

MOBILE APPLICATION FOR CONCRETE
STRENGTH MEASUREMENT TOOLS BY
EXPLOITING HEAT IMAGING INFORMATION

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BY EXPLOITING HEAT IMAGING INFORMATION

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Thesis submitted in fulfillment of the requirements
for the award of the degree of
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ABSTRAK

Alat pengukur kekuatan konkrit akan mengira kekuatan konkrit berdasarkan maklumat yang diperolehi daripada imej haba. Sistem yang akan dibina ini akan menggunakan aplikasi dalam telefon. Aplikasi tersebut bertindak mengimbas objek konkrit yang baru diuji untuk mengira haba. Disebabkan tiada sistem sedia ada yang berkaitan dengan menganalisis pengimejan haba inframerah, sistem ini akan dibangunkan. Ia dibina untuk memudahkan sistem pengiraan kekuatan konkrit berdasarkan pengedaran haba daripada imej haba inframerah. Menggunakan sistem ini, kaedah pengukuran kekuatan konkrit menjadi lebih mudah dan cepat. Tiga objektif perlu dicapai sementara membina sistem ini. Sistem ini akan dibangunkan dalam aplikasi telefon mudah alih. Pengguna hanya perlu mengimbas gambar konkrit yang baru diuji dan aplikasi tersebut akan menangkap imej haba yang terdapat pada konkrit tersebut. Aplikasi tersebut juga boleh mengira berapa banyak pengedaran haba telah berlaku. Selepas itu, barulah pengguna boleh mengetahui berapa kekuatan konkrit itu.

ABSTRACT

Concrete strength measurement tool is use to count the concrete strength based on the heat image information. This system will be using a mobile application. The application act to scan the concrete that had been just tested to find out the heat information. Since there are no existed system related to the infrared heat imaging, this system will be developed. It is being built to facilitate the concrete strength measuring system based on the heat distribution from the heat infrared imaging. Using this system, the method of measuring the concrete strength becomes easier and faster. There are three objectives that need to be achieved in while getting this project done. This proposed system will be develop in a mobile application. The user just needs to scan the newly tested concrete into the mobile application and the application will capture the heat image found on the concrete. The application can also counts the heat reading of the concrete. Towards the end, the user will know how much is the strength of the concrete.

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LIST OF SYMBOLS

FTEK	Faculty of Engineering Technology
RAD	Rapid Application Development

LIST OF ABBREVIATIONS

FTEK	Faculty of Engineering Technology
RAD	Rapid Application Development

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This chapter will explain generally about the Concrete Strength Measurement Tools. Concrete is a well-known artificial material on Earth. The concrete is able to be made from the combination of cements, water and aggregate. All these three combinations will go through a hydration process. The water and aggregate mixture will be helping the cement to become hard. Once it hardens, the cements become strong and a durable material. Obviously, it is the main thing in a construction field due to the functionality and flexibility. As we know, all the buildings are built using concrete to keep the building sturdy and stand for a longer period. For instance, skyscrapers, flyovers, houses and barricades.

Concrete is also known to have a compressive strength as the maximum compressive stress that the material can sustain without fracture under a gradual applied load. Some material may crack and fracture once it reaches the compressive strength limit. For engineers, it is the most common measurement used during designing buildings.

There are two types of major testing which are Destructive Test and Non-Destructive Test (NDT). Firstly, the Destructive Test. It is done by taking building specimens and using a compression test for concrete strength test (Jedidi Malek, 2004). Then, the spot of the taken specimen on the building needs to be repaired. These will cause more damage and cost towards the building. Secondly, the Non-Destructive Test is a method which will not do damage to the building while measuring the concrete strength. Rebound hammer and Ultrasonic Pulse Velocity (UPV) test are examples of Non-Destructive Test. A concrete strength measurement tool that retrieves information from a thermal imaging by using a mobile application is proposed through this project.

The students from Faculty of Engineering Technology in University Malaysia Pahang (Gambang campus) are among the people who had been using the concrete strength measurement tools in their laboratory experiments. They are required to use traditional the method which is hand mixing and mixer hardware. The experiments also required the students to calculate the concrete strength.

Generally, this is a mobilized system that measure the concrete strength by calculating the average diameter of the color contour taken from the heat produced from the concrete through imaging process. The infrared camera will capture the image and detect the heat distribution. The centre of the concrete will be heated for 5 seconds in 25 centimetres from the torch. The thermal image will be captured in a distance of 160 centimetres after being heated to get the heat distribution.

1.2 PROBLEM STATEMENT

Up until now, the concrete strength measurement are being tested by using the compressive test. By using this method, there may cause damage especially towards the old building since the concrete sample need to be taken from the building. It also will lessen the aesthetic value of structure like the surface of concrete being cored. In this project, a new method for Non-Destructive Test is being proposed by analyzing infrared thermal imaging.

This new system cannot measure the concrete strength directly since it is using an infrared camera through a mobile application to capture the heat distribution of concrete and has not been computerized. Currently, each color contour diameter is measured using standard application that is, AutoCad. By using this proposed system, the Concrete Strength Measurement information can be retrieved from a thermal image by using mobile application.

1.3 OBJECTIVES

This project's objectives are :

- To design a measurement tools in the mobile application for the new method which is by using the thermal imaging.
- To develop the measurement tools application that has been designed.
- To test all the button functionality existed in the developed system of mobile application.

1.4 PROJECT SCOPE

i. Functionality :

It is an application to measure the strength by repossess the information and calculate the diameter of the color contour on the image formed on the camera.

ii. User/Client :

It will be used by the students of Engineering Technology Faculty.

iii. Platform :

It will be using the Android based application platform.

iv. Software :

JAVA language will be used to design and in the Android Studio application will the Concrete Measurement Tools system be developed.

1.5 THESIS ORGANIZATION

This proposal report consists of three chapters. The chapters involved are introduction, literature review and methodology.

Chapter One is about the front matter to the project. The idea of the project will be discuss fully in this chapter. All the problem statement that contain reasons of why should this system be developed including the project's objectives and scopes are being explained thoroughly. Then, Chapter Two will explain about the literature review of the

project. All of the other three existing system which are adjacent to the concrete measurement tools are being compared in this chapter. Next, Chapter Three will explore on the method that will be used in developing the mobile application system and how the system flow. Chapter Four will be explaining on the system implementation into the mobile application, testing and the results for concrete measurement also been attached. Lastly, the conclusion of this project will be conclude in Chapter Five. On this chapter, further proposition and recommendation of this project will be analyze.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Mobile application for concrete strength measurement tool by exploiting information from heat imaging is the title of my project. The main purpose is to evolve an application that can be used to calculate the concrete strength using the thermal imaging information. In Universiti Malaysia Pahang, the students of Engineering Technology Faculty are using the standard techniques, Compressive Test. To conduct a test using this method, the students require to seize some of the building concrete specimen. The old building may crack and the building structural most probably changes when applying this method.

Generally, a hotter object will produce more radiation (Rouse, 2011). This project uses thermal image produced by the infrared camera or the thermal camera to calculate the strength of concrete. The thermal camera or infrared camera is attached to the mobile phone and able to take the image. From there, we can recuperate the information on differentiation of heat distribution on the structure of concrete. Thermal camera is one of a heat sensor that are able to spot a the differes occur in temperature (Rouse, 2011). The concrete that are captured by the camera will produce a heat energy. By calculating the temperature difference at certain diameter, the concrete strength at a certain diameter will be measured. The colour difference in the thermal image will determine the temperature of the heat exposed. Lastly, we will able to detect the concrete strength at a certain diameter.

2.2 Existing System

There is a few existing systems that had been using the thermal image for heat detection developed before. The systems are Infrared for Underground Leakage Detection, Infrared for Electrical Observation, and Infrared for Screening and Medical Thermography. These existing systems had been using the thermal camera to produce the thermal image and identify the heat.

2.2.1 Infrared for Underground Leakage Detection

Leakage is an issue that normally happens in underground piping systems. There will cost a lot of money consuming the solution to overcome this system is to use infrared radar to identify leakage of underground pipes without having to re-dig the pipe.

This can be done even if it is underneath or inside a concrete wall since this radar is able to identify flaws and leakage that happen in certain places. It also can monitor the buried infrastructure and evaluate the water pipe conditions at the current time. The radar technology has provided a 3-dimensional view of the underground water pipe network. The condition of both metallic and non-metallic is also given at the same time. Since the capability to spot a leakage may be unnatural since the temperature of the ground differs.

The infrared survey can be done in many ways. For outdoor piping, it is pre-eminent to do at night because it will reduce the probability of heat from the Sun through the surroundings affecting the results. While the piping system that is located indoors, can be done at any period of time. During the surveying, the pipeline path and the leakage spot are able to be spotted by the thermal image that will be displayed. Through expert analysis, the distinct shaped line may indicate that there is a leaking spot. This leaking area will be marked and further action should be taken. The benefit of this system is the use of money and time period will be lessened since the authorities do not have to dig up the water piping to find the leakage. The thermal imaging camera used for this system is FLIR E60. And it has very detailed thermal images which show the temperature related flaws.

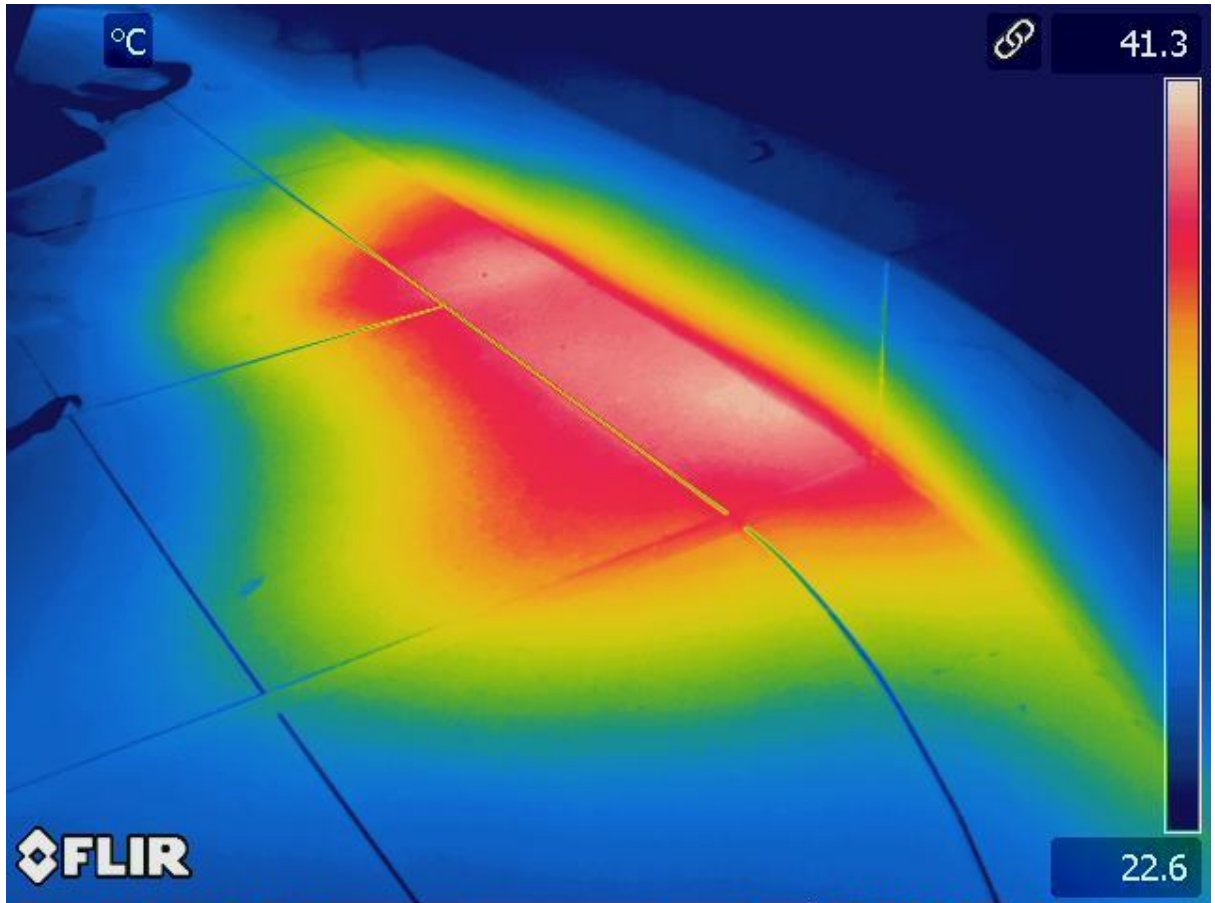


Figure 2.2.1 : Piping system leakage cause by hot water

2.2.2 Infrared for Electrical Observation

The motive of infrared for electrical observation is to identify the parts that is causing the failing in a network circuit or in the hardware components (Baker, 2008). Infrared thermography is used to discover the infrared energy from the area that have excess heat and converts it to temperature. It also can displays the image of temperature distribution. The failure to the circuit or even harm to the hardware component can be avoid if the issue can be diagnosed and fix faster. This is the supreme result to detect the leakage spots in network connection during the early phase.

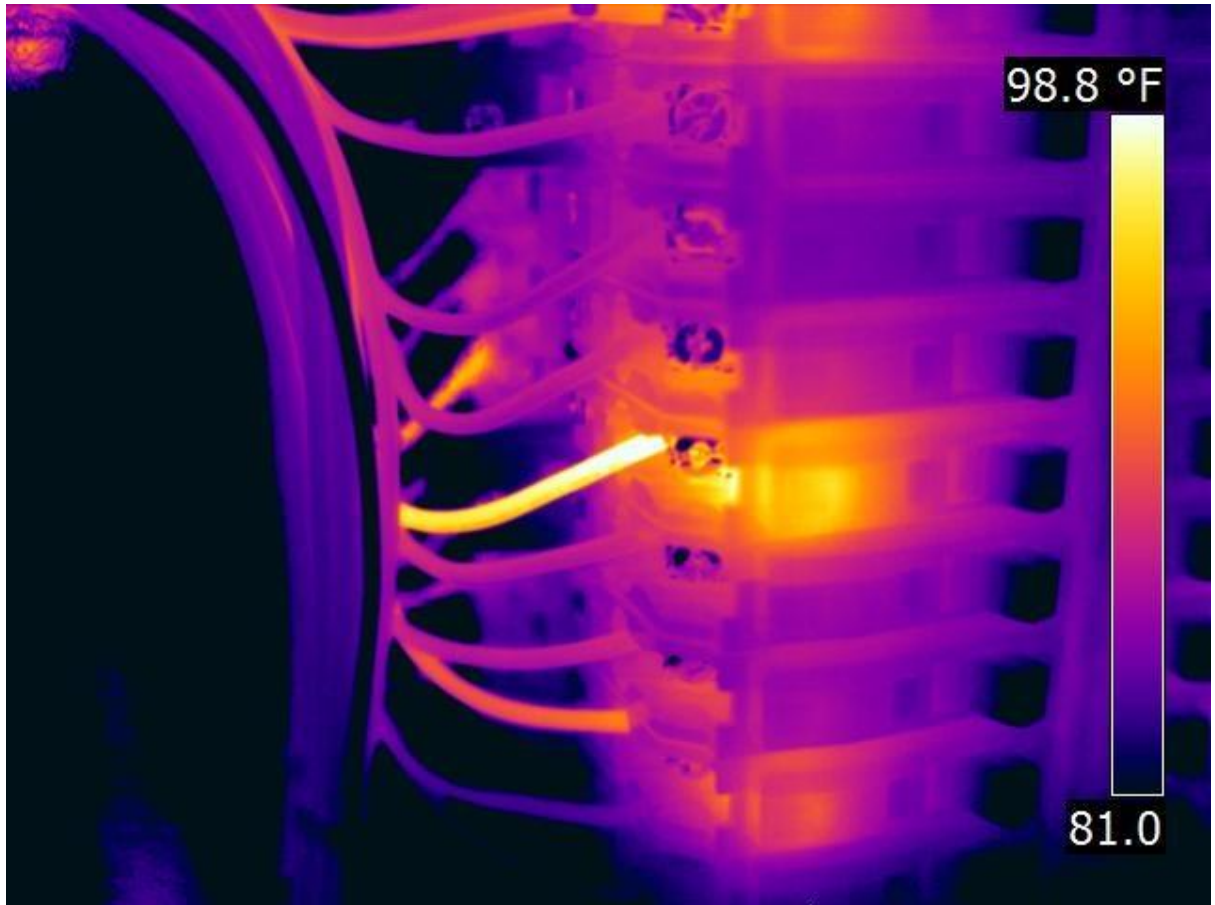


Figure 2.2.2 : Heat generated from loose connection

The increase in resistance and heat are the main cause of electrical failure component. The infrared camera will detect the heat exposed from the hardware component since the electrical things tend to become hotter than usual before become failure. Infrared inspection method is most likely to spot early on the electrical failure components. Thus, the components that been unfunction will first heat up to let go a higher heat that it exposed than usual to be detected by the infrared thermography before the inner electrical components burnt.

The infrared thermography are able to measure the temperature of the object through the infrared energy that are letting out. The thermal image will show where the heat spot are detect. The benefits of using this system are the safety of the surrounding environment. For instant, in a complex industrial where a high speed network are run, a hazardous conditions may be generated from a sudden failure. It also allow the

detection of the electric leak and burnt components without any contact with electrical things before any serious damage or other addition failure could occur (Baker, 2008).

2.2.3 Infrared for Screening and Medical Thermography

The infrared can also rate the heat in human body. The software is developed to measure the pathological processes since it has an effect on the human skin (Möhrke, 2009). The infrared device will be able to detect the surface temperature on the human skin. Depending on the blood circulation inside the body, the temperature of the skin are able to detect on the particular time.

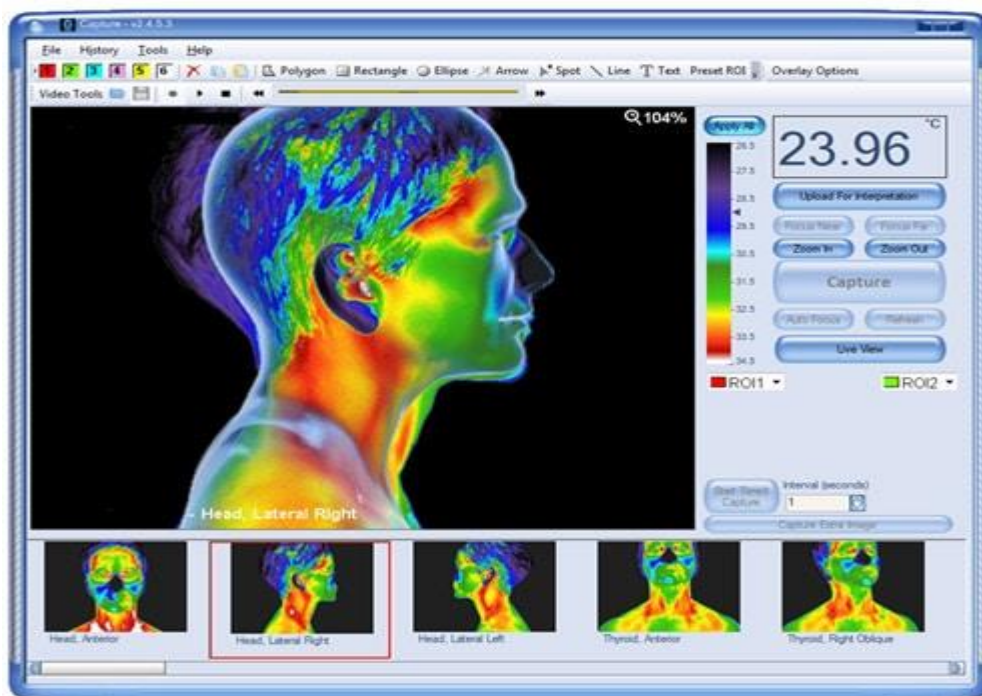


Figure 2.2.3 : Skin surface temperature

Through this result, the condition of internal organ of a person scanned are able to be observe by the user. This method can be implement widely towards the heat of human skin to obtain the diagnostic data. The infrared screening is a very aware of the slightest

temperature changes on the exterior of the human skin. This infrared screening has been proved to be a higher quality when involving the health screening.

2.3 Comparison between Existing Systems

Each of the three existing system have different features which makes the system better than the other. The aspect compared are the features, the temperature it can be used, thermal sensitivity of the system detector, the accuracy of temperature measurement, ability to record video and whether it is support on the mobile application or not.

Table 2.3 : Comparison between existing system

Aspect	Infrared for Underground Leaks Detection	Infrared for Electrical Observation System	Infrared for Screening and Medical Thermography	Concrete Strength Measurement Tools
Features	<ul style="list-style-type: none"> Spot spill evidence from underground system. 	<ul style="list-style-type: none"> Thermal image produced showing place had been electric shot. 	<ul style="list-style-type: none"> Thermogram shows flaw for internal organs. 	<ul style="list-style-type: none"> Can measure concrete strength. Thermal image produced, shows heat distribution in concrete.
Temperature (°C)	Min : -20°C Max : 650°C	Min : -20 Max : 650°C	Min : -40°C Max : 120°C	-20°C to 120°C

Thermal sensitivity (°C)	Less than 5	Less than 0.045	Less than 30	0°C to 35°C
Record a video	✓	✓	✓	✓
Have an application in mobile phone				Yes

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter will explain on how the concrete measurement strength tool process are developed. For this project, the SDLC model that is chosen is Rapid Application Development (RAD) model. The details of the usage of RAD model will also be explore more.

3.2 Rationalization of Chosen Methodology

Software Development Life Cycle (SDLC) contains the usage of techniques for the system development. It also help to guide the developer to evolve a usable system and fortify the system standard. Since there are many types of SDLC model that can be choose, the system developer need to choose the model that fit the requirement and demands from the client.

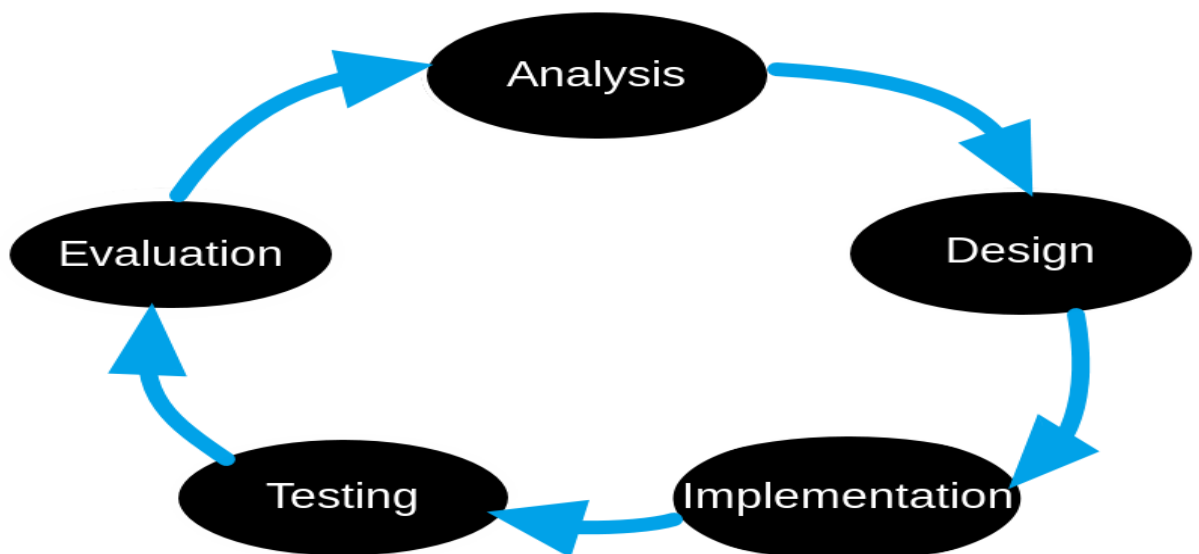


Figure 3.2 : Process that are involve in SDLC model

As per known, SDLC contains five process phase. The phase are planning, analysis, design, implementation and maintenance. Each SDLC stage phase has a major task to evolve the system. SDLC has various models that can be used to develop the system. Not all kinds of system are able to fit the diverse models in SDLC. The system developer should have checked thorough the models and choosethe type of SDLC models that fit the system. The various models of SDLC are Waterfall Model, Iterative Model, Spiral Model, RAD model, V-Model and Big-Bang Model.

RAD model approach is chosen as the method to evolve and finish the project. This Rapid Application Development (RAD) model is a fitting software development process for this project as RAD model are able to produce a quality system in a shorter time. RAD model is the most fitting for this project as the time needed in development through Rad model is short.

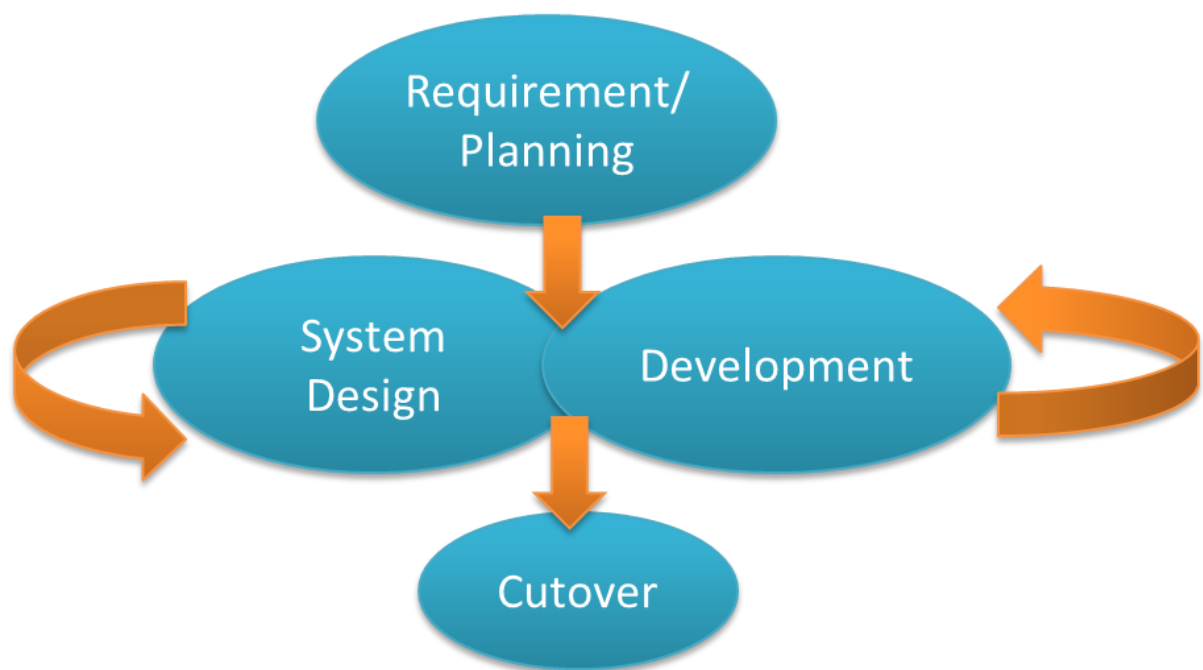


Figure 3.2.1: Four stages in RAD model

The phases exist in RAD model are system requirements planning, system design, development and cutover. The system design and development can be in a phase. This is because the system design and development phase are continuously be done until the requirement demands from the client had achieve. This Rapid Application Development

(RAD) lifecycle are planned to convince the developers to assemble a system as the user or client demands.

The benefits of implementing the RAD model is that it can lessen system development period. It also increases the reusability of components. Through RAD model, a system can be alter or update if any improvements need to be done. If a development phase is done but the client wanted to improve or drop any function, the developer can still fulfil the client demands by doing the system design and development phase again. This makes the RAD model approach gives the client a greater satisfaction when using the system. Other than that, it has a fast delivery time of development process if the developer does strictly follow the RAD model protocol. This will lead to a simple and better quality of system whenever it is used.

3.3 The Stages of Chosen Methodology

The four stages of Rapid Application Development model are system requirements planning, system design, development and cutover. Each of the RAD phase has a particular job to be done onto the system. The system design and development phase will be running uninterrupted until the system achieve the client's demands to proceed towards the last phase.

3.3.1 Requirement planning phase

The users, managers and IT staffs will discuss on the business demands. They will also discuss on the system requirements, project scope, deciding the person who generated the software and what kind of software need to evolve. For this project, all the requirements are gathered by having the interview with the client. The client of this project is Assoc. Professor Dr Andri Kusbiantoro, the Deputy Dean Research and Graduate Study of Faculty of Engineering Technology in Universiti Malaysia Pahang

(Gambang Campus). The interview was held in Assoc. Professor Dr Andri Kusbiantoro room.

During the interview, the client had described the purpose of developing this project. He had also told about the project requirement. There were some questions asked to know what the client demand towards this project. Discovering the resources on the Internet and estimated time needed to developed the system also includes in the planning phase. After the interview and fact-finding about the requirement is done, all The objectives, problem statement, scope and project requirement are able to interpreted.

3.3.2 System design phase

System design phase are also called as Modelling phase. It is a continuous interactive process. The client demands are studied attentively to ease interpreting the system requirement before the system can be progressed and modified the system. Initial modelling and prototypes are created after all the requirement and data needed are gathered and the architecture of the system is fixed on. The previous requirement is used to create and design Context Diagram, Graphical User Interface (GUI), General and System Flowchart. This project will use Android Studio application software for the development in the mobile application.

i. Context diagram

The only entity that this system will use is the user. The user will upload the image of the concrete structure taken by the infrared camera. After that, the system will calculate the strength and shows the result of the concrete strength to the user.

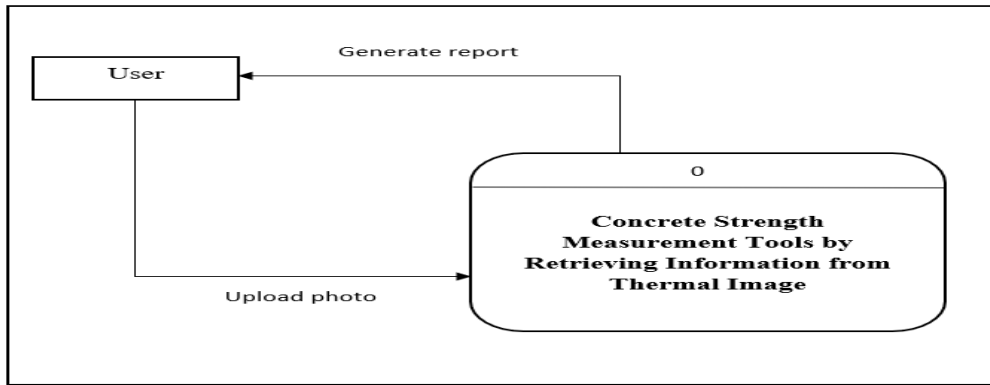


Figure 3.3.2.1 : Context Diagram of the system

ii. General Flowchart

The infrared camera will be attached to the mobile and the thermal image will be taken from the infrared camera. After the thermal image has been captured, the user required are able to see the thermal image when the user opens through the mobile application. After that, all the thermal images that have been taken will be calculated to know the strength of the concrete based on the diameter on which part it is taken.

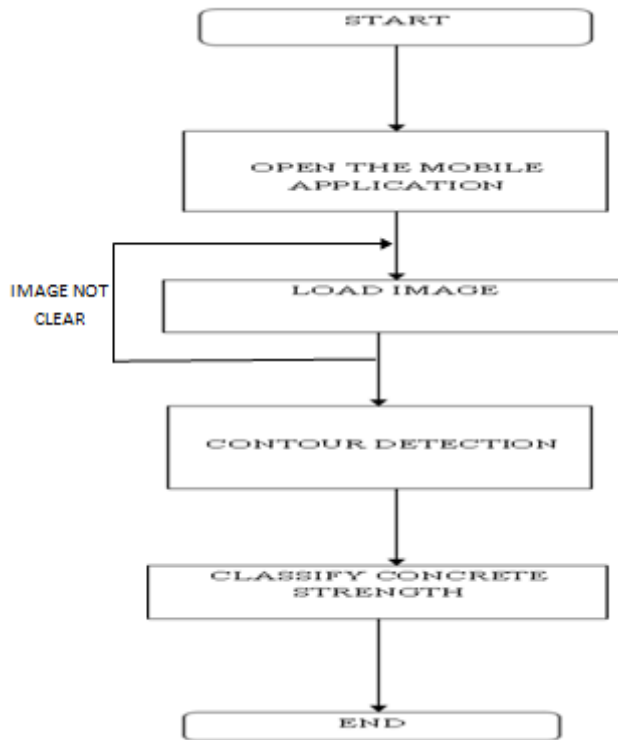


Figure 3.3.2.2 : General flowchart of the system

iii. Flowchart of System

The user must take the heated concrete picture using the thermal camera. The thermal image produced by the thermal camera has different types of color. Then, the thermal image that had been captured through the infrared camera will be rescale to 450PX x 450PX to equalize it. The color image that has been rescale will be display in a figure. The thermal image that is in RGB colour image then will be transform to hue, saturation and value colour space. The hue, saturation and value colour space is among the image processing conversion method. The image will be separated to H (hue), S (saturation) and V (value).

The element that holds H (hue) will take to produce the color contour plot of data image. It will then be displayed to the user.this make the user easy to select which three points that they want to calculate as the concrete strength. These three points will calculate the diameter, radius and centre of the contour image. All the data then saved in a text file. Based on the diameter of the contour circle, a calculation is made. This is

to determine the strength of concrete. Lastly, the output will shows the concrete strength of the thermal image.

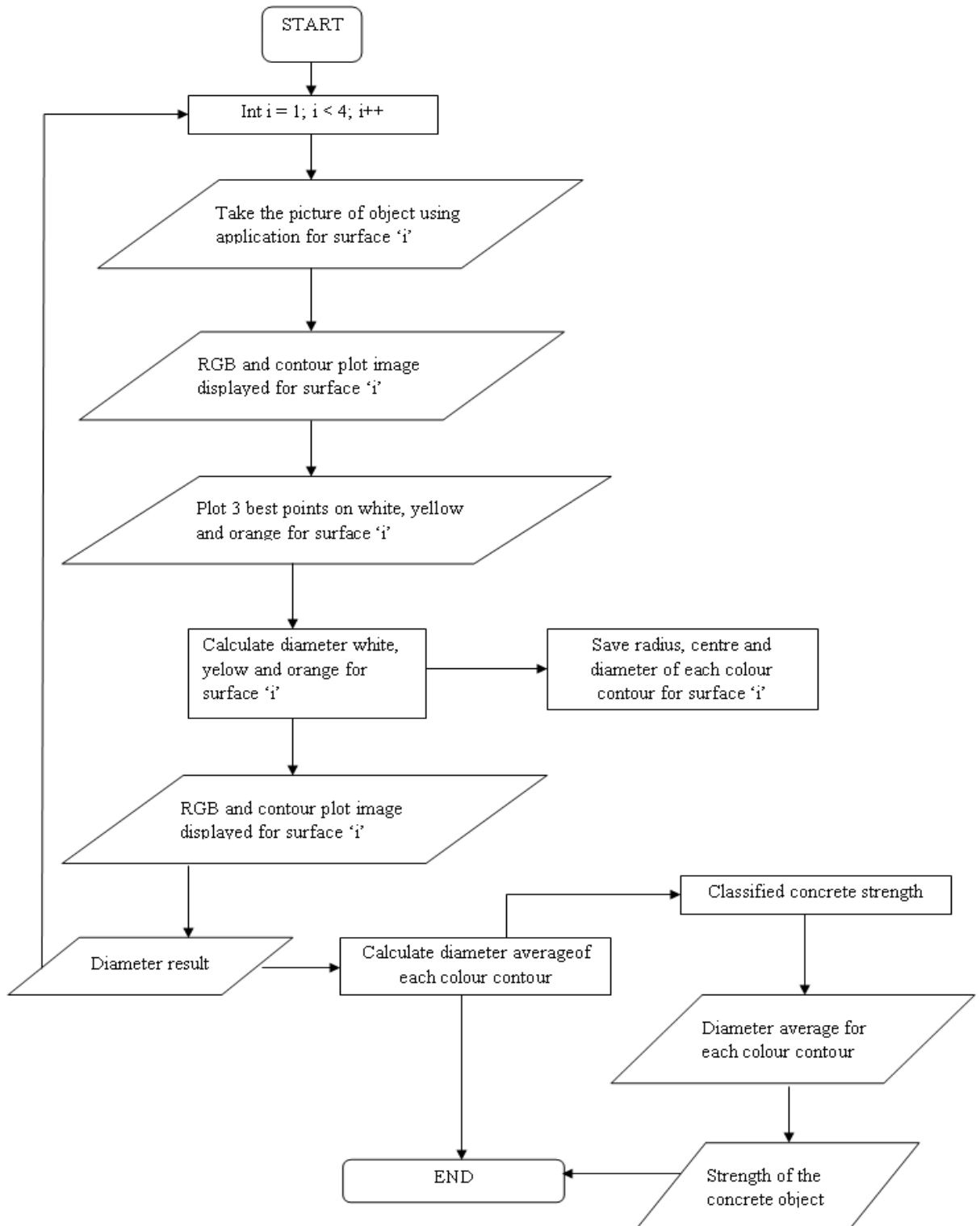


Figure 3.3.2.3 : Full flowchart of the system

iv. Graphical User Interface (GUI)

The Graphical User Interface (GUI) is one of the main item when a new system is being build. To make it is usable and very ease whenever user use, the GUI must be user friendly with the button used in the interface. This mobile application system will be having five interfaces. The first interface will be the open page of the application for those who is new a new user of the application.

In the second interface, user need to click the project that the user want to do. The user can either view the existed file (not new user) or create new file. Once the new project button is push, the application will simultaneously open the camera to get the imaging. Before starting the new project, make sure that the thermal camera is attached. INPUT 1 button is to set the thermal image so it will not be affect the other thermal image. The coloured button act as to get diameter of color contour to calculate the concrete strength. Both INPUT 2 and 3 button have the same button function with INPUT 1 button, to get diameter of color contour to calculate the concrete strength. After that, the diameter of each color contour for each input will be appeared in the respective text field. Then, there is a calculate button at the bottom right of the application to calculate average. When the calculate button had been pushed, then only the system start to calculate. The next interface will be displaying the concrete strength that had been calculated on the text field. The calculation of concrete strength is the last operation of this mobile application system.

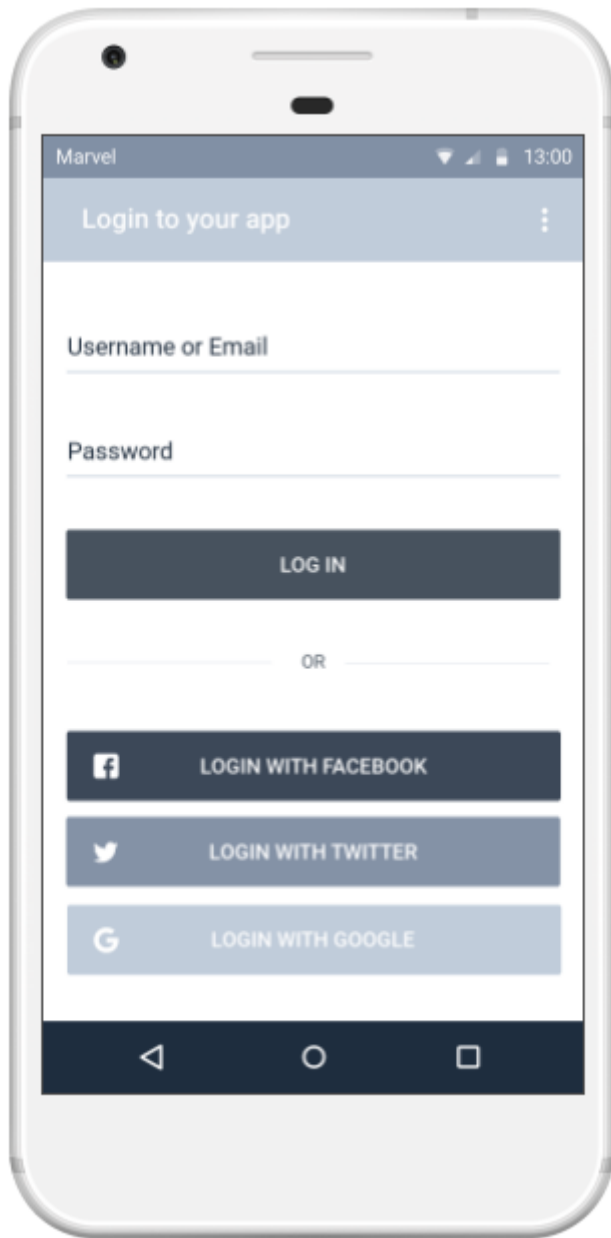


Figure 3.3.2.4 : Login interface of the Grafical User Interface. This is for the new user.

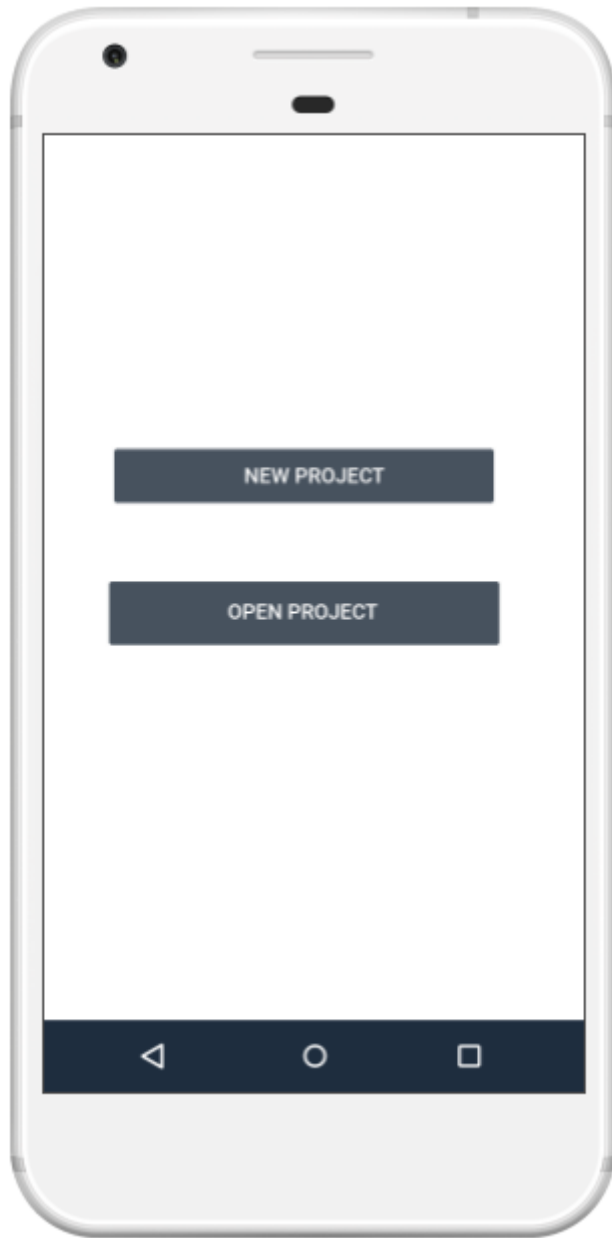


Figure 3.3.2.5 : Interface of the Grafical User Interface. This is for the user to start or open existed file.

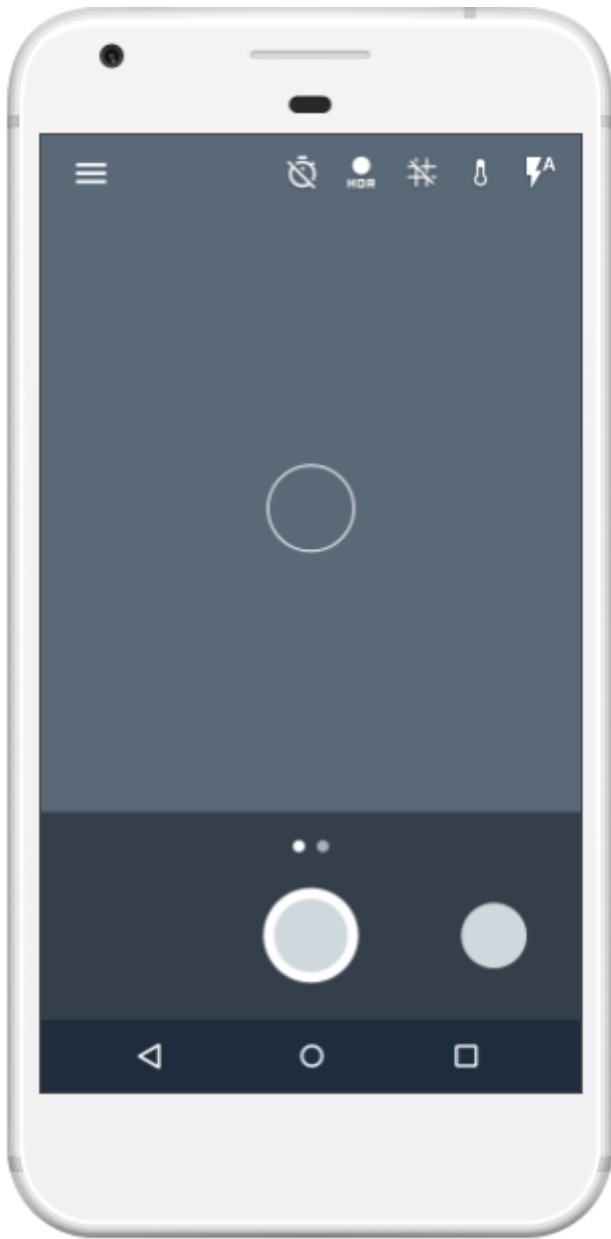


Figure 3.3.2.6 : Interface of the Grafical User Interface.

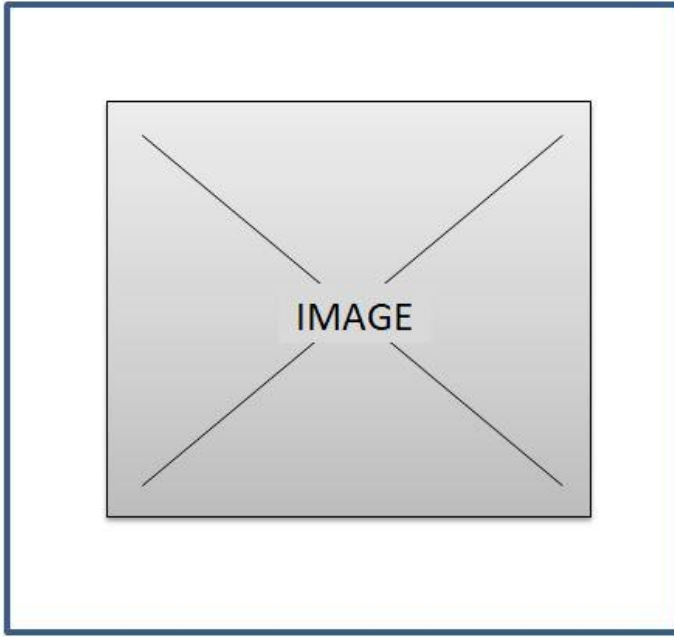


Figure 3.3.2.7 : Interface output for RGB image

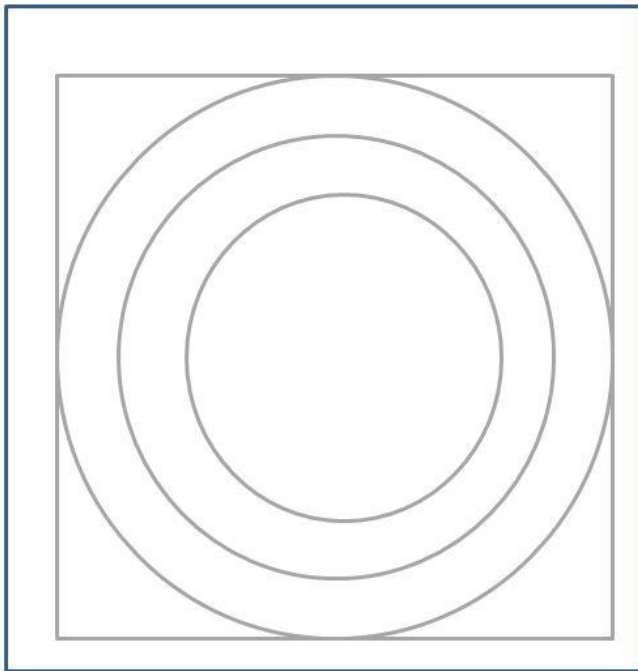


Figure 3.3.2.8 : Interface output for contour image

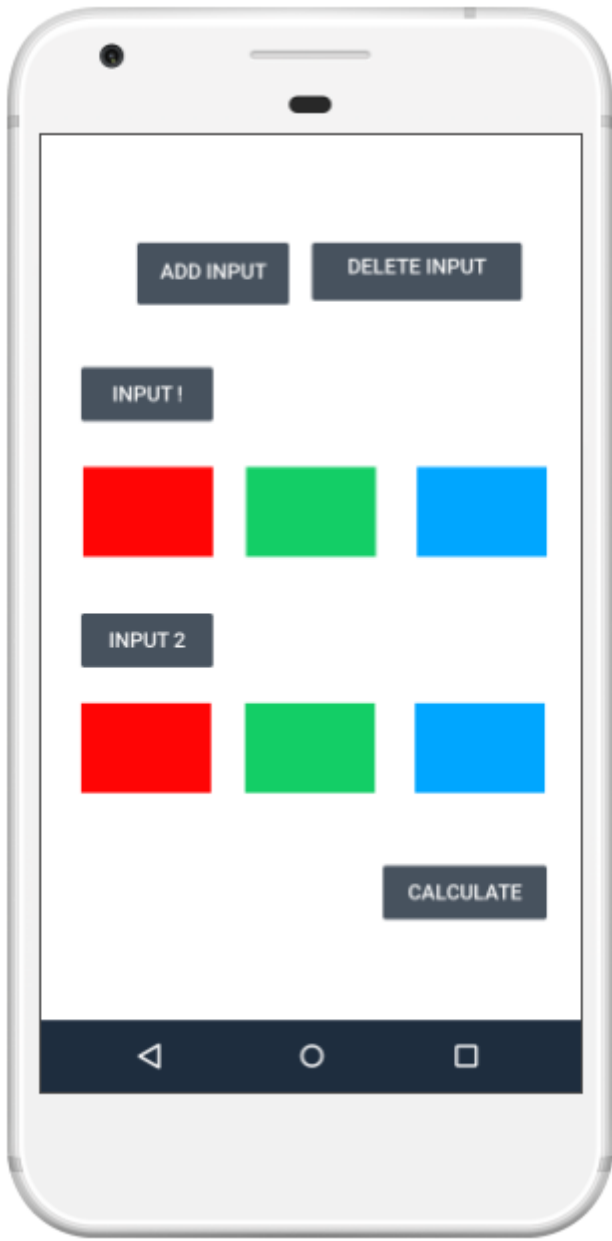


Figure 3.3.2.9 : Interface of the Grafical Usser Interface.

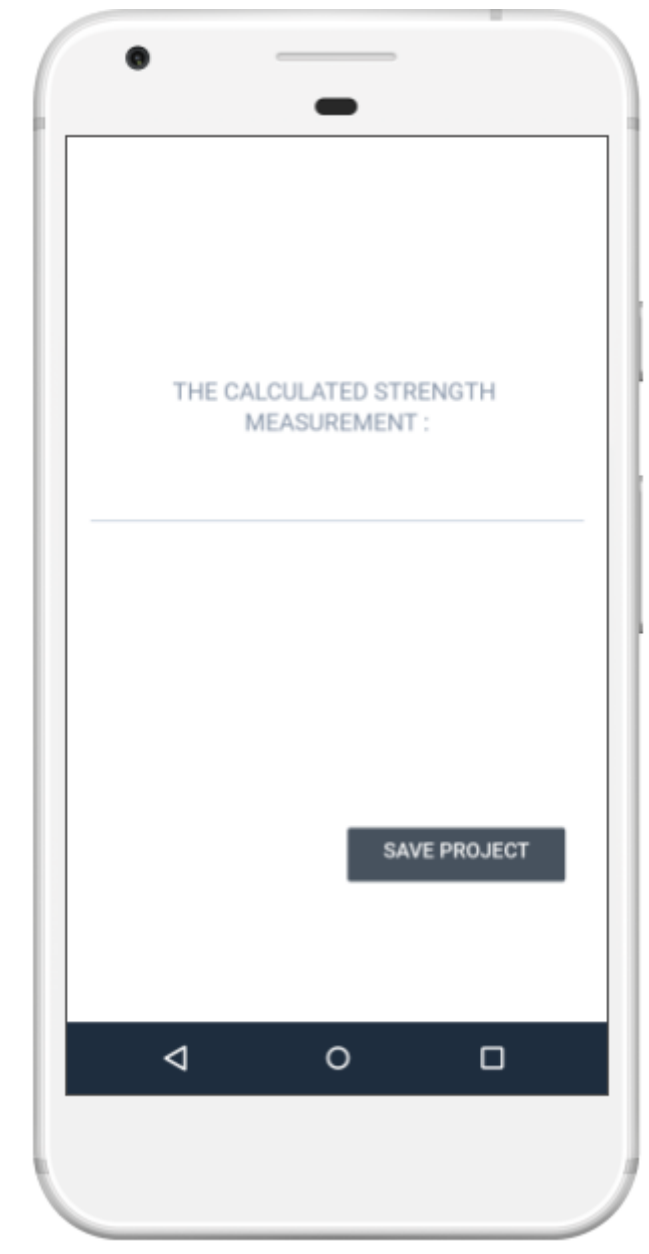


Figure 3.3.2.10 : Interface of the Grafical Usser Interface.

3.3.3 Development Phase

The developer will apply the designated system. It focused on the program and application development task. The task included are the programming and application development, codings, integration-unit and system testing. The designated project prototype during the design phase is utilize again in this phase. The programming and application development task used in this phase are the use in most of actual application coding. The prototype testing also take place in this phase. The system development

will use the applicable language for Android based application which is JAVA language. The functionalities of button in the system are tested and display to the client to make sure that it achieve the client requirement.

The probable threat of the system were recognized simultaneously with the probable result to lessen the probable threat. Every developed system must have the probable threat that might happen or fragility incase there are things happen abruptly. During this phase, the developer required to check or repeat the design and development phase to alter the necessary whenever problems occurred. Development phase is redo as necessary, whenever new components or alterations are form.

3.3.4 Cutover phase

Cutover is the final phase in RAD model. It mimicking the final tasks in the SDLC which is implementation phase. It transfer the production environment from old to the current version. A restorative list should be created to keep track of additional tasks to be execute. Then the full-scale testing. The user will accept to test the system. The system testing will be conducted by the user to notice whether the demands are satisfied or not. This testing aid the developer to notify if there are any alter or error occurred. The system change over and the user training is included in the cutover phase.

3.4 Hardware and Software That Required

The system requirement are splitted into hardware and software. Both requirements helps the process of developing the system.

3.4.1 Hardware Requirement

Table 3.4.1 : The hardware requirement and the purpose of each hardware in this project

Hardware	Function/Purpose
Mobile Phone	<ul style="list-style-type: none">• To run the operating system which is using Android.• To run and test the system.
Pendrive	<ul style="list-style-type: none">• Used to save data and documents as a backup.
Laptop	<ul style="list-style-type: none">• Documentation preparation.• Used to designing and developing the project.
Printer	<ul style="list-style-type: none">• To print the documentation and report

3.4.2 Software Requirement

Table 3.4.2 : The software requirement and the purpose of each software in this project

Software	Purpose
Microsoft Office 2007	<ul style="list-style-type: none">• To prepare the documentation• To prepare presentation slide
Andoid Application Studio	<ul style="list-style-type: none">• To evolve the project so it can be use through mobile application• Use in algorithm development, simulation and prototyping
Opencv	<ul style="list-style-type: none">• To get the fuction from Opencv library

3.5 Gantt Chart

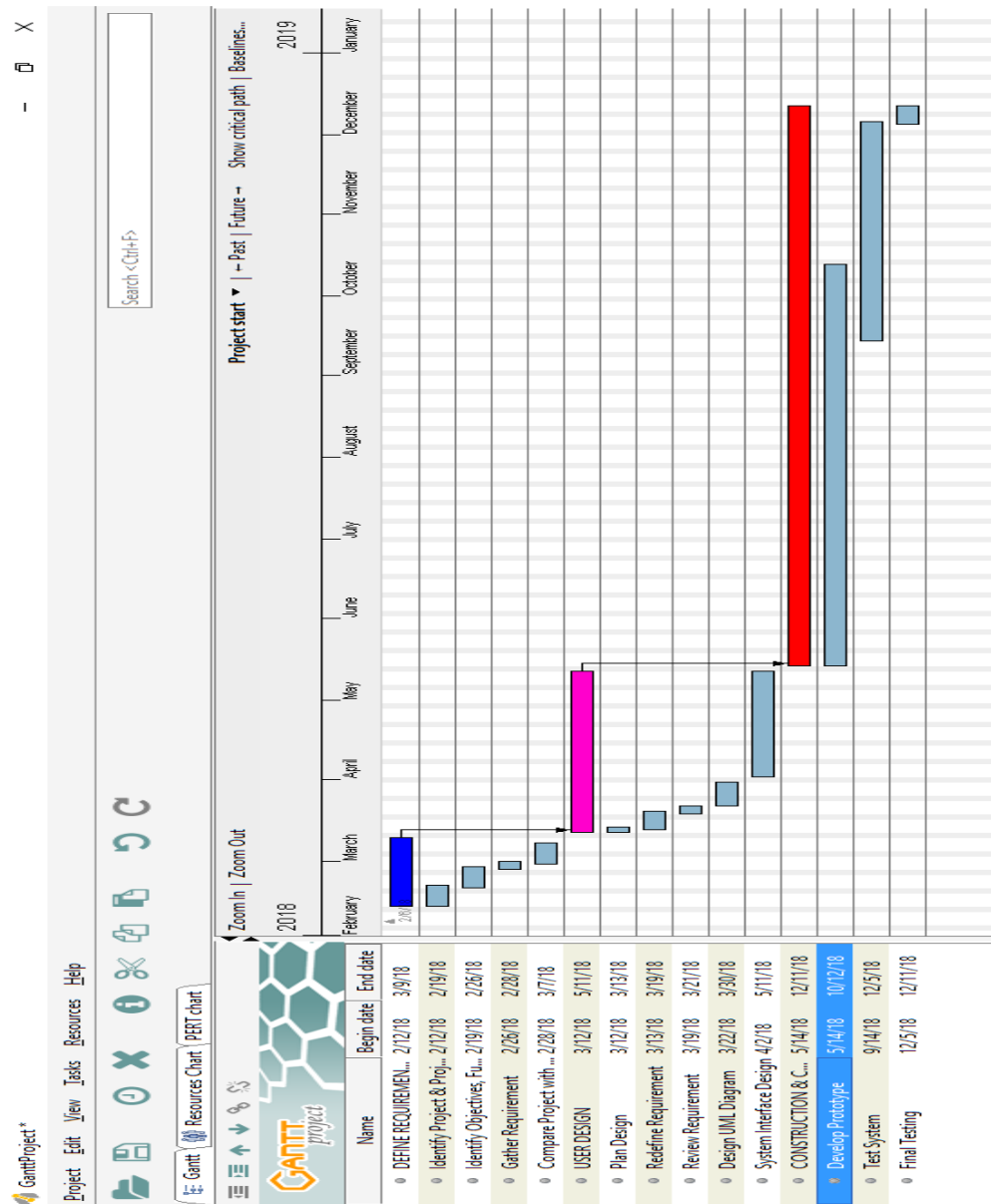


Figure 3.5 : The Gantt chart of this project

3.6 SUMMARY

As a conclusion, this chapter explain on the method that had been used to develop the mobile application for Concrete Strength Measurement Tool by exploiting the heat imaging information. RAD has been chosen as the method of this project since it is the most satisfactory method for the project development. Without all the requirements in the software and hardware chosen, the project are unable to be develop smoothly.

CHAPTER 4

INTRODUCTION

4.1 INTRODUCTION

This chapter will explain more on the implementation, testing and the results that being gotten from the running application. The interface made in the Android Studio application is the calculation of Concrete Strength Measurement System. Other than that, the system able to save and open the recorded data and interface. There will be testing process where all the functionalities that had been use in the mobile application can run smoothly or not. The results are based on the testing process been held. It will also show that the objectives in this project are fulfilled.

4.2 Implementation of Concrete Strength Measurement System in Android Studio

4.2.1 Development Environment

Generally, Concrete Strength Measurement System is a standalone system or can be as a system to a specific task. The main function of this system is to calculate the concrete strength by the methodology selected. The methodology used to build this system is RAD methodology. The process of testing for this system is being held in the construction phase of the methodology before it being hands over to the client. This system used JAVA programming language to develop the functionalities.

There are some functions being declared in the codes of the system. It is for the ease of use of the functions to be called in the other classes. Before implementing the right codes and algorithm, it was first tested to see whether the output of the function fulfil the client requirements and whether the method and algorithm is suitable to use in this project. The codes are being run using Android Studio application software. Opencv library is also being used in the Android Studio application since there are some

function that is not available in Android Studio itself such as Image Processing function. There are several lines of codes been used to call the existing function in the Android Studio application.

4.2.2 Tools and Technologies

The implementation of Concrete Strength Measurement System is done in Android Studio application. This is because the application able to connect the interface done to the mobile interface. It is also being written in JAVA language. The interface for the heat imaging is done by using Matlab application. By referring the codes in Matlab application, all the function used to calculate, drawing plot will be taken from the Opencv library. The Opencv library need to be downloaded and imported into the Android studio application. Once it is downloaded, the function can be use smoothly.

4.3 Testing and Result Discussion

4.3.1 Testing Function

The first interface of the application will lead the user to decide what they want to do with the application. As shown in the Figure 4.3.1 below, there will be three button that lead to different page, button 'New Project', 'Open Project' and 'Exit'. 'New Project' button will proceed to camera where it will take new picture on the spot. This camera can be used by using function existed in the Opencv library or connect it to the FLIR camera. 'Open Project' button will go to next page where the image is being upload to the application to create the contour plot. There also an Exit button where the user think that he or she does not want to continue the application and exit the application.



FIGURE 4.3.1 : There will be two button that lead to next activity and an exit button to shut the activity

When clicking the 'Open Project', the user will go to a new interface where they need to upload the photo of heat imaging taken from the Gallery of the mobile phone. They need to upload three photo of heat imaging which are the picture from front, back and the side. In the interface also include a button, 'Outline'. The 'Outline' button have the configuration of changing the heat imaging picture into a contour line picture. The contour will be upload and replace the heat imaging picture. Once uploaded, the user will plot three point on each picture. The point that they will do is to get the diameter of contour of each surface.



FIGURE 4.3.2 : Uploading the image of the heat imaging

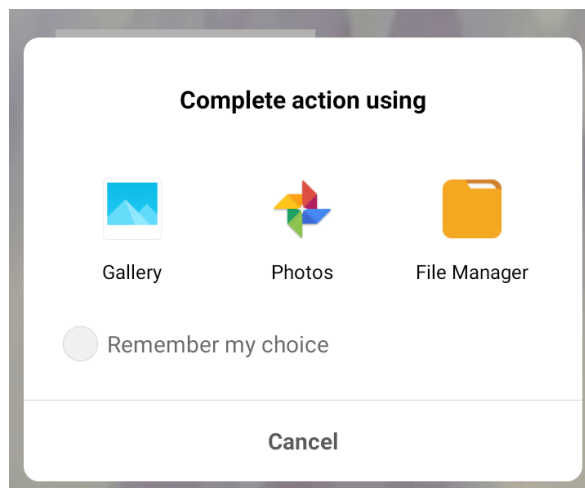


FIGURE 4.3.3 : From the gallery of the phone, the user will choose which heat imaging picture he/she want to upload

The heat imaging are able to be upload to the mobile application but the contour picture is gotten by from the Matlab application since the button in the mobile application are not functioning well.

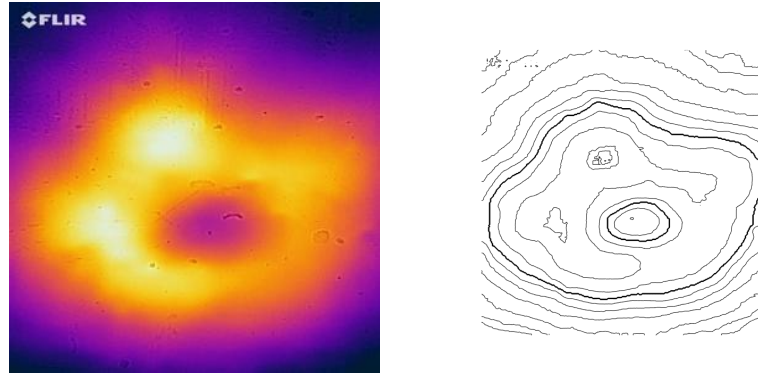


FIGURE 4.3.4 : The image on the left is from FLIR camera and the right is the contour draw based on the heat imaging picture (Front part picture)

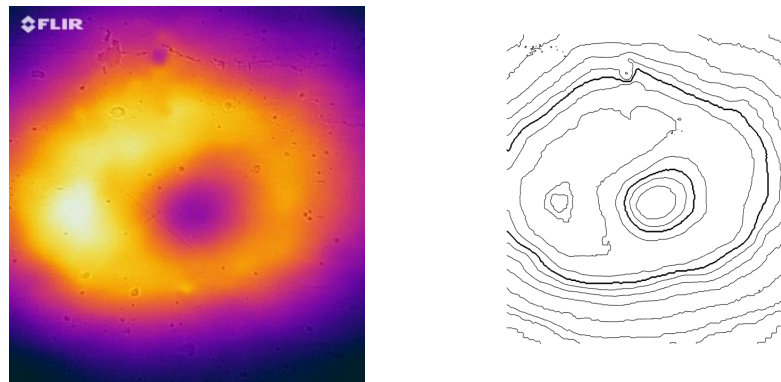


FIGURE 4.3.5 : The image on the left is from FLIR camera and the right is the contour draw based on the heat imaging picture (Side part picture)

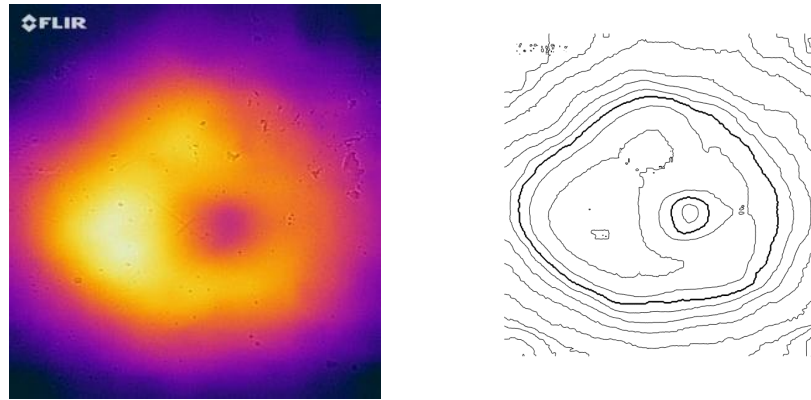


FIGURE 4.3.6 : The image on the left is from FLIR camera and the right is the contour draw based on the heat imaging picture (Back part picture)

To choose the exact spot, the picture must be clear and exact. Thus, the picture must be zoom in. In this project, the function used is the pich-in zoom where it is more comfortable to be use since it is touch screen. The ‘zoom image’ button will open the picture and the user can start zoom in the picture.

Once the user had clicked 3 spot in the zoom in picture, the diameter results for each contour diameter (orange, yellow, white) will appear in the text field under the 'zoom image' button respectively. The process will be the same for Picture 2 and Picture 3 as shown in Figure 4.3.7

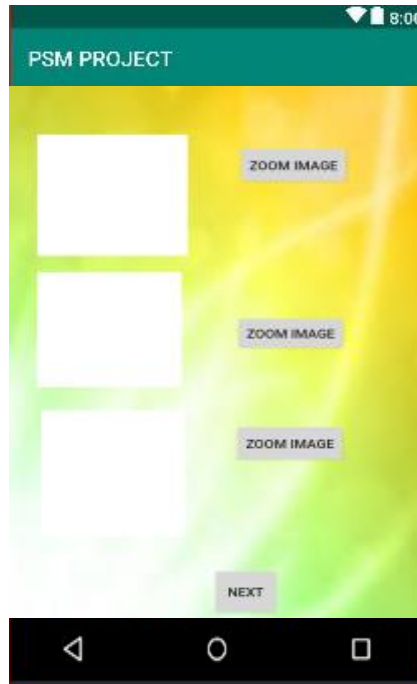


FIGURE 4.3.7 : The page that will enter the diameter of each contour on each picture

When the user click on 'Picture 1' button, it will gives out the diameter that had been calculated from the previous page. The same goes to button 'Picture 2' and 'Picture 3'. This will be the last interface in this project. Since it is the last interface, the system will calculate the total average of contour plot on each diameter (yellow, orange, white). By pushing the button 'Total Average/Concrete Strength', the average of all 3 pictures will be calculated and displayed. Thus, by then the user will get the concrete strength.

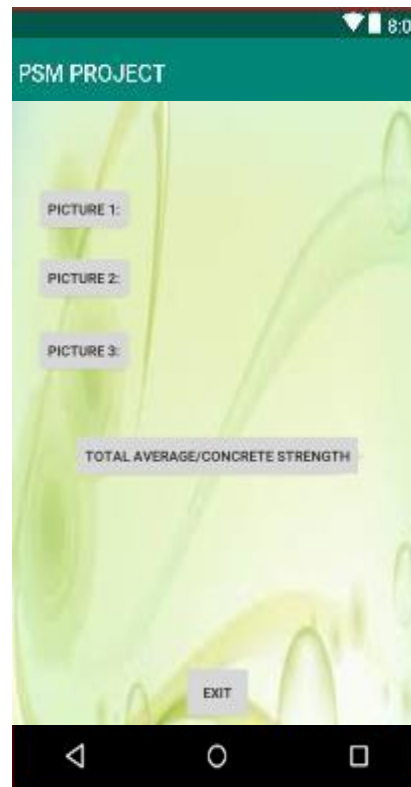


FIGURE 4.3.8 : The average of diameter in each contour is calculated and get the concrete strength

When doing the test function of this project, I get that the button are not as funtional as they need to be. The button that being function are the exit button, the loading image button, the calculation button and the button that lead to the next and previous interface. The calculation button will execute the output but need to be user input since they cannot retrieve the calculation in the contour plot image.

CHAPTER 5

CONCLUSION

5.1 Introduction

In this chapter will include the conclusion of Concrete Srength Measurement System. All the objectives, methodology, project implementation, research constrain and future of the project are discussed in this chapter.

As we know, the Concrete Strength Measurement System is a system that able to calculate the strength of concrete by retrieving the heat imaging information. Through this project, the system will be used to help the user in getting the concrete strength using the new measurement method as previously since there is no existed system that can help in getting the concrete strength. For the designing part, it follows what the client wants and the button required to assist user when using the system. The functionality of the system also need to be tested by the client.

This project uses Rapid Application Development (RAD) approach as the model approach of methodology to help the designing of the system. Since this project is the continuous project, the codes that being used in Matlab is being used as a reference. It is because by refering to the codes, I am able to understand more on how to make it run in a mobile application. In this project, the programming language that I will be using is JAVA language. There are some function that are not in the Android Studio library such as changing a heat image into contour line. Thus, I had imported a new module library called Opencv so it can run the application smoothly. This is because the Android application is being used in JAVA language.

5.2 Project Constraint

There are some constraints while completing this project. The constraints are :

i. Time

As a university student, I also takes other courses at the same time. From the other subject, also have projects, assignment, test, quizzes that the students need to commit in every semester. Giving full commitment to this project is very challenging since there is deadline for other projects of differents subjects. The students also needed to join curricular and university programs.

ii. Development phase

During the early phase, it is hard to find the information about the project as it is a new system to be developed. There are also problems in getting the comparison with other existed system. Once the Development phase started, the codes start getting error. This is because this project is a continuous project where before this, this project is developed in Matlab. In this project, the codes need to be done in JAVA language since Android is using JAVA language. The constraints occur often when trying to use the fuction in Opencv library.

5.3 Future of the project

Concrete Strength Measurement System is the system where the basic function to calculate the concrete strength is being developed in the Android application. The codes from Matlab is being referred and change it into JAVA language, the error had been occur mostly in the calculation function and the function from the imported library. The system may enhanced into the web based system where the students are able to have the access of the system in the laboratory. The web-based system is sometime preferable depends on what type of situation. The continuation of this project also can be in the form of mobile application where it is upgrade to a simpler system or build in an IOS version.

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