
4	Doctor	√	-
5	Patient	√	-
6	Type of Drug	√	-
7	Unit	√	-
8	Drug	√	-
9	User	√	-
Trasaction			
10	Diagnosed	√	-
11	Recipe	√	-
Report			
12	Recap Doctor	√	-
13	Recap the Patient	√	-
14	Cost	√	-
15	Doctor's Fee	√	-

Testing is the process of running or executing a program with the main purpose of finding errors [23]. Testing is done to identify and identify possible errors [24]. Application Test with black box done by client in this case user. Table 8 can show mapping result testing with black box.

I. Software Increment

Software Increment is the stage for releasing applications that have been created with the XP framework.

V. CONCLUSION

The purpose of the system development framework is to get a life cycle and blueprint of system development, XP is well used in the development of object-oriented systems. The XP framework provides changes to system development according to the needs of the user at any time during the application development phase, so that the user's need for an apps that suits their needs is greatly accommodated. With the XP framework that every step always involves users, programmers, and parts of

testing so that the applications created can be completed in a timely manner and in accordance with the needs of users. Applications created in this study using the XP framework, is a medical record application that is tested in black box to complete the computerized application of clinic include: data collection master, transaction data, and generate reports.

At the time of application development with the XP framework must involve from the user, so that each system module made more suitable to the needs of the user to minimize misperception between the user and the application creator. Within the framework with XP it places great emphasis on the program, so CRC makers must be thorough and consider the interconnectedness of CRCs with each other.

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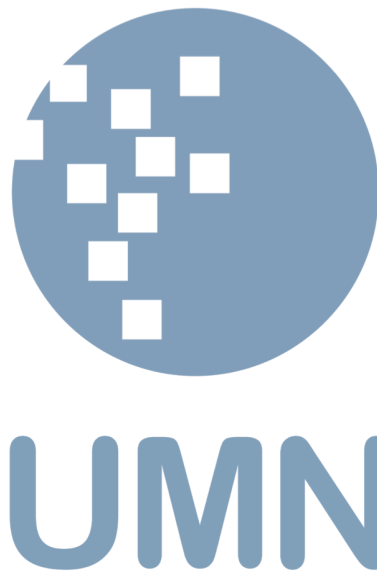
Design of TTL Based Routing Algorithm on UTAR Network on Chip Communication Architecture

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Abstract— **XY adaptive routing protocol is a routing protocol used on UTAR NoC communication architecture. This routing algorithm adapts shortest-path first algorithm, which it will not able to work optimally if the closest route have no longer enough bandwidth to continue the packet. The router will store Packet inside and forwarded to the nearest router when closest route has enough bandwidth. This paper suggests TTL based routing algorithm to resolve this issue. TTL based routing algorithm adapts XY adaptive routing protocol by adding several limits on RTL UTAR NoC and added bit in each packet sent by router. TTL based algorithm used more bit and parameters in choosing alternative routes inside the communication architecture. Use of TTL on TTL based routing different from use TTL on communication network. Packets that carry TTL value that equal to Maximum TTL will be route using XY adaptive routing protocol. TTL based routing algorithm has shown better performance compared to XY adaptive routing on some of the experiment done using MSCL NoC Traffic Pattern Suite. This research also proves that TTL based routing algorithm cannot work optimally on small-scaled architecture.**

Keywords—UTAR NoC; XY Adaptive Routing Protocol; MSCL Traffic Pattern Suite; RTL; TTL (key words)

I. INTRODUCTION

Mesh and Torus have been selected as topologies in UTAR NoC, because Mesh topology has been considered more by designer due to its simplicity.[1] Most NoC use 2D mesh topologies because of the good tradeoff between cost and performance, XY routing is very common, for mesh topologies, although not standard, due to its property of being deadlock-free.[2] Hence UTAR NoC implements Adaptive and deterministic XY routing.[1] There is a flaw on XY adaptive routing that is being used by UTAR NoC, which is XY routing protocol cannot choose another route other than the shortest path. So if the bandwidth is full in the possible route, the packet will be delayed until the bandwidth is available in that route, although there is an available bandwidth in other route. In this paper, a routing protocol which will using all available bandwidth in a router will be discussed.

II. UTAR NoC MICROARCHITECTURE

In UTAR NoC Flit, packet that will be send by Processing Block (PB) will be encapsulated to flit. Flit contains a valid bit, is_tail bit, destination bit, vitual channel bit, source bit, and data bit.[1]

Fig.1 UTAR NoC's Flit

The "valid bit" fields define the validity of a flit. This field will be set as one when sending a new flit. "is tail" field determines whether a flit is a tail or not. A large packet can be broken down into several flits, and a tail flit is the last flit of this group. The destination field provides the information of the flit destination address. The width of this field may vary depending on the size of the network. The Virtual channel field indicates which VC is to be used to send out the flit. The source field provides the information of the flits sender address. The data field contains the data itself. [1]

The UTAR NoC is composed of a number of UTAR NoC Routers. The number of the router depends on the size of the network itself. The UTAR NoC router has five ports connecitons which are the North, East, South, West and PB connections. There are eight pins for each port of the routers:

flit_in pins is for the incoming flit from neighbour router or PB to the router.

EN_flit_in pins is for the enable signal of the incoming flit to the router.

flit_out pins is for the outgoing flit from the router to the next neighbour router.

EN_flit_out pins is for enable signal of the outgoing flit to next router the incoming flit to the router.

credit_in pins is for incoming credit from neighbour router or PB to the router.

EN_credit_in is for the enable signal of the incoming credit to the router.

credit_out pins is for outgoing credit from the router or PB to the neighbour router.

EN_credit_out pin is for the enable signal of the outgoing flit from the router [1].
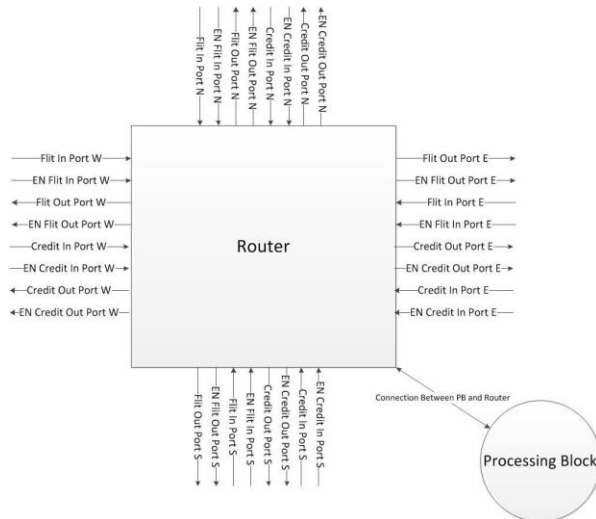

Fig.2 UTAR NoC Router

The router has five input ports and output ports corresponding to the four neighboring directions and the local processing element (PE) port. The major component which constitute the router are input buffer, route computation logic, virtual channel allocator, switch allocator, credit mechanism, and crossbar switch. The UTAR NoC router is input-buffered, in which packets are stored in buffer only at the input ports. The buffers are responsible for storing flits when they enter the router, and housing them throughout the duration in the router. The router computation logic determines all of the path from the source of the flit to its destination. The allocator (VC and crossbar) determines which flits are selected to proceed to the next stage where they travese the crossbar. The credit mechanism takes its role in the flow control protocol. Finally, the crossbar switch is responsible for physically moving flits from the input port to the output port.
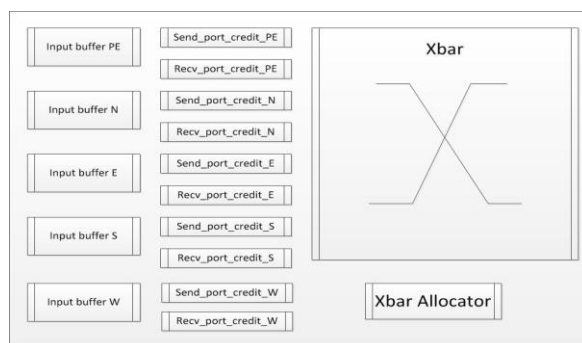

Fig.3 UTAR Router Microarchitecture

III. ADAPTIVE XY ROUTING

The Adaptive XY routing algorithm is derivative of classic XY routing algorithm [3]. XY routing algorithm will using current coordinates for the router current address(Cx, Cy) and will compare with the destination router address(Dx,Dy) of the packet, depends up on the comparison output of routing algorithm routes the packets. If $(Dx > Cx)$ flit will move to East else, it takes the West turn up to $(Dx\ Cx)$ become equal this passion is called as horizontal alignment. Now (Dy, Cy) undergo compression, if it is found that $(Dy > Cy)$ then flit moves toward North else flit moves toward South up to $(Dy\ Cy)$ become equal. When $(Cx\ Dx)$ and $(Cy\ Dy)$ are equal, means that packet has reach its destination.

In UTAR NoC, router has information about congestion's condition on each port. The congestion value equal to the remaining bandwidth on each port. The congestion value on port will reduces when router sending a flit throught that port, and the congestion value on port will increases when that port receive a credit from other router.

Adaptive XY routing will be used this information to choose the right path for the packet to go through. Adaptive XY routing works like XY routing, but in addition Adaptive XY routing will check congestion's condition on each posible route. If $(Dx > Cx)$ and $(Dy > Cy)$ but congestion value on X-dimension is less than congestion value on Y-dimension, if we use XY routing usually the packet will be sent to East first until $(Dx\ Cx)$ are equal, but if we use Adaptive XY routing the packet will be sent to North first due congestion value on X-dimension is less than congestion value on Y-dimension..

IV. THE TIME-TO-LIVE (TTL)

The time-to-live (TTL) is the number of hops that a packet is permitted to travel before being discarded by a router. [4] An IP TTL is set initially by the system sending the packet. It can be set to any value between 1 and 255; different operating systems set different defaults. Each router that receives the packet subtracts at least one from the count; if the count remains greater than zero, the router forwards the packet, otherwise it discards it and sends an Internet Control Message Protocol (ICMP) message back to the originating host, which may trigger a resend. [5]

A specific TTL number can indicate the maximum range for a packet. For example, zero restricts it to the same host, one to the same subnet, 32 to the same site, 64 to the same region and 128 to the same continent; 255 is unrestricted. [4]

V. TTL BASED ROUTING

TTL based routing works differently from adaptive XY routing. TTL based routing at first will works like adaptive XY routing, but when congestion value on all possible shortest path route equal to some value, TTL based routing will give a new route that have better

congestion value than all possible route. The route that given will be ensured not the route that packet comes from. TTL based routing using shortest path route to avoid a livelock, and make sure the packet will not wonder too long in the network.

TTL on TTL based routing works like TTL on Network communication. The different is the packet that has reach certain amount of value, the packet wont be dropped, however, the packet will get the top priority to be sent to the shortest path. When TTL on packet has reach amount of value, TTL based routing will work same as adaptive XY routing.

In order to implements TTL based routing to UTAR NoC, some RTL must be changed. UTAR NoC's flit needs to be added TTL field. TTL field can flexibly modified depends on network size and how many times packet allowed to hop.

valid_bit	is_tail	destination	virtual_channel	TTL	source	data
1-bit	1-bit	8-bit	1-bit	3-bit	8-bit	56-bit

Fig.4 Modified UTAR NoC's Flit

VI. MSCL NoC Traffic Pattern Suite

MCSL NoC traffic pattern suite is a realistic traffic benchmark suite. It currently includes a set of realistic traffic patterns for eight typical MPSoC applications and cover popular NoC architecture in various scales. MCSL captures not only the communication behaviors in NoCs but also the temporal dependecies among them. Each traffic pattern in MCSL has two versions, a recorded traffic pattern and a statistical traffic pattern. The recorded version provides detailed communication traces for comprehensive NoC studies, while the statistical version helps to accelerate NoC exploration at the cost of accuracy. [6]

The methodology uses formal computational models to capture both communication and computation requirements of applications. It optimizes application mapping and scheduling to faithfully maximize overall system performance and utilization before extracting realistic traffic patterns through cycle-accurate simulations. [6]

MSCL NoC traffic pattern suite will be used to measure the throughput, and latency of both adaptive XY routing and TTL based routing.

VII. SIMULATION RESULT

The simulations were performed using mesh topologies with network sizes of 8x8, 4x4, and 2x2 as they represented several topologies that approached the actual network size, and the processing time of the application will be scaled by 100%, 50% and 20%. After both routing is running all the MPSoC application provided by MSCL NoC Traffic Patern Suite and MPSoC application that have been scaled using all the network size that suggested, we will got

the comparison result of throughput and latecy value for the both routing on each applications.

In the simulation resulted the percentage comparison of the value of throughput of TTL based routing on adaptive XY Routing (in the pie diagram) shown in figure 5 and the percentage of Latency value comparison between TTL based routing values on adaptive XY Routing (in the pie diagram) shown in Figure 6 as follows:

From Fig.5 we can assume that TTL based routing can finish the application first as TTL based routing has 62.2% better throughput value than adaptive XY routing.
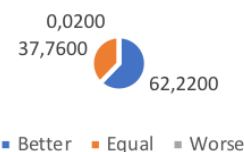
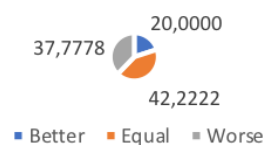Fig.5 Comparison result (Throughput)

Fig.6 Comparison result (Latency)

This happens because TTL based routing use all available bandwidth on a router so the packet will not be stored on router when the shortest route have no available bandwidth, instead the packet will be sent to the route with an available bandwidth. However, this will cause the latency worse than adaptive XY routing, because the packet will wonder around in the network if the shortest route to the destination ceaselessly has no available bandwidth. As shown at Fig.6 that TTL based routing has 37.8% worse latency value. Due to 2x2 network size test, TTL based routing has 42.2% equal latency value because TTL based routing cannot give more optional route.

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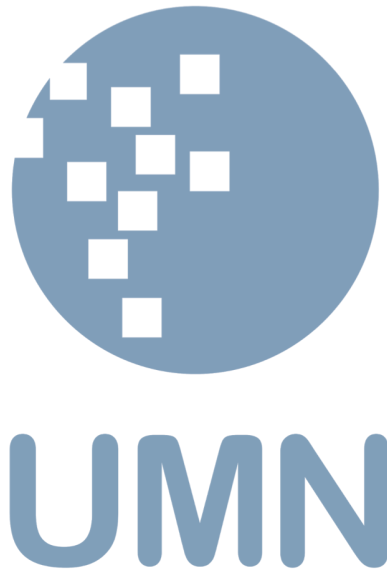
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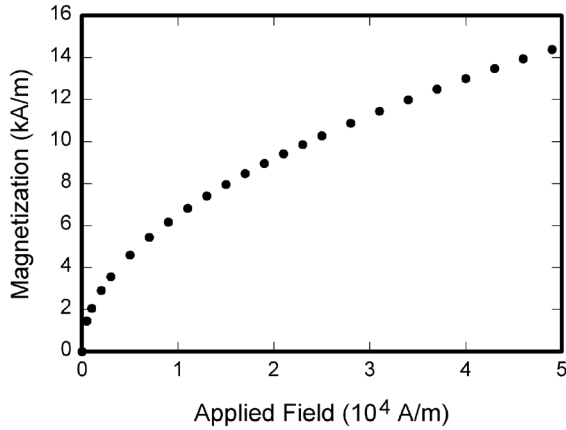TABLE I.   TABLE STYLES

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