POLITEKNIK
MALAYSIA
SEBERANG PERAI

DIPLOMA KEJURUTERAAN ELEKTRONIK (KOMPUTER)

POLITEKNIK SEBERANG PERAI

AUTONOMOUS FIRE FIGHTER

PREPARED BY:

GOBINATH S/O SHANMUGAM (10DTK15F1049)

PUVEN KUMAAR S/O GOVINDARAJAN (10DTK15F1143)

SUPERVISOR

PUAN NASROLAYUZE BINTI MD SAAD

JUNE 2017

POLITEKNIK
MALAYSIA
SEBERANG PERAI

AUTONOMOUS FIRE FIGHTER

FROM :

GOBINATH S/O SHANMUGAM (10DTK15F1049)

PUVEN KUMAAR S/O GOVINDARAJAN (10DTK15F1143)

This report is to meet the needs for the awards of the Diploma in Electronic Engineering (Computer) in the Department of Electrical Engineering Polytechnic.

JUNE 2017

ABSTRACT

Nowadays, in industrial, commercial and domestic world, automation assumes an essential part; it is really a planning of various components so as to control, sense, regulate and instruct itself to accomplish a wanted result. My aim is to create a smart multiple sensor based fire fighting robot in our everyday life. So, "A Smart Autonomous Fire Detector which Deflects Obstacle on Pathway" created with an extinguisher and some other important elements which controlled by a microcontroller. The system is cost effective, has an extensive use, which can present effective and good outcome during execution. It can be utilized purposely in commercial, domestic sectors and industrial uses which the condition of automatic job needed. I create the fire sensing system utilizing flame sensors that constantly observe the presence of fire. If any fire detected, it will extinguish the fire using a water pump that gives to it. Fire Fighting Robot also able to avoid obstacles on its pathway by changing its direction of movement. This method is possible with the use of ultrasonic sensors. After extinguishing the fire it will move back to find another any presence of fire. It voluntarily senses and extinguishes fire without human guidance. This is mean to simulate the actual world process of robot executing a fire extinguishing task.

ABSTRAK

Kini dalam dunia industri, komersil dan domestik, automasi memainkan peranan yang penting; ia sebenarnya susunan unsur-unsur yang berbeza dalam usaha untuk mengawal, mengesan, dan mengarahkan dirinya untuk mencapai keputusan yang dikehendaki. Matlamat saya adalah untuk mencipta sebuah robot pintar dalam kehidupan seharian kita yang boleh memadam api berasaskan pelbagai sensor. Oleh itu, sebuah robot pintar yang boleh memadam api serta menghalang halangan dalam perjalanan telah dicipta dengan alat pemadam api dan beberapa komponen yang telah boleh dikawal oleh pengawal mikro. Sistem ini adalah kos efektif dan mempunyai pelbagai aplikasi yang boleh menunjukkan hasil yang baik dan berkesan apabila melaksanakannya. Ia boleh sengaja digunakan dalam perdagangan, sektor domestik dan kegunaan industri di mana keperluan tuntutan kerja automatik diperlukan. Saya mereka bentuk sistem pengesan kebakaran menggunakan sensor api yang sentiasa memerhatikan kehadiran api. Jika apa-apa kebakaran dikesan, ia akan memadamkan api menggunakan pam air yang disediakan kepadanya. Robot ini juga dapat mengelakkan halangan di laluannya dengan menukar arah pergerakannya. Kaedah ini boleh dilakukan dengan penggunaan sensor ultrasonik. Selepas pemadam api ia akan kembali untuk mencari kehadiran api yang lain. Ia mengesan dan memadamkan api secara sukarela tanpa bantuan manusia. Ini bermaksud robot melaksanakan tugas dengan situasi dunia sebenar dengan proses simulasi.

APPRECIATION

In the first place , i want to express my thankfulness to the god concerning the blessing given which I could finish my final year project. During making this paper, I have been collaborating with several people in helping me to finish this project.

I want to express my genuine appreciation to my supervisor Madam Nasrolayuze binti Md Saad to the significant guidance, primary thoughts, continuous assistance and inspiration to make sure this project achievable. I respect his reliable assistance from the earlier until the end of this project.

I acknowledge my sincere appreciation to my parents for their sacrifice, love, and dream in my life. I can't find the suitable words that may appropriately portray my gratefulness for their assistance, commitment and confidence in my capacity to accomplish my aims. Special thanks must be given to my group mates. I like to appreciate their ideas and comments that were significant for the effective accomplishment of this final year project.

The following category is the individuals who aid me to influence besides raise further in my project and constantly help me in order to finish this project. I truly welcome the information and thought given.

VERIFICATION

We here by declare that this report is the effort of our own to make successful project with information retrieved from the source that were mentioned in the accreditation.

Reviewed and approved by :

Name of supervisor : Madam Nasrolayuze binti Md Saad

Signature of Supervisor

Date : 3 OKTOBER 2017

"We declare that this is the result of our own except for each of which we have explained the source".

Signature :

Name : Gobinath S/O Shanmugam

Matric No : 10DTK15F1049

Date : 3/10/2017

Signature :

Name : Puuven kumaar S/O Govindarajan

Matric No : 10DTK15F1143

Date : 3/10/2017

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 : INTRODUCTION

1.1 INTRODUCTION

These days, machinery and robotic construction turn into significant in serving human. This project support to create interest besides inventions in the robotics sector as functioning in a reasonable and possible ways to save a life and moderate damage of property. This fire fighting robot able to sense and extinguish a fire automatically. It is about assembly systems with DC motors, flame sensors, ultrasonic sensor and water pump, along with major connections. With the innovation of such a device, human and property can be rescued at a much higher rate with moderate damage brought by the fire.

This robot executes the subsequent method: environmental detection, corresponding motor control. This robot progress data from several sensors and key hardware features through the microcontroller. All types of signal got by the microcontroller will be managed and performed to achieve the mission of the robot. This robot can be stayed away from work region with obstacles in follow its mission to extinguish the fire.

The robot will observe the work region by executing undirected movements; it as an optional method utilized by humans, particularly the fire fighter to fight fire. In real life, a destructive burnt region frequently occurs without our understanding. Thus, this type of robot will need in the marketplace with high demand since it is helpful to the human along with the environment.

1.5.1 Fire detection

The robot can identify the existence of fire within a particular range over the flame sensor. Sensitivity of detecting the fire is decided by calculating the distance from the robot to the fire, and after that the distance will be added in the program.

1.5.2 Obstacle avoidance

The robot will stay away from the obstacle utilizing ultrasonic sensor throughout the fire sensing process. The distance from the robot to the obstacle also decided from calculations and will add in the program. The robot will turn its position of movement to stay away from a clash with objects.

1.5.3 Extinguish fire

After exploring randomly, once the fire has been identified it will extinguish the fire automatically by using water. Robot movement and concentration depending on horizontal work region.

1.6 IMPORTANCE AND IMPACT OF PROJECT

The importance of this project is to help the public to fight the fire while waiting for the Fire Fighter to come. The impact that we will receive is it will help to bring a change in each and everyone's life . Work area with barrier can be avoided by this robot , in pursuing its ability to extinguish fire . Robot will monitor the work area by performing random movements.

1.2 PROJECT BACKGROUND

For final project ,we decided to made a smart autonomous fire fighting robot which is generally reliable and consistent . It can provide greater efficiency to detect the flame and it can be extinguish fire before it become uncontrollable and threat to life. Hence, this robot can play a crucial role. The features that firefighting robot will have such as Fire detection, Obstacle avoidance and Extinguish fire.

1.3 PROBLEM STATEMENT

Fire fighting robot is particularly created for help humans, especially for fire fighter who deal with fire in extinguishing fire situation. This robot can be used at home or residential based on what way its setup. It can be utilized by fire fighters or individuals, the objective is one and only to protect life when facing the fire.

Fire fighters are more unsafe to death over their everyday routine in fire fighting. The utilization of robots is one of the options for decreasing fire fighter losses and improving fire fighter abilities. Not like humans, the robot has a more ability to aware, not tired and ready to operate 24 hours based on the program of work given to the robot.

Sometimes a problem for help could occur from the assigned fire department. Details over a phone call require certain time to decide the area of the fire incident. Furthermore, the vehicle that fire fighter used was large and hard to go through the

traffic jam. By creation of fire fighting robot, the time can decrease by situating the robot in a high-risk location of a fire.

Having water sprays in each fire system for every building has its own disadvantages such as it may damage furniture, gadgets and documents in the buildings. However, by utilizing the robot, it can extinguish the fire at the targeted spot only. Other than that, the robot can created with high sensitivity sensors that can sense the existence of fire, smoke and heat which unable to sense by human's sensitivity.

1.4 OBJECTIVE

The objectives of the project are:

- To create robot that can replace conventional fire fighter , therefore reduce risk of injuries tremendously.
- To reduce or avoid damages and losses.
- Can be utilize as a primary solution to extinguish the fire.

1.5 PROJECT SCOPE

Made a smart autonomous fire fighting robot which is normally safe and steady. It can give more efficiency to sense the flame and it would be extinguish fire ahead it goes strong and risk to human life. Therefore, this robot can play an important role. The fire fighting robot will have characteristic such as:

1.7 SUMMARY

We have chosen this project in a thought of it will bring advantages to people who really need it and this will also give them to get the things they want. Since semester 1 to semester 5 we have learned a lot of coding and also practical. We feel that all this while what we have been learning will be utilized fully and it will help us to do the project well. By doing this project, it actually helped us to think out of the box especially from the view of pros and cons of this project. It also helped us to analyse what are the problem we might see just to make the project perfect. We have learnt what are things we should use to build this project just to make it in to a success.

CHAPTER 2 : LITERATURE REVIEW

2.1 INTRODUCTION

A Smart Autonomous Fire Detector Robot has the ability and capability to run automatically, avoiding obstacles and at the same time find and detect flame and extinguish them using water mechanism. An ultrasonic sensor used to avoid the obstacle while flame sensor used for initial detection of the flame. Robot movement was driven by a DC geared motor with encoder. Using an Arduino microcontroller this robot process information from several sensors and main hardware portion. This section basically guides for preparing the entire report content, including the graphical illustrations. Studies performed on existing robot also carried out in this chapter to assess the characteristics of a Fire Fighting Robot and to be taken as a reference.

2.2 CONCEPT / THEORY

Robot is a machine that looks like a human being and performs various complex tasks. Now, let's have a good look at existing firefighting robots. Virtual Reality simulation of Fire Fighting Robot 191 (Indonesia) is a virtual adaptation of competition robot, that took part in Panitia Kontes Robot cerdas Indonesia competition in 2006. This system was developed in MATLAB/Simulink with the help of «virtual Reality Toolbox» plug.in. It is oriented for initial testing of controlling algorithms. Its important to notice, that even the robot itself doesn't have enough level of functionality, because of low-detailed formalization of environment.

The robot could operate only in corridor-room environment, without strange objects. Only one fire source is meant and there are auxiliary marks on floor, that mean for example room entrance.

Pokey the Fire-Fighting Robot (USA) is the firefighting robot, that made its way out of competitions, and became more serious" than other systems. In [10] there are detailed description of used equipment and basic algorithms of operating. Robots operating environment is a building, so the robot is equipped with necessary sensors, for example, with a line sensor, that could be unuseful in conditions of dense smoke. The main advantages of robot are:

- using of two types of fire sensors, working in different ways;
- using of complex firefighting tool;

The main disadvantages are :

- short distance of sensor's work . The fire could be recognized at the distance not more than 1.5m. at longer distances the sensors works bad, ad developers say
- low efficiency of on board computer, able only to carry main tasks, without its extension and complexization
- absence of optical means of environment perception.

The device is described as autonomous mean of firefighting in houses and any civil buildings. Fire Protection Robot (USA) - another competition project, developed for «15th Annual Trinity College Fire Fighter Robot Competition». Robot has more complex organization, than one, shown above and is oriented for solving larger variety of tasks. The main system's advantage are :

- more complex algorithms, used for fire detection.

- using of sound sensor for activating.
- presence of some additional navigation sensors.

The main disadvantages are:

- Low-efficiency computer;
- low-power chassis;
- absence of home-return algorithm;
- absence of mapping;

Firefighting Robot is an American Trinity College development, that was only on early- prototype stage (in 2008). It was supposed to this robot to be an autonomous device, with 15 minutes limited working time, after which it will return to the supply station. This approach is one of the best variants for firefighting in houses and non-industrial buildings. The main disadvantages are:

- the little working time and low-stock of "water" .

2.3 PREVIOUS RESEARCH

The robot below show the characteristic of the previous robot that have been similar with this robot project and used in the literature reviews :

2.3.1 Rolly Fire Fighter robot by William Dubel , Hector Gongora , Kevin Bechtold and Daisy Diaz

Figure 2.1

This firefighting robot is designed to search for a fire in a small floor plan of a house , extinguish the fire (by placing a cup over the LEDs) , and then return to the front of the house . The navigation of the robot throughout the house is achieved by data provided by a line tracker and ultrasound transducers. The deployment of the extinguish device is implemented with a custom arm controlled by servos.

2.3.2 Fire Protection robot by Viet Do , Ryan Norder and Ryan Spraetz

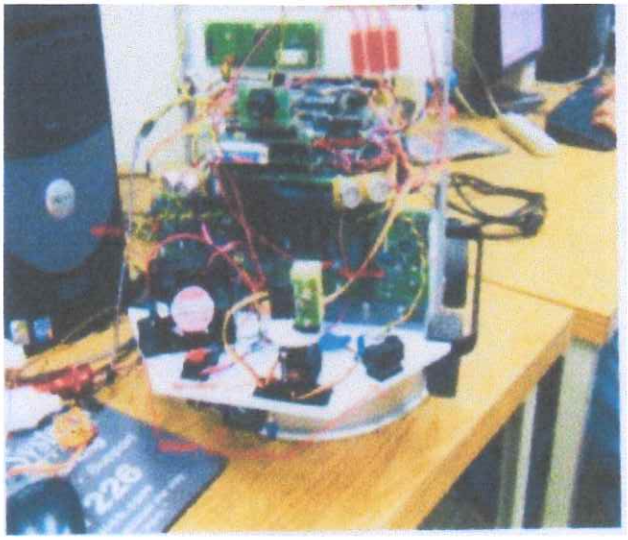

Figure 2.2

This robot designed to enter a room and seek out a spot where there is extreme heat possibly due to a fire . Upon entering the room , the robot will once again use the colour camera to pinpoint a spot where there is a large concentration of light. Once the robot has driven up to the light source , the heat sensor is activated to check and see if there is a large amount of heat being generated. If there is an excessive amount of heat generated , the fan is turned on and rotated quickly with a servo motor to put out the flame . if the flame is not put out the fan will turn on again and continue to blow on the flame . Once the flame is extinguished , the robot leaves the homes.

2.3.3 Autonomous Mobile Robot : Recognize and Response to fire by Nik Md Hafizul Hasmi B Md Suhaimi.

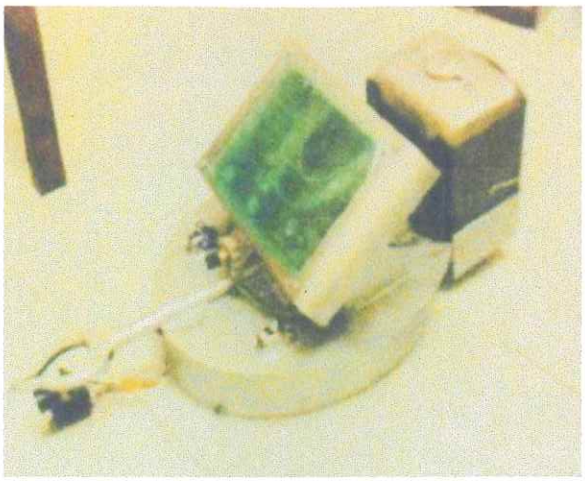

Figure 2.3

This project will discuss about the development of a mobile robot which is can train and control an autonomous robot that has a multifunction . The robot acquires basic navigation skill as well as the ability to detect a fire and to extinguish it. This robot is supported by RC circuit as driver for DC motors and other electronic components. This robot equipped with fire sensor that can be expand and attract so it can recognize and response to fire to operating water pump system. The battery monitoring circuit also equipped in this robot to make an easier to monitoring the overall robot battery power.

2.3.4 Component that used are such as:

- Arduino Mega
- DC motor
- Wheel
- Motor driver
- 12V battery
- Flame sensor
- Water pump
- Ultrasonic sensor
- Buzzer
- LED

2.3.4.1 Arduino Mega

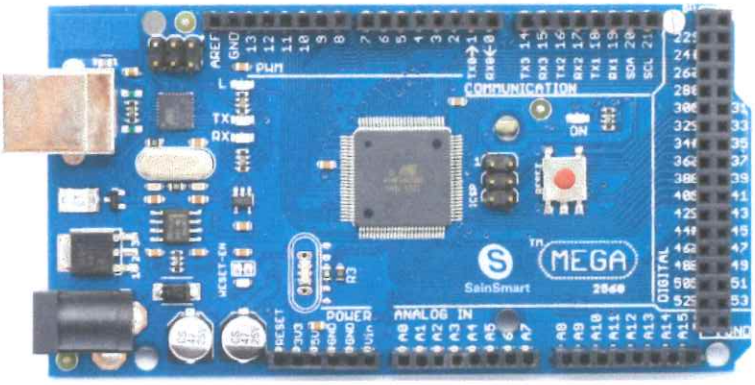

Figure 2.4

The Arduino Mega is a microcontroller board based on the ATmega1280 (datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

2.3.4.2 DC Motor

Figure 2.5

Working principle of a DC motor. A motor is an electrical machine which converts electrical energy into mechanical energy. The principle of working of a DC motor is that "whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force".

2.3.4.3 Wheel

Figure 2.6

A differential wheeled robot is a mobile robot whose movement is based on two separately driven wheels placed on either side of the robot body. It can thus change its direction by varying the relative rate of rotation of its wheels and hence does not require an additional steering motion.

2.3.4.4 Motor driver

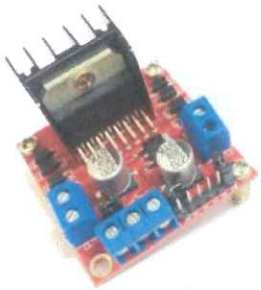

Figure 2.7

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC.

2.3.4.5 12v Battery

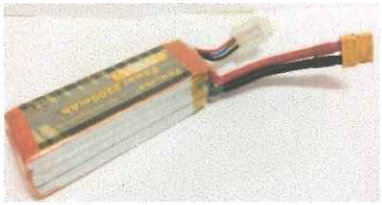

Figure 2.8

LiPo batteries (short for Lithium Polymer) are a type of rechargeable battery that has taken the electric RC world by storm, especially for planes, helicopters, and multi-rotor/drone.They are the main reason electric flight is now a very viable option over fuel powered models.RC LiPo .batteries have four main things going for them that make them the perfect battery choice for RC planes and even more so for RC helicopters over conventional rechargeable battery types such as NiCad, or NiMH.

2.3.4.6 Flames sensor

Figure 2.9

Flame Sensor can be used to detect fire source or other light sources of the wavelength in the range of 760nm - 1100 nm. It is based on the YG1006 sensor which is a high speed and high sensitive NPN silicon phototransistor. Due to its black epoxy, the sensor is sensitive to infrared radiation.

2.3.4.7 Water pump

Figure 2.10

The pump is powered by an electric motor that drives an impeller, or centrifugal pump. The impeller moves water, called drive water, from the well through a narrow orifice, or jet, mounted in the housing in front of the impeller. ... Its function is to slow down thewater and increase the pressure.

2.3.4.8 Ultarsonic sensor

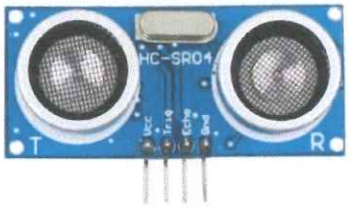

Figure 2.11

The Ultrasonic Sensor sends out a high-frequency sound pulse and then times how long it takes for the echo of the sound to reflect back. The sensor has 2 openings on its front. One opening transmits ultrasonic waves, (like a tiny speaker), the other receives them, (like a tiny microphone).

2.3.4.9 Buzzer

Figure 2.12

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

2.3.4.10 LED

Figure 2.13

A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it. The light is not particularly bright, but in most LEDs it is monochromatic, occurring at a single wavelength.

2.4 PRICE OF THE COMPONENTS

NO	NAME OF THE COMPONENTS	QUANTITY	PRICE(RM)
1	Ultrasonic sensor	3	31.80
2	Flame sensor	1	5.85
3	Arduino Mega	1	45.00
4	L298N	2	23.00
5	Jumper	1	1.80
6	Motor	2	80
7	Water pump	1	20.40
8	Aluminium L	2	5.00
9	Aluminium base	2	30
10	Tank	1	4.20
11	Acorn nut	2	11.30
12	Sprinkler	1	10.50
13	Screw nut	11	32.80
14	Coupling	2	11.00
15	Jumper MF	10	6.00

Table 2.4 : Price and list of the components.

2.5 SUMMARY

This section discuss about the past project and history about fire fighter robot. This part also discuss about the development of a mobile robot which it can be train and control an autonomous robot that has a multifunction. The robot acquires basic navigation skills as well as the ability to detect a fire and to extinguish it. This robot is controlled by a microcontroller Arduino Mega and supported by Bluetooth as a driver for dc motor and other electronics components. This robot equipped with fire sensor that can be expand and attract so it can recognize and response to fire to operating water pump system. The battery monitoring circuit also equipped in this robot to make an easier to monitoring the overall robot battery power.

CHAPTER 3 : METHODOLOGY

3.1 INTRODUCTION

There are various segments in the progress of designing autonomous fire fighting robot. These segments could be clarified utilizing intended methodology. Methodology is the most significant in project progress to make sure project achievement and take after precise procedure. Entire explanations of the parts and the study were done precisely on fire fighting robot in order to make sure that the procedure of building up this robot must be given the right way to execute. Figure 3.1 indicates the block diagram for this robot. This block diagram indicates how an autonomous fire fighter robot executes. Inputs such as flame sensor and ultrasonic sensor control by microcontroller. Using this input, main board sets the references and uses this information to relating to its output such as DC motor and water pump.

Figure 3.1: Block diagram of autonomous fire fighting robot

The most important part is to be implemented in this project is hardware and software parts. Flowcharts below show some work flows of this project, which Figure 3.2 is the flowchart of the report work and Figure 3.3 is the flowchart of project work. Hardware consideration and type of software used also explained through this part.

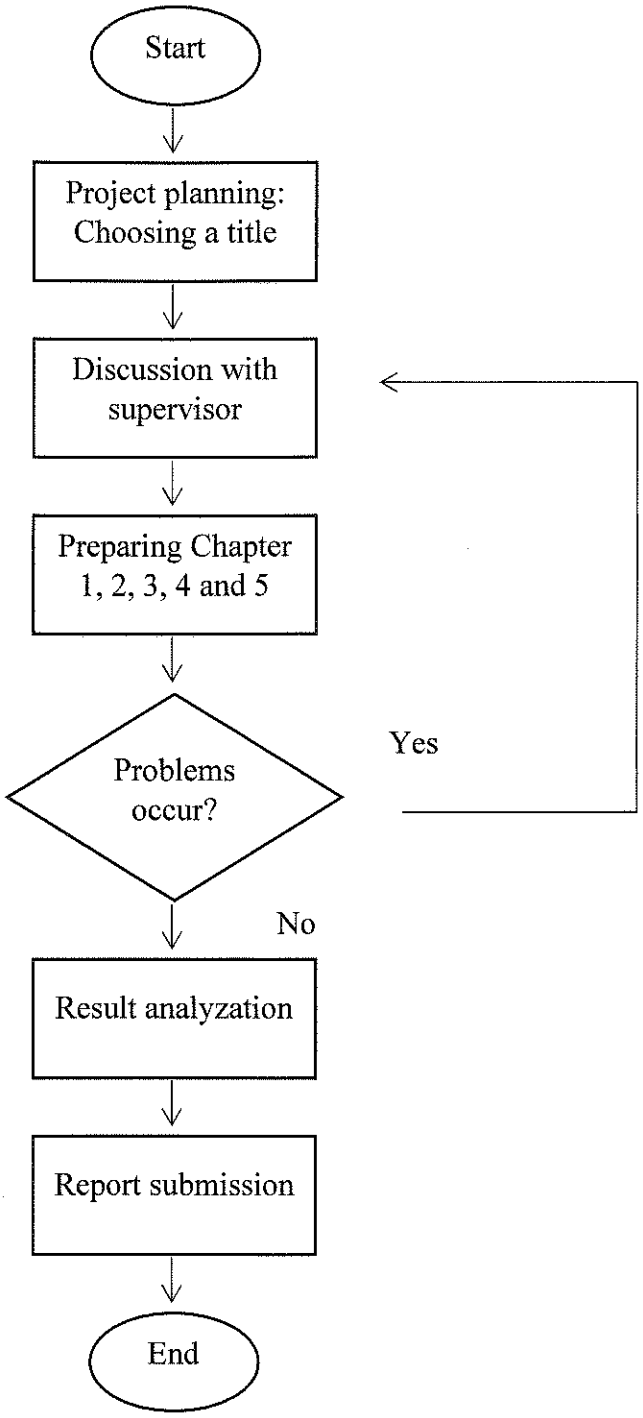

Figure 3.2: Flowchart of report work