

FIRE FIGHTER ROBOT

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**DIPLOMA KEJURUTERAAN ELEKTRONIK (KOMPUTER)
JABATAN KEJURUTERAAN ELEKTRIK & ELEKTRONIK
POLITEKNIK SEBERANG PERAI**

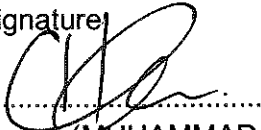
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ANNOUNCEMENT

This project report titled "Fire Fighter Robot" has been submitted, reviewed and confirmed as meeting the conditions and requirement of writing projects as required.

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

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ABSTRACT

A robot can be defined as a programmable, self-controlled device consisting of electronic, electrical or mechanical units. It is a machine that functions in place of living agent/people. Robot are especially desirable for certain place because, unlike humans, the robot will never get tired. The robot can also work in physical conditions that are uncomfortable or even dangerous. It can also control by human. This project can led on extinguish the fire efficiency with reliability. This project protect fireman for the fire rescuer life or death, due location not familiar or unexpected explosion.

ABSTRAK

Robot boleh ditakrifkan sebagai alat kawalan sendiri yang boleh diprogramkan yang terdiri daripada unit elektronik, elektrik atau mekanikal. Ia adalah mesin yang berfungsi sebagai agen / orang hidup. Robot sangat wajar untuk tempat tertentu kerana, tidak seperti manusia, robot itu tidak akan pernah letih. Robot juga boleh berfungsi dalam keadaan fizikal yang tidak selesa atau bahkan berbahaya. Ia juga boleh dikawal oleh manusia. Projek ini boleh menyebabkan pemadaman kecekapan kebakaran dengan kebolehpercayaan. Projek ini melindungi petugas pemadam kebakaran untuk kehidupan penyelamat atau kematian, lokasi yang disebabkan oleh letupan tidak biasa atau tak terduga.

APPRECIATION

First and foremost, I wish to express we sincere appreciation to my supervisor, Encik Amir Bin Abu Bakar for encouragement, guidance, critics, and supports given throughout the progress of this project. Without their continued support and interest, this project would not have been the same as presented here. In preparing this report, I was in contact with many people, and thoughts. Our sincere appreciation also extends to family members who has been so tolerant and supports us all these years. Thanks for their encouragement, love and emotional supports that they had given to us.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The objective of this research is to develop the medium-size fire fighter robot. The prototyped of fire fighter robot has been developed. The prototyped consists of two independence driven wheels and a dc water pump. The control system which includes controller by via Bluetooth. There are many sections in the development of designing to control the robot. These sections can be simplified using methodic approach.

1.2 OBJECTIVE

The purpose of this project (Prototype) is to design and implement a controlled Fire Fighter Robot via Bluetooth connection by using android smartphone.

1. To develop the robot that can be control by arduino
2. To build the robot easier and familiar to control by using bluetooth
3. To develop the robot can use the DC water pump

1.3 PROBLEM STATEMENT

In our life, the use of robotics in certain places is becoming popular in recent years, and commonly we heard from Japan provide a lot of mechanism that familiar to human. This robot been build are because limitation of movement, efficiency, humanity and many more, human been create are perfectly to do some task. Beside that, the main objective build fire fighter robot is want to reduce the number of the death in fire cases. Many cases injuries, trauma or death is cause of explosion or trap inside burning. The next reason are to easier to through inside room or place in small way to make sure either have or not victim. This robot also can extinguish fire and through a small space. Lastly the purpose of exist this build fire fighter robot is to save time in rescue job.

1.4 SCOPE AND LIMITATION PROJECT

The scope of this project cover several issues listed as below:

- i. The fire fighter robot is operated on plain surface with fire
- ii. The fire fighter robot for indoor and outdoor but in plain surface
- iii. The fire fighter robot is only available to move at range of 8 meter
- iv. The fire fighter robot is can extinguish small fire but not fire source from fuel

CHAPTER 2

LITERATURE REVIEW

2.1 BACKGROUND OF PROJECT

A robot can be defined as a programmable, self-control device consisting of electronic, electrical and mechanical units. It's a machine that functions in place of living people. Robot are desirable for certain place because, unlike humans, the robot will never get tired or excuse. The function of fire fighter robot is to extinguish fire and through the flame without any consultant. This robot is control by using Bluetooth module.

2.2 RELATED WORK FOR PROJECT

Nowadays, The main goal of this project is to develop a robotic vehicle which is used to find and fight fire remotely through RF application in an event of any major fire hazard particularly in industries. The paper published by (Tushar Nandkishor Satbhai, Rahul M. Karande, Anant Vijay Patil, Prof. Manish Patil, July 2014) about "Fire Fighting Robot". Major fire accidents do occur in industries like nuclear power plants, petroleum refineries, gas tanks,

chemical factories and other large-scale fire industries resulting in quite serious consequences. Thousands of people have lost their lives in such mishaps. Therefore, this project is enhanced to control fire through a robotic vehicle with the advancement in the field of Robotics, human intervention is becoming less everyday and robots are used widely for purpose of safety. In our day to day life fire accidents are very common and sometime it becomes very difficult for fireman to save human life. In such case fire fighting robot comes in picture. The fire extinguishing robotic vehicle can be controlled wirelessly through RF communication. The vehicle is controlled through connected remote key input. The language input allows a user to interact with the robot which is familiar to most of the people. The medium of interaction between humans and computers is on the processing of speech. The proposed vehicle has a water jet spray which is capable of sprinkling water. The sprinkler can be moved towards the required direction. The advent of new high-speed technology provided realistic opportunity for new robot controls and realization of new methods of control theory. This technical improvement together with the need for high performance robots created faster, more accurate and more intelligent robots using new robots control devices, new drivers and advanced control algorithms. This project describes a new economical solution of robot control systems. The presented robot control system can be used for different sophisticated robotic applications. The controlling devices of the whole system are Microcontrollers, wireless transceiver modules, water jet spray, DC motors and buzzer are interfaced to Microcontroller. When the user fed the commands through a remote controlled device, the microcontroller interfaced to it reads the command and sends relevant data of that command wirelessly using transceiver module. This data is received by the transceiver module on the robot and fed sit to microcontroller which acts accordingly on motors and pump. The complete system consists of two subsystems transmitter section and the receiver section. This project controls left, right, forward and backward movement of robot wirelessly within 500m range using 433 MHz RF frequency. At the receiver side of robot PIC microcontroller is also used. The microcontroller takes command

wirelessly transmitted by a RF transmitter. The need for a device that can detect and extinguish a fire on its own is long past due. Many house fires originate when someone is either sleeping or not home. With the invention of such a device, people and property can be saved at a much higher rate with relatively minimal damage caused by the fire. Our main objective was to design and build a prototype system that could autonomously detect and extinguish fire.

Meanwhile, the paper published by (Jacques Penders, Lyuba Alboul, Ulf Witkowski, Amir Naghsh, Joan Saez-Pons, Stefan Herbrechtsmeier & Mohamed El-Habbal, 02 Apr 2012) about a review on Fire Fighter Bot. Emergencies in industrial warehouses are a major concern for fire-fighters. The large dimensions, together with the development of dense smoke that drastically reduces visibility, represent major challenges. The GUARDIANS robot swarm is designed to assist fire-fighters in searching a large warehouse. In this paper we discuss the technology developed for a swarm of robots assisting fire-fighters. We explain the swarming algorithms that provide the functionality by which the robots react to and follow humans while no communication is required. Next we discuss the wireless communication system, which is a so-called mobile ad-hoc network. The communication network provides also the means to locate the robots and humans. Thus, the robot swarm is able to provide guidance information to the humans. Together with the fire-fighters we explored how the robot swarm should feed information back to the human fire-fighter. We have designed and experimented with interfaces for presenting swarm-based information to human beings.

Finally, the paper proposed by (Paul Scerri, University of Southern California, Marina Del Ray, CA April 2013) about a prototype infrastructure for distributed robot-agent-person teams. Effective coordination of robots, agents and people promises to improve the safety, robustness and quality with which shared goals are achieved by harnessing the highly heterogeneous entities' diverse capabilities. Proxy-based integration architectures are emerging as a standard method for coordinating teams of heterogeneous entities. Such architectures are

designed to meet imposing challenges such as ensuring that the diverse capabilities of the group members are effectively utilized, avoiding incoordination in a noisy, uncertain environment and reacting flexibly to changes in the environment. However, we contend that previous architectures have gone too far in taking coordination responsibility away from entities and giving it to proxies. Our goal is to create a proxy-based integration infrastructure where there is a beneficial symbiotic relationship between the proxies and the team members. By leveraging the coordination abilities of both proxies and socially capable team members the quality of the coordination can be improved. We present two key new ideas to achieve this goal. First, coordination tasks are represented as explicit *roles*, hence the responsibilities not the actions are specified, thus allowing the team to leverage the coordination skills of the most capable team members. Second, building on the first idea, we have developed a novel role allocation and reallocation algorithm. These ideas have been realized in a prototype software proxy architecture and used to create heterogeneous teams for an urban disaster recovery domain. Using the rescue domain as a test bed, we have experimented with the role allocation algorithm and observed results to support the hypothesis that leveraging the coordination capabilities of people can help the performance of the team.

2.3 COMPONENT ON BOARD

The function of fire fighter robot is to save people become easier than taking risk fireman. This robot is control by Bluetooth module and send the output to an Arduino. Next, this robot is used Arduino UNO to operate and the function of Arduino is control the movement of robot. After that, the DC motors is connect to two 9V battery as power supply. Lastly, the description of components are explained briefly at below.

2.3.1 IC (L293D)

L293D is dual H-bridge motor driver integrated circuit (IC). The motor driver takes a low-current control signal and provides a greater-current signal because it acts as current amplifier. Moreover, two DC motors can be driven simultaneously with both in forward and reverse direction in common mode od operation. In the motor operation, two motor are controlled by input logic at pin 2 & 7 and 10 & 15. In additional, input logic 00 or 11 will stop the corresponding motor. Meanwhile, logic 01 and 10 will rotate it in clockwise and anti-clockwise directions respectively. To start the operating process, the enable pins 1 and 9 that corresponding to the two motors must be high. Lastly, the driver gets disabled when the enable input is low and the outputs will off and stay in the high-impedance state.

<https://potentiallabs.com/cart/l293d-ic>

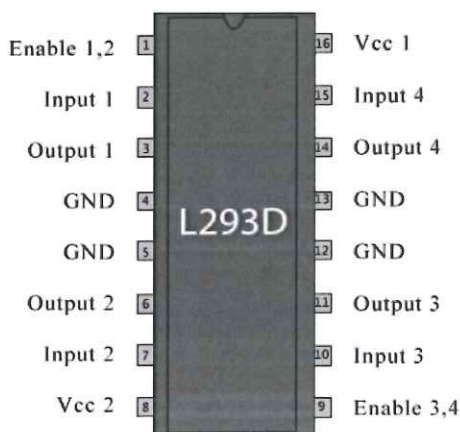


Figure 2.3.1: L293D

2.3.2 DC MOTOR

The function of DC motor is converts direct current electrical power into mechanical power. Next, magnetic fields are the most common types rely on the forces. Generally, DC motors will contain some internal mechanism, electromechanical or electronic to change the direction of current flow. Then, commonly of the DC motor usage are for movement with spin 360 degree clockwise and anti-clockwise. Moreover, DC motor are widely used because it can be powered from existing direct-current lightning power distribution systems. Furthermore, the benefit use DC motor its gain speed control over wide range by using a variable supply voltage. Beside that, the small DC motor are use in tools, toys and appliances. Meanwhile, the larger DC motor are used in propulsion of electric vehicles, elevator and others. In additional, the function of universal motor it can be operate on direct current but in the lightweight motor used for portable power tools and appliances. Lastly, the DC motors with AC motors are possible in many way that can be replaced by the advent of power electronics.

<https://learn.adafruit.com/adafruit-arduino-lesson-13-dc-motors/overview>



Figure 2.3.2: DC motor

2.3.3 ARDUINO UNO

Generally, Arduino is an open source computer hardware and software company, project and user community. Next, the function of Arduino are design and manufacture single-board microcontrollers and microcontroller kits. Mostly, its is for building digital devices and interactive object that can sense and control object in the physical world. Then, the project's product are distributed as open source hardware include with software and licensed for manufacture of Arduino board and software distributed by anyone. Next, arduino board, use a variety of microprocessor and controllers. Moreover, the board contain set of digital and analog input/output (i/O) pins. Those pins may be interfaced to various expansion board as shields and other circuits. In additional, the board is featured serial communication interface and include Universal Serial Bus (USB) on same models.



Figure 2.3.3 : Arduino UNO

2.3.4 POWER SUPPLY

The 9 volt battery was introduced for early transistor radios. Next, it has a rectangle shape with round edges and a polarized snap connector at the top. This type battery of the battery commonly used in walkie-talkie, clock, RC car and smoke detector. Then, the 9-volt battery commonly available in primary carbon-zinc, alkaline chemistry, it available in primary lithium iron disulphide, rechargeable, with contain nickel-cadmium, nickel-metal hydride and lithium-ion. After that, the battery has both terminals in a snap connector on the one end. The smaller circular (male) terminal is positive. Meanwhile, the large hexagonal or octagonal (female) is terminal negative. Plus, the battery polarization is normally obvious because the mechanical connection only possible in one configuration. In additional, a problem with this style of connector is that it is very easy to connect two batteries together in a short circuit. This situation make the battery very easy to discharge at short time, generate heat and possibly can make explode or damage the circuit. So, the battery should be kept in original packaging. Lastly, the type of battery can be connected to each other in series circuit to provide more voltage. https://en.wikipedia.org/wiki/Nine-volt_battery



Figure 2.3.4: 9V battery and connector (battery to arduino board)

2.3.5 DC WATER PUMP

DC water pump is for make the water from source been pump in and out. For example, making new lake are commonly use water pump where from the river been pump as input and goes to lake. DC water pump use are in small matter where the usage are widely in gardening because the pressure of use and voltage requirement are low.

<http://www.mybotic.com.my/categories/DC-Water-Pump/109>



Figure 2.3.5 : DC Water Pump

2.3.6 JUMPER WIRE

A jumper wire is a electrical wire or connection in cable between component, pins and others. Next, the function of jumper wire is used to interconnect the component of a breadboard, other prototype and test circuit internally or with other equipment and component by soldering. Then, jump wire is fitted by insert the end connector into the slot provided in a breadboard, the header connector of circuit board, or a piece of test equipment. After that, the categories of jumper wire are male and female, female to female and male to male. Plus, the jumper wire have many different in colour and size which is depend on the uses for easier to remind. In breadboard, jumper wire established connection between the main board to the output or input component. Lastly, the jumper wire should always be placed the right position to get the current flow and work efficiently. <https://www.cytron.com.my/c-428-jumper-wire>



Figure 2.3.6: Jumper Wire

2.3.7 BLUETOOTH MODULE (HC-06)

Nowadays, Bluetooth usage are commonly in area of telecommunication, computing, networking and consumer electronic for transfer any input and output. Next, Bluetooth is wireless technology standard for exchange some data in short time and far distance than infrared. The IEEE (Institute of Electrical and Electronics Engineers) 802.15.1. So the Bluetooth SIG (Signal Interest Group) oversees development of specification to manage the qualification program and protect the trademarks. Furthermore, a manufacturer must follow Bluetooth SIG standard to market it the Bluetooth device. Lastly, the individual qualifying devices are licensed by a network of patents apply to the technology.

<https://mcuoneclipse.com/2013/06/19/using-the-hc-06-bluetooth-module/>

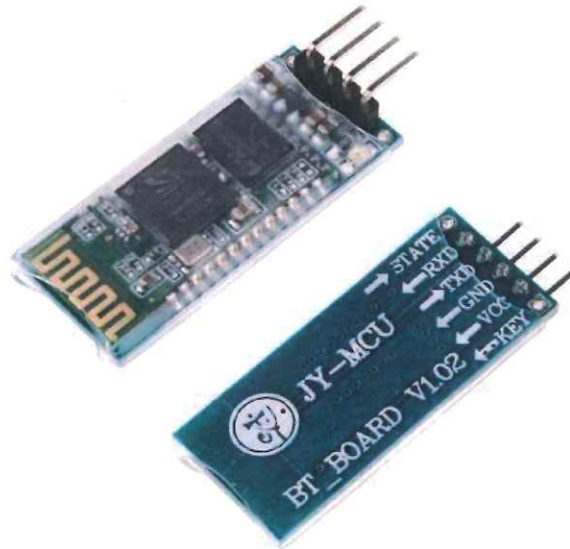


Figure 2.3.7 : Bluetooth Module (HC-06)

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

In the field of study, methodology is systematic and theoretical analysis of the methods. This will explain the theoretical analysis of the body of methods and principles associated with the project. This also offer the understanding of which set of methods to be applied when developed the project. The methodology that was used in this project which entitled as fire fighter robot are in two ways which is by using hardware and also software.

The hardware consists of Arduino Uno, Bluetooth module, two geared DC motors, a motor driver, DC water pump and a power supply. The Arduino Uno controls all the process to be carried out in the system. Two of geared DC motors are used for the movement of the robot and which are driven by motor driver (L298N). The Bluetooth module is used to transmit the commands from the mobile phone. Our system can be started and stopped by the mobile phones. DC water pump function for suck the water tank and fountain by flow at main hose.

The software that was use is called Arduino and it allow the user to write the proper coding in the computer and insert it to the Arduino Uno. The software that was used to control the robot is called Bluetooth Serial Controller. The user must pair the phone with the Bluetooth module and set the controller according to the coding.

Finally, the project will run and able to be control via Bluetooth. The project should achieve its objective and extinguish fire efficient. This project will be very useful for fireman that safe from the death.

3.2 BLOCK DIAGRAM FOR HARDWARE

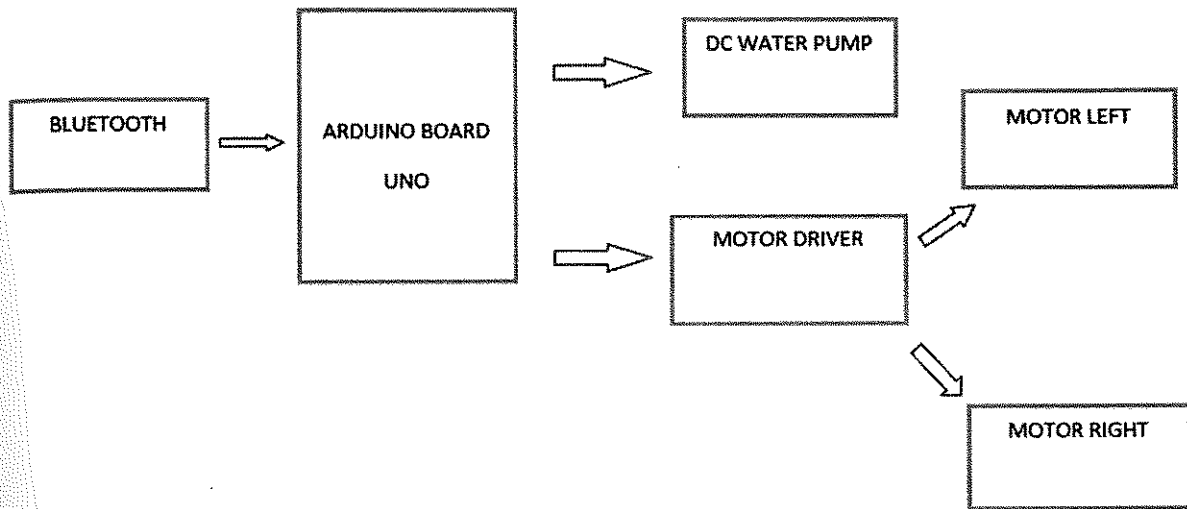


Figure 3.2: Block Diagram

The block diagram above shows the operation of fire fighter robot, which consists of a Bluetooth module, Arduino Uno Bord, power supply 12 volts, 2 DC Motor (6 until 9 volts each), DC water pump (12 volts), and Motor Driver using IC L298N. The project is control via mobile phone by an app called Bluetooth Serial Controller. Every coding is set in the phone so the user is able to control the robot. Every coding is set in the phone so the user is able to control the robot. When the input signal send to the Bluetooth module, the output signal will transfer to the Arduino UNO board to control the movement of robot. When the power supplied to the motor driver, the two DC motor and DC water pump will start function. Meanwhile, the DC water pump is used to suck the tank water and flow to the hose. When the connection is successful, the robot will start to work.

3.3 FLOW CHART FOR HARDWARE

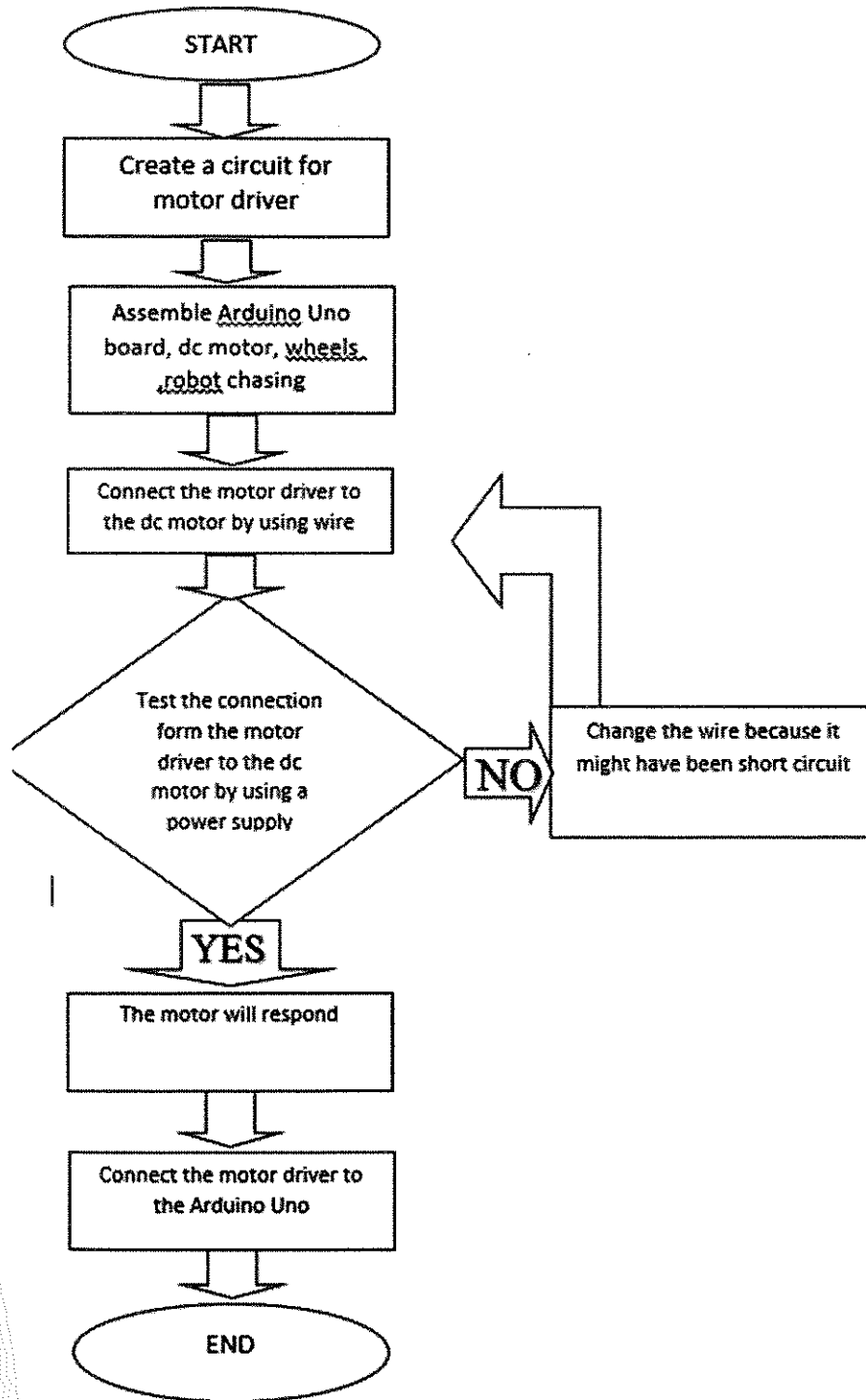


Figure.3.3.1 Flow Chart for Hardware

The figure above shows the steps on how to assemble it. First, create a circuit for motor driver with etching, drilling and soldering method. Next, assemble Arduino UNO board, dc motor and wheels robot chasing. Then, connect the motor driver to the dc motor by using male-to-male jumper wire. After that, supply the power to test the connection between motor driver and dc motor. If the connection is successful, the motor will function well. Moreover, connect the motor driver to the Arduino board. If the connection is unsuccessful, change the wire because it might have been short circuit.

3.4 FLOW CHART FOR SOFTWARE

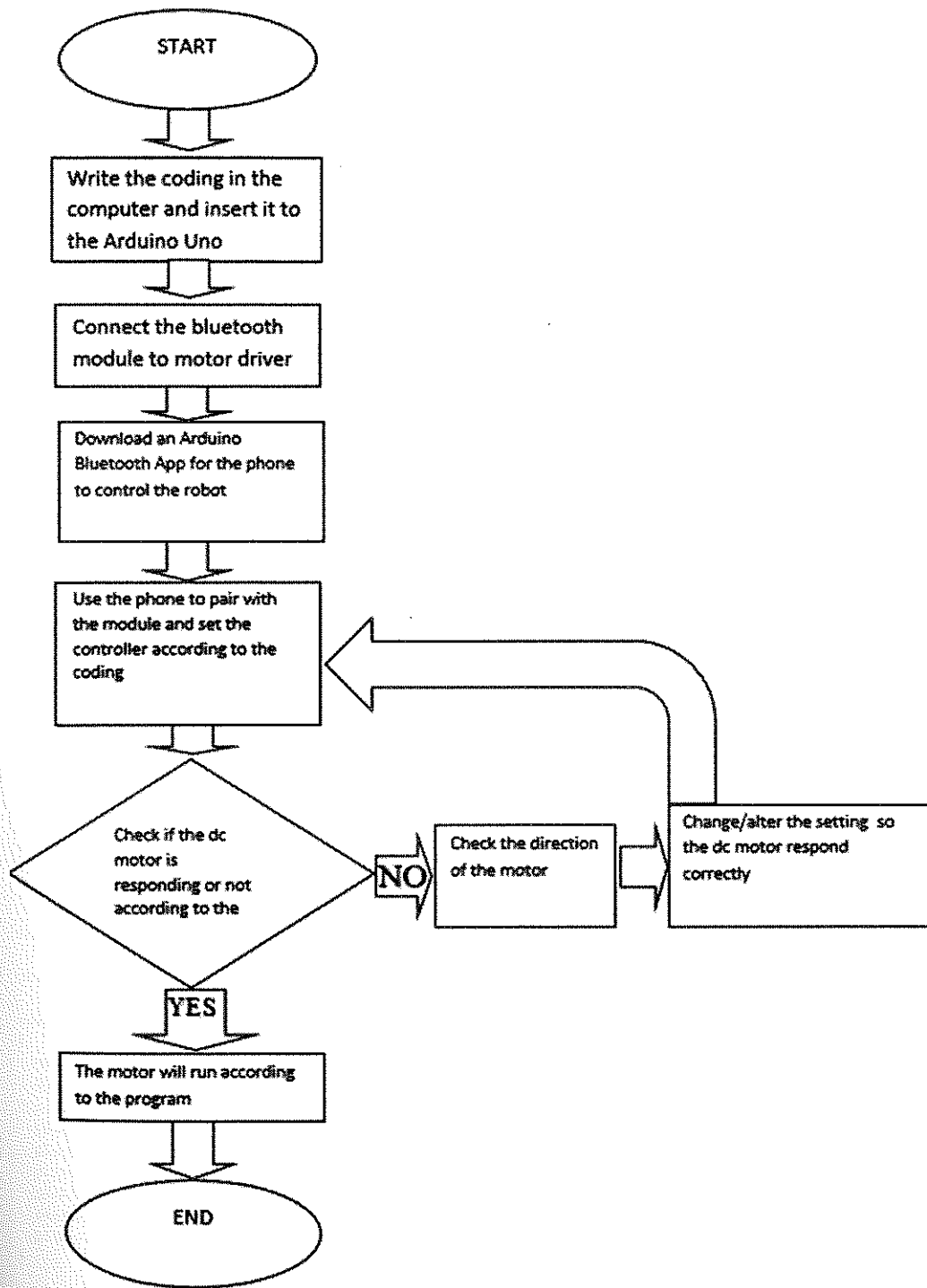


Figure.3.4.1 Flow Chart for Software

The figure above shows the flow chart for the software. The user must write the coding and insert it to the Arduino Uno. Then connect the bluetooth module with the motor driver. Next, download the Bluetooth Serial Controller to control the robot. After that use the phone to pair with the module. While controlling the robot, check if the dc motor