DEVELOPMENT OF AN AUTOMATIC LAWN MOWER USING BLUETOOTH

NAZIRATUL AZRINA BINTI MOHAMAD	10DTK15F1105
SITI ZAKIAH BINTI MOHD HAMDAN	10DTK15F1102
NUR AINA BINTI ABD RAZAK	10DTK15F1030

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"We declare that this work as the product of we're own effort with the exception of excerpts cited from other works of which the sources were duly noted"

Student : .....

NAZIRATUL AZRINA BINTI MOHAMAD

Date : 3/11/17

Student : .....

SITI ZAKIAH BINTI MOHD HAMDAN

Date : 3/11/17

Student : .....

NUR AINA BINTI ABD RAZAK

Date : 3/11/17

Supervisor : .....

MRS. MASLIZA BINTI MASKIN

Dedicated to,

Thanks to Allah,

For give me a good health and strength while making this report.

Our beloved father and mother,

Who has always been we epitome of love and always pray for we strength to finish up this report.

Our beloved relatives,

Our siblings,

Thank you for your support and pray.

The person who has been very understanding and helpful,

Mrs. Masliza Binti Maskin ,

For the support and guidance. Hope that we always be remembered.

Our unforgettable friends,

Our housemate, our Classmate and all DTK students intake June 2017,

Our struggle not yet ends.

Finally, friends that always together during this third years study,

Hopefully achieved what we aspired.

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Last but not least, we're would express our appreciation to all our friends who support we're whether direct or in directly on this project. Theirs help are so meaningful and supportive.

ABSTRACT

The rapid development of technology, especially in the field of robot development that makes the quality of human life is higher. Robots were developed not to facilitate human work. Many tools are made to make their work easier and faster. In the robot world there is a mobile robot category. Mobile robots are robots that can move or move places and can be controlled automatically or manually. By utilizing technology using Arduino and Android it can realization become real Control robot with Bluetooth transmission media can happen with existence of support application on smartphone through android. For that it was made "Automatic Lawn Mower using Bluetooth via Android Smartphone". The program for author robots is created in an Arduino software, which contains commands that will be inserted into the UNO microcontroller chip as the brain of the robot. For mobile robot drives using dc motor gearboxes placed on the rear position of mobile robot, While for user interface, we use Arduino Bluetooth controller software for robot control applications. Communication between wheeled robots by using Bluetooth communication media through smart phones.

ABSTRAK

Perkembangan teknologi yang semakin pesat khususnya dalam bidang perkembangan robot yang menjadikan kualiti kehidupan manusia semakin tinggi. Robot dikembangkan tidak lain untuk mempermudah pekerjaan manusia. Banyak peralatan dibuat yang fungsinya mempermudah suatu pekerjaan menjadi lebih efisien dan cepat. Dalam dunia robot terdapat kategori mobile robot. Mobile robot adalah robot yang dapat bergerak atau berpindah tempat dan dapat dikendalikan secara automatic atau manual. Dengan memanfaatkan teknologi yang menggunakan Arduino dan Android hal tersebut dapat realisasi menjadi nyata Pengendalian robot dengan media transmisi Bluetooth dapat terjadi dengan adanya aplikasi penyokong pada smartphone melalui android. Untuk itu dibuat lah "Automatic Lawn Mower using Bluetooth via Android Smartphone". Program untuk robot penulis buat dalam sebuah software Arduino, yang berisi perintah-perintah yang akan dimasukkan ke dalam chip Mikrokontroler UNO sebagai otak dari robot. Untuk penggerak mobile robot menggunakan gearbox motor dc yang ditempatkan pada posisi belakang mobile robot, Sedangkan untuk antaramuka dengan pengguna, kami menggunakan software Arduino Bluetooth controller untuk aplikasi pengendali robot. Komunikasi antara robot beroda dengan menggunakan media komunikasi Bluetooth melalui smart phone.

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CHAPTER 1
INTRODUCTION

1.1 Background

The rapid development of technology, especially in the field of robot development that makes the quality of human life is higher. Robots were developed not to facilitate human work. Many tools are made to make their work easier and faster. Perhaps many think that it takes a very high level of expertise to design, plan, and create a project, especially electronics. Creating an electronics project can be started from a basic level in a fairly simple and easy way to apply in the manufacture of a tool. For that, it is necessary to make a plan to create an electronics project.

From project 1, we make robots that can be changed to other robots for two projects. Robot Automatic Lawn Mower is a robot equipped with cutting blades and can be controlled through Android Smartphone with Bluetooth communication media. Android smartphones will send data on the Microcontroller UNO wirelessly. In this final project, using Bluetooth series HC-06. Construction of this cutting-edge robot has 3 wheels that can move forward, backward, right turn, turn left and stop. The robot also comes with a cutting knife whose function is to cut the grass. This cutting knife has 2 blade points. Communication from this Android Smartphone uses Bluetooth devices. Automated grass cutting robot will be developed. The prototype robot dimensions are about 25cm x 25cm x 16cm and weighs about 3 kg.

The communication used is serial communication using Bluetooth. On the smartphone, there is a Bluetooth used as a transmitter and on the Bluetooth cutting machine we use Bluetooth (HC-05) as receiver. The data is sent on a serial via the RX-TX port on each Bluetooth. Stages in the making of this lawn mower consist of:

(1) design, (2) making tools, (3) circuit testing. Designing in this final project, this robot is rectangular, which will be placed 4 DC motors and 1 DC motor in the middle for cutting blade.

Therefore, this design process will be created to avoid errors in the manufacture of robots. Robots to be created will be useful in the process of controlling the motion of the appliance. In the process of making a robot will be performed tests on the system.

1.2 Problem Statement

This project is specifically designed to address problems that often burden the grass machine users. It is effective and practical for users who want a machine capable of solving problems such as the use of labor in cutting grass. Additionally, existing machines that we know operate with the increasingly limited oil to generate power on the motor. This motor then creates noise and releases smoke during operation. In addition, the system is more complex where consumers need to be near the machine for cutting-edge work just for monitoring. The large mechanical parts of the lawn mower also increase the cost either for maintenance or overhaul.

1.3 Objective of Project

This project is designed with several initiatives to repair existing machines. It covers a number of aspects that are perceived to fit the current situation and needs. The main objectives of this project are:

a) To develop a robot lawn mower that can function by using Arduino

b) To develop a robot that can cut lawn grass in small square feet

c) Reduce the use of increasingly restricted raw materials as Automatic lawn mower using Bluetooth does not use oil elements

1.4 Scope of Project

There was an article that state that we use robot in our daily life to make life easier and to do work more efficiently. Robot are uses in many places such as in hospital, factory, and even in certain university. Our main goal is to use our robot to cut lawns and followed all the instructions that we upload in Arduino board.

- The developed automatic lawn mower robot is operated on the grass using smartphones via Bluetooth Module
- The developed automatic lawn mower robot is limited under each grass in small square feet
- The developed automatic lawn mower robot is only for outdoor

1.5 Significant of Project

The advantage of conventional method by human is the job can be done for many an area with grass like the home page. The disadvantages of conventional methods by human can be described in four major points. First point is manual labour. Manual labours for conventional method undeniably gamble with high risk and along time consumption. The second point is limited efficiency. The process could be very slow as it depends on human expertise to finish the job. The third disadvantage is budget constraint. Using conventional method by human or by customized machine involves high cost for its equipment and suppliers, labours cost, insurance and by the machine itself. The last point is limiting factors. There are certain limiting factors with job done by human. If the job is done by human, it depends on weather and daylight factor. This project is hoped to overcome the limitation of conventional methods. The project is focusing in developing a automatic lawn mower robot for cut of grass.

1.6 Summary

In this chapter we discuss the objectives to be achieved in undertaking this project. Additionally, the scope of the study includes the problem statement. The purpose of this problem statement is to be discussed as the project is to overcome the problems identified to attract consumers and to satisfy consumers' expectations. The importance of the study described in this chapter is about what should be emphasized in implementing this project. Among the most important aspects is that this project should have security features and meet the needs of consumers.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This literary study involves readings aimed at obtaining information related to this study through reading from articles, journals, theses, books and resources from the internet. In implementing a project, it is very important to conduct a study on the components to be used to complete the project. This chapter explains the main components used in producing this project. In addition, this chapter describes the material used, for literary purposes, it is the overall trend of the title, theoretical proposals, the methodology, the evidence and the conclusions or the problems. The importance of this study is to help facilitate users to learn about the components and materials used in project success.

2.2 Related works

In this section we will discuss about the previous work that have done which related to this project. Many research has being done in order to find the appropriate way to optimize the use of lawn mower. Many proposed the method on how the movement of the lawn mower which can give the optimum result on the path travel. There are six related work found and listed below.

2.2.1 Design and Implementation of Autonomous Lawn Mower Robot Controller

This paper basically focus on designing an automated lawn mower controller which can use to mower the grass at lawns and playground. It used the concept of 'sense-act' whereby it does not fully depend on the workspace surrounding. The automated lawn mower have the feature of detecting the grass. Besides that it have GPS system which allocated the path for the robot movement. Other than that, some sensor such as sonar sensor which use to detect obstacles, encoder to calculate the distance the lawn mower travel together with the GPS system

2.2.2 Design and Implementation of a Control Algorithm for an autonomous lawn mower

This report discuss on the way of implementing GPS system for automated lawn mower path flow. Besides that it also stated there they used PID controller to increase the performance of the motor speed which can provide better flow. Besides that, their project also included encoder to calculate distance but their encode was made by magnetic and hall sensor which placed around the wheel and it calculate the number of magnetic field strength while moving which will convert the number of magnet to distance travelled. The lawn mower performance are being watch.

2.3 Arduino UNO

Arduino UNO is a component on the shelf (COTS) circuit board which aim for the helping people on their project. It is based on ATmega328 microcontroller. Rather than making own circuit board from scratch, Arduino UNO provide a sufficient circuit board which able to program and contain most of the necessary pin function. Arduino UNO board consist of 14 input output pin whereby 6 of them can be used as PWM output. Besides that it contain also 6 analog to digital (ADC) pin. Basically, Arduino UNO operate at 5V and the input power source need to be a range of 7V to 12V. Figure 2.6 shows the Arduino UNO board.

Table 2.1 Summary of Arduino UNO microcontroller board

Item	Details
Microcontroller	ATmega328
Operating system	5V
Recommend voltage	7-12V
Limited voltage	6-20V
Digital I/O pin	14 (6 provide PWM)
Analogue input pin	6 pins
DC current I/O Pin	40 mA per pin
DC current 3.3V Pin	50 mA per pin
Flash memory	32 KB (0.5 KB for bootloader)
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz

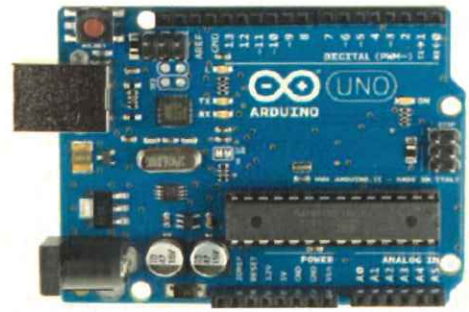


Figure 2.1 Arduino UNO

2.4 DC Motor

DC motor is a device that convert electrical form into mechanical form of energy. There are many kind of DC motor such as DC motor, separately excited DC motor and self-excited DC motor. DC motor was powered by DC current. There are various voltage input for DC motor and the common voltage input for DC motor are 3V, 5V, 12V, and 24V. There are advantages for DC motor which are the DC motor perform better than AC motor, and DC motor provide excellent of controlling the speed.

Figure 2.2 : 3V-6V DC motor

2.5 Motor Driver L293D

The L293D is a dual h-bridge driver IC. The IC is also referred to as a push-pull four channel driver. An h-bridge is ideal for driving motors. The L293D provides two h-bridges for driving both motors on the robot base. The motor direction is controlled by logic signals from the microcontroller. Two signals per motor are required to control the direction.

In previous week, I have mention about the H Bridge circuit that used to control the motor and it must need a transistor to control the direction. So, this IC might be used in DC motor circuit.

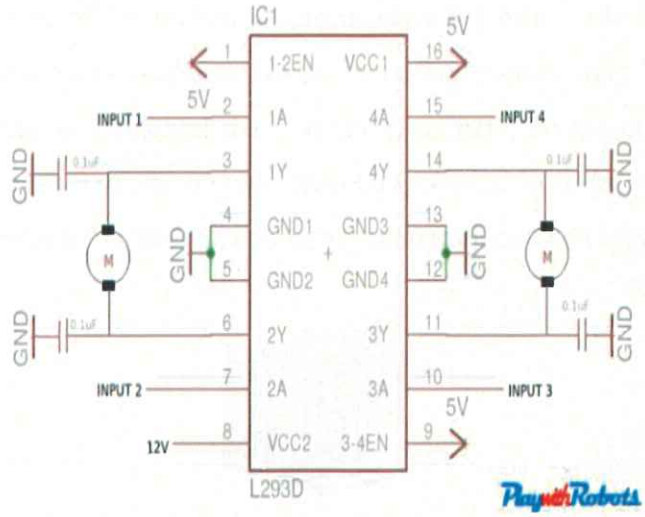


Figure 2.3 Motor controller using L293D circuit diagram

2.6 Bluetooth Module

This Bluetooth module can easily achieve serial wireless data transmission. Its operating frequency is among the most popular 2.4GHz ISM frequency band (i.e. Industrial, scientific and medical). It adopts Bluetooth 2.0+EDR standard. In Bluetooth 2.0, signal transmit time of different devices stands at a 0.5 seconds interval so that the workload of bluetooth chip can be reduced substantially and more sleeping time can be saved for bluetooth. This module is set with serial interface, which is easy to use and simplifies the overall design/development cycle.

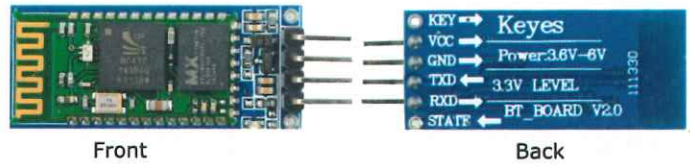


Figure 2.4 : Bluetooth Module

2.7 Switch

A rocker switch is an on/off switch that rocks (rather than trips) when pressed, which means one side of the switch is raised while the other side is depressed much like a rocking horse rocks back and forth. A rocker switch may have a circle (for "on") on one end and a horizontal dash or line (for "off") on the other to let the user known if the device is on or off. Rocker switches are used in surge protector s, display monitors, computer power supplies, and many other devices and applications.

Figure 2.5 : Rocker Switch

2.8 Computer Aided Software

Computer software will be used in this project to modelling and design of a robot. There are many computer software and each of them have their own function. Human used computer software to ease their design. With computer software, one can perform their task efficiently and fast. Below are the example of computer software:

a. Google Sketch-Up
b. Proteus Software
c. Arduino 1.0.5 IDE

2.8.1 Google Sketch-Up

Sketch-up, marketed officially as Trimble Sketch-Up, is a 3D modeling program for applications such as architectural, civil and mechanical engineering, film, and video game design. A freeware version, Sketch-up Make, and a paid version with additional functionality, Sketch-up Pro, are available. It was launched in 2000 but became free when Google took over in 2006. In April 2012, Google announced that they will sell Sketch-Up to Trimble, a company best known for GPS location services.

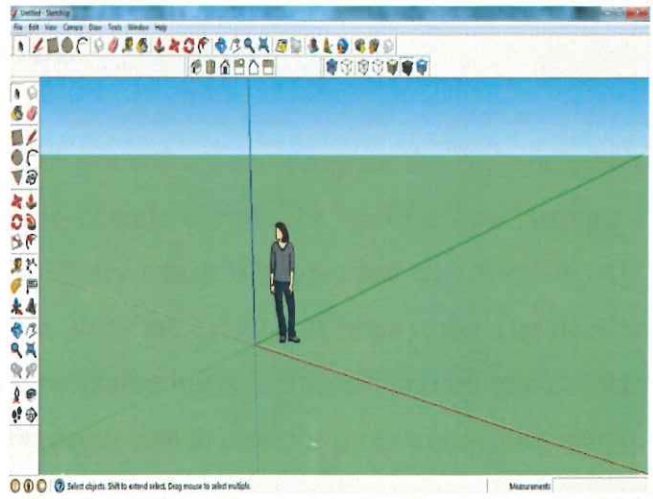


Figure 2.6 : Software Google Sketch-Up

2.8.2 Proteus Software

Proteus Profesional design combines the ISIS schematic Capture and ARES PCB layout program to provide a powerful, integrated and easy to use tools suite for education and profesional PCB Design

As a profesional PCB Design Software with integrated shape based auto router, it provides features such as fully featured schematic capture, highly configurable design rules, interactive SPICE circuit simulator, extensive support for power planes, industry standard CADCAM & ODB++ output, and integrated 3D viewer.

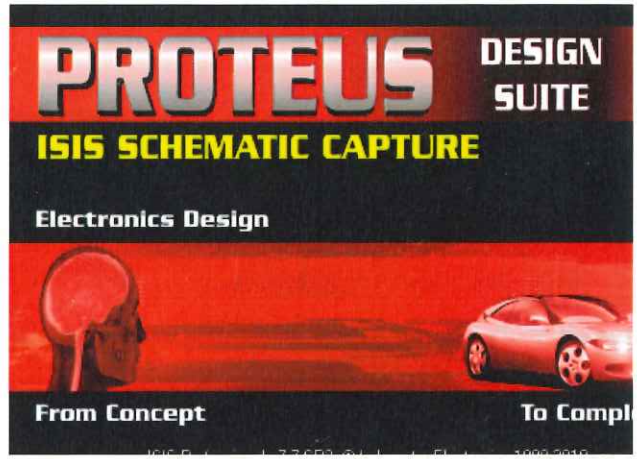


Figure 2.7 : Software Proteus

2.8.3 Arduino 1.0.5 IDE

Arduino 1.0.5 IDE is a software to program the Arduino UNO. This software is an open source and can download from the web for free. Arduino 1.0.5 IDE have their own programming library which is simple and user-friendly. All the coding are given as well as example. With the existing of library, the user does not need to have a great knowledge on c programming to write Arduino program. Table 2.8 shows the sample of Arduino library code which used for programing microcontroller.

Table 2.2 Sample Arduino library code

setup()	loop()	pinMode()	digitalWrite()
digitalRead()	analogRead()	analogWrite()	Serial
#define	#include	logic HIGH	logic LOW

Figure 2.8 User Interface of Arduino 1.0.5 IDE

2.9 Type Of Grass

2.9.1 Annual Ryegrass

Annual Ryegrass also known as the Italian ryegrass often used for both lawn and for grazing for livestock. It is a cool – season grass where it have the ability to live under moderate temperature or even sunny conditions. Ryegrass also used as to plant along the mountain bank to prevent soil erosion. Ryegrass usually treat as forage plant for animals. Ryegrass has a grow habit of toward upright and it has shallow roots. Figure 2.9 shows the example of Annual Ryegrass.

Figure 2.9 Annual Ryegrass

2.9.2 Red Fescue

Red fescue is a cool – season grass lives in mountain sites, such as cabins, camps whereby these place is low input mowing. It can spread itself slowly to around it grow place. These grass are not aggressive as it usually found along the roadside where mowing grass seldom occurs. It is easy to identifier as it had deep green color and a fine blade shape. Figure 2.10 shows the example of Red Fescue.

Figure 2.10 Red Fescue

2.9.3 Carpet Grass

Carpet grass is a perennial, creeping grass. It usually grow on less soil and wet soil. It can grow under any weather as it is a strong adaption grass toward its surrounding. This grass can be plant using sprigs and seed. This grass grows rapidly whereby it can spread very fast to its nearest spot. It usually used as lawn for household garden. Carpet grass typically for place that the present of soil for long period. It can be used for various kind of fields such as playground. Figure 2.11 shows the example of Carpet Grass.

Figure 2.11 Carpet grass

2.10 Summary

This chapter studied various fields that used for development an automatic lawn mower. Components such as Arduino UNO, DC Motor, Motor Driver L293D, Bluetooth Module, Switch used in this project were discussed. These include software such as Google Sketch-Up, Proteus and Arduino 1.0.5 IDE which were used for design and programming. Several techniques for robot routing were presented in this chapter.

CHAPTER 3
METHODOLOGY

3.1 Introduction

Planned planning is needed in the implementation of a project. Each step is organized and systematically arranged to facilitate and launch project implementation. In order to get the work procedure of a project that starts from idea generation to product generation stage or better known as methodology, a study to develop the implementation process should be made first.

This includes a description of all methods or methods used to complete the project. All listed work procedures must be followed to facilitate project execution. This process starts from obtaining project titles to project production from raw materials. After getting some of the factors that have been considered, then the selection of certain circuits and the appropriate components are made.

This chapter discusses the method use to design an automatic lawn mower. There several steps taken to complete the task. Before starting to build a robot, many initial steps have taken such as research on automatic lawn mower which is discuses in Chapter 2 literature review 2.2 related work.

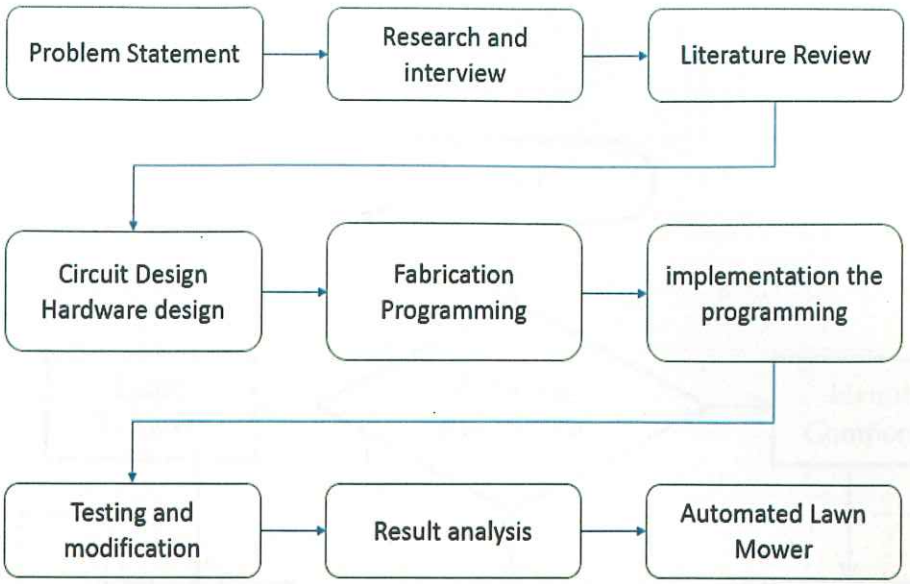


Figure 3.1 Research Methodology Flow

3.2 Block Diagram and Flow Chart

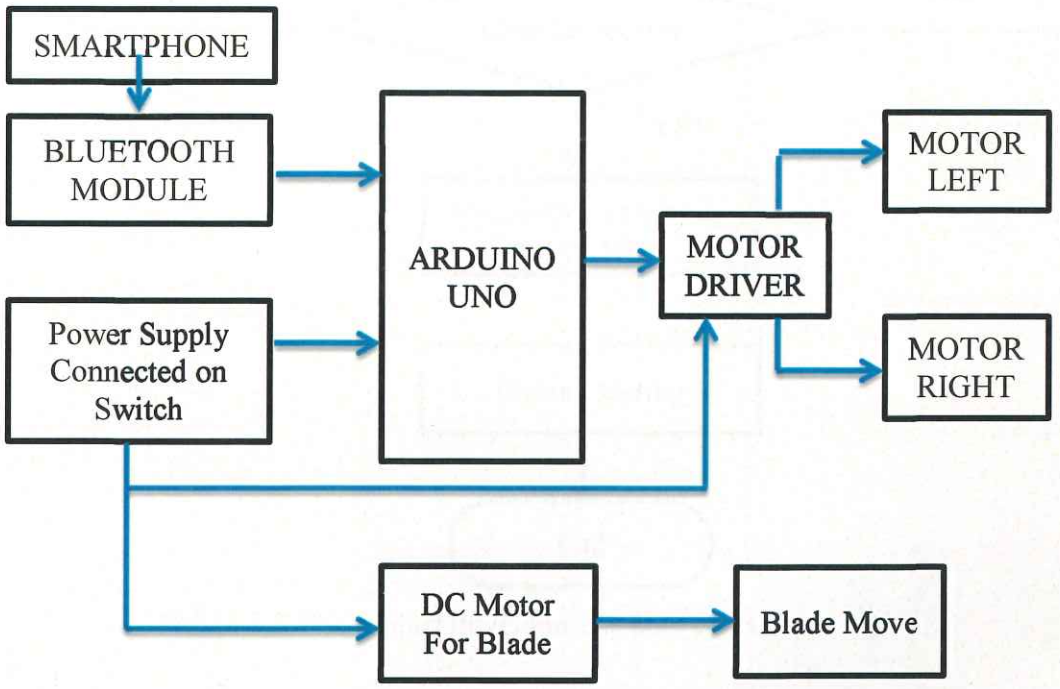


Figure 3.2 Block Diagram System

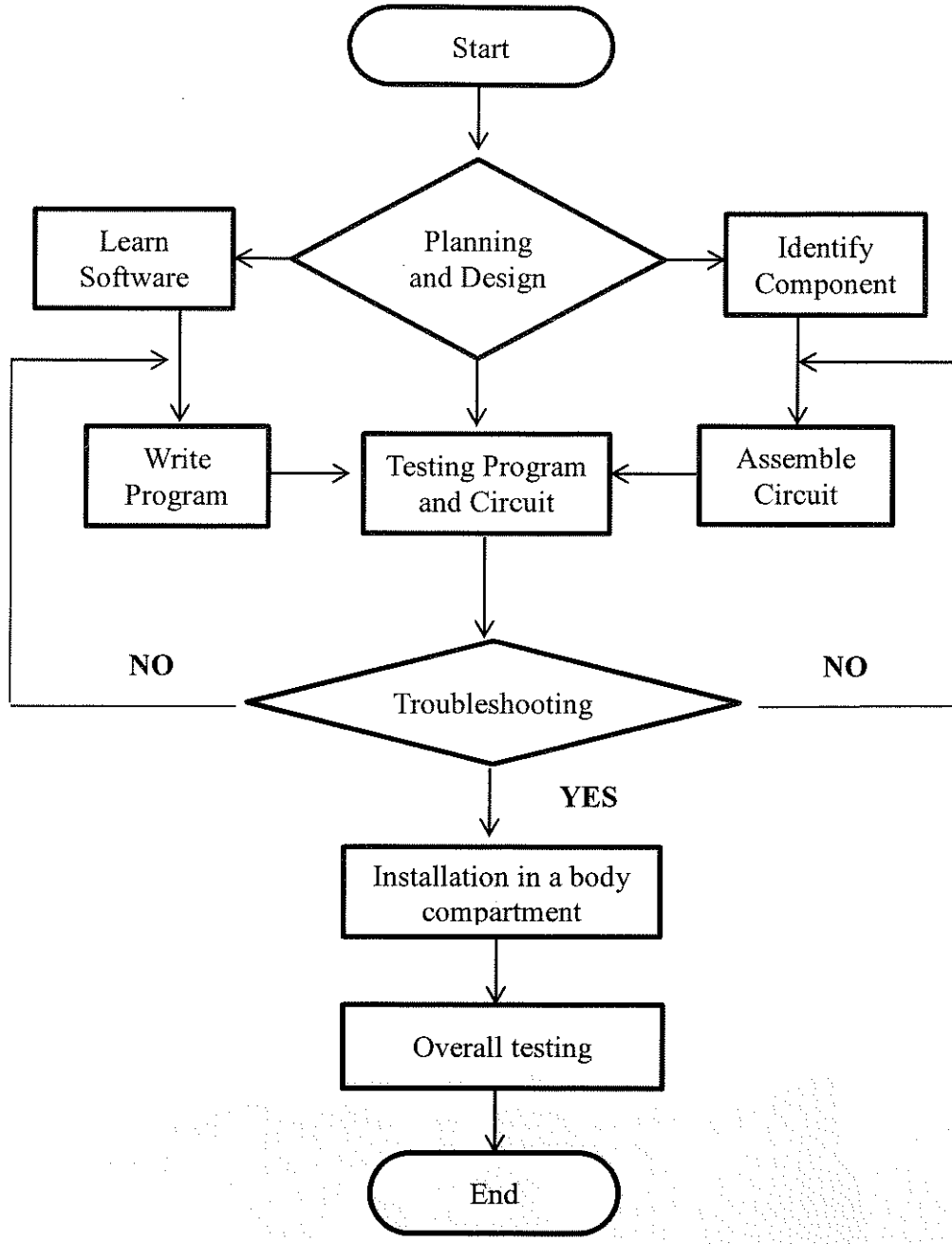


Figure 3.3 The project development flow chart

3.3 Equipment Implementation

In the process of developing and designing automatic lawn mowers, the use of appropriate equipment and hardware is crucial for further rolling out work processes as well as safety factors that need to be emphasized. The equipment and tools used should be in line with the current scope of work. The following equipment and hardware are used throughout the process of developing this system: -

Hand tool type:

- Drill Machine
- Plier
- Soldering Iron (Sucker)
- Saws and Ragum
- Cutter
- Long Nose
- Wire Stripper
- Kikir various forms

Types of testing tools:

- Multimeter

Figure 3.4 Equipment

3.4 Software Implementation

The software that will be used in this project are Google Sketch-Up, and Arduino 1.0.4 IDE. Google Sketch-Up will be used for designing the 3D model of the lawn mower. The Arduino 1.0.4 IDE will be used to program the microcontroller.

3.4.1 Modelling Design in Google Sketch-Up

Google Sketch-Up is a tools to design any 3D model electronically. In designing, it will need two segment when drawing. The first is the Google Sketch-Up parts and the Google Sketch-Up assembly. At first several part of the lawn mower was drawn. After that, all the part will be combine or assemble together to form a full lawn mower.

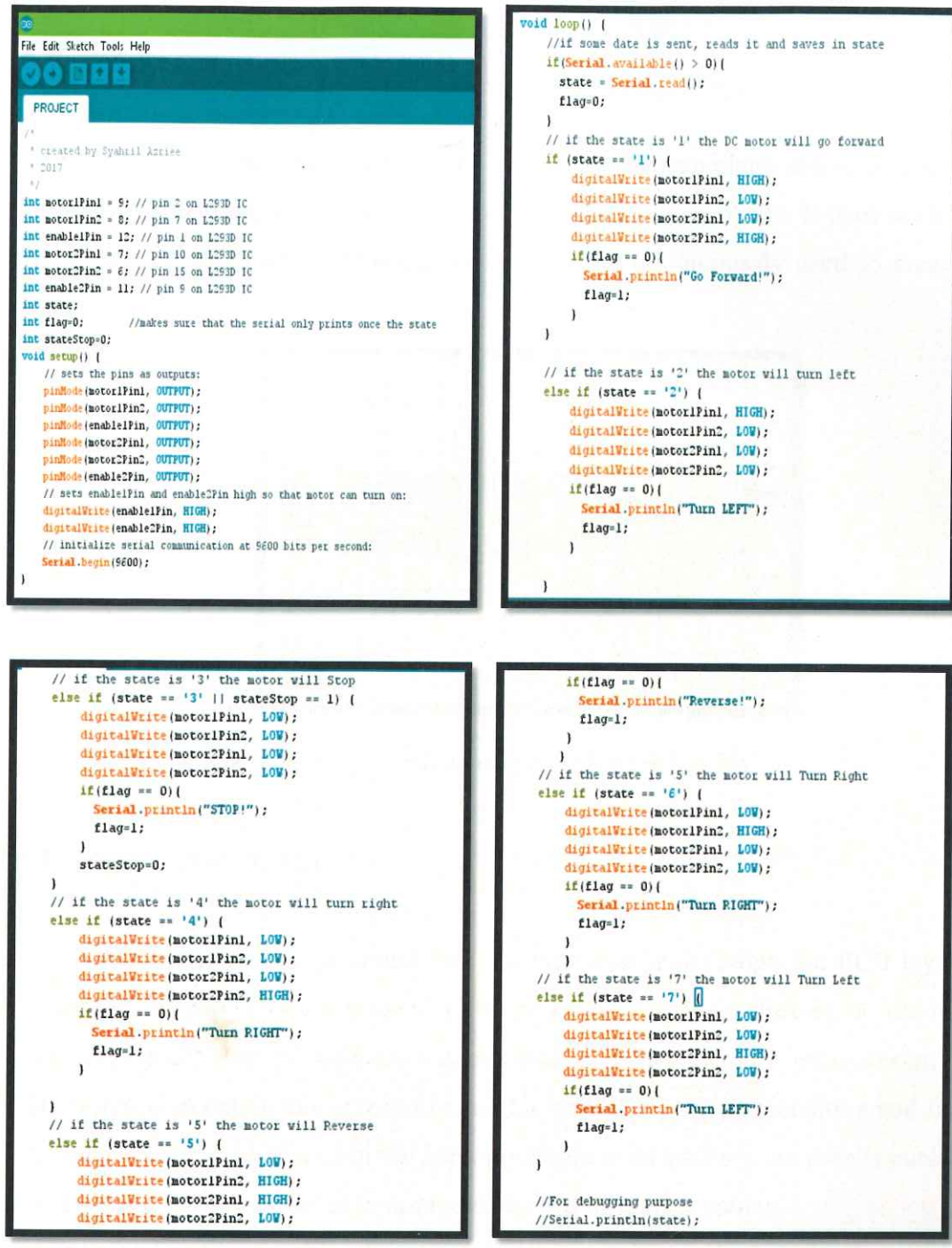
In Google Sketch-Up, several technique will be used such as extruded boss/base extrude cut, fillet, mirror pattern and linear pattern. First, a rectangle will be drawn and it dimension fixed to 250mm x 250mm x 150mm. From this several part will be cut to form the desire pattern. Several hole also made to indicate the screw position. There are three part will be drawn which are two back wheel the body and two front wheel

.

After finished drawing, the part will combine together using Google Sketch-Up assembly feature to assemble the parts drawn. Tuning and refinement will be made at the end of drawing to prevent any error occur. Refining such as increase or decrease the dimension of the part due to some obstacle.

3.4.2 Programming

To enable a robot to move or operate, a microcontroller is needed in order to allow the robot to function by itself. Arduino UNO will be used as the microcontroller for this project. The movement and the path of the lawn mower will be program into the microcontroller and it will also being control from Smartphones and Power supply input to enhance the flow. Figure 3.5 shows the coding program will then turn into c programming and compiled into the Arduino UNO using Arduino 1.0.5 IDE complier.



```
File Edit Sketch Tools Help

PROJECT

/*
 * created by Syahril Azriee
 * 2017
 */
int motor1Pin1 = 9; // pin 2 on L293D IC
int motor1Pin2 = 8; // pin 7 on L293D IC
int enable1Pin = 12; // pin 1 on L293D IC
int motor2Pin1 = 7; // pin 10 on L293D IC
int motor2Pin2 = 6; // pin 15 on L293D IC
int enable2Pin = 11; // pin 9 on L293D IC
int state;
int flag=0;        //makes sure that the serial only prints once the state
int stateStop=0;
void setup() {
    // sets the pins as outputs:
    pinMode(motor1Pin1, OUTPUT);
    pinMode(motor1Pin2, OUTPUT);
    pinMode(enable1Pin, OUTPUT);
    pinMode(motor2Pin1, OUTPUT);
    pinMode(motor2Pin2, OUTPUT);
    pinMode(enable2Pin, OUTPUT);
    // sets enable1Pin and enable2Pin high so that motor can turn on:
    digitalWrite(enable1Pin, HIGH);
    digitalWrite(enable2Pin, HIGH);
    // initialize serial communication at 9600 bits per second:
    Serial.begin(9600);
}
```

```
void loop() {
    //if some date is sent, reads it and saves in state
    if(Serial.available() > 0){
      state = Serial.read();
      flag=0;
    }
    // if the state is '1' the DC motor will go forward
    if (state == '1') {
        digitalWrite(motor1Pin1, HIGH);
        digitalWrite(motor1Pin2, LOW);
        digitalWrite(motor2Pin1, LOW);
        digitalWrite(motor2Pin2, HIGH);
        if(flag == 0){
          Serial.println("Go Forward!");
          flag=1;
        }
    }

    // if the state is '2' the motor will turn left
    else if (state == '2') {
        digitalWrite(motor1Pin1, HIGH);
        digitalWrite(motor1Pin2, LOW);
        digitalWrite(motor2Pin1, LOW);
        digitalWrite(motor2Pin2, LOW);
        if(flag == 0){
          Serial.println("Turn LEFT");
          flag=1;
        }

    }
```

```
    // if the state is '3' the motor will Stop
    else if (state == '3' || stateStop == 1) {
        digitalWrite(motor1Pin1, LOW);
        digitalWrite(motor1Pin2, LOW);
        digitalWrite(motor2Pin1, LOW);
        digitalWrite(motor2Pin2, LOW);
        if(flag == 0){
          Serial.println("STOP!");
          flag=1;
        }
        stateStop=0;
    }
    // if the state is '4' the motor will turn right
    else if (state == '4') {
        digitalWrite(motor1Pin1, LOW);
        digitalWrite(motor1Pin2, LOW);
        digitalWrite(motor2Pin1, LOW);
        digitalWrite(motor2Pin2, HIGH);
        if(flag == 0){
          Serial.println("Turn RIGHT");
          flag=1;
        }

    }
    // if the state is '5' the motor will Reverse
    else if (state == '5') {
        digitalWrite(motor1Pin1, LOW);
        digitalWrite(motor1Pin2, HIGH);
        digitalWrite(motor2Pin1, HIGH);
        digitalWrite(motor2Pin2, LOW);
```

```
        if(flag == 0){
          Serial.println("Reverse!");
          flag=1;
        }
    }
    // if the state is '6' the motor will Turn Right
    else if (state == '6') {
        digitalWrite(motor1Pin1, LOW);
        digitalWrite(motor1Pin2, HIGH);
        digitalWrite(motor2Pin1, LOW);
        digitalWrite(motor2Pin2, LOW);
        if(flag == 0){
          Serial.println("Turn RIGHT");
          flag=1;
        }
    }
    // if the state is '7' the motor will Turn Left
    else if (state == '7') {
        digitalWrite(motor1Pin1, LOW);
        digitalWrite(motor1Pin2, LOW);
        digitalWrite(motor2Pin1, HIGH);
        digitalWrite(motor2Pin2, LOW);
        if(flag == 0){
          Serial.println("Turn LEFT");
          flag=1;
        }
    }

    //For debugging purpose
    //Serial.println(state);
```

Figure 3.5 shows the coding program Bluetooth

3.5 Process of Design Circuit In PCB

3.5.1 Create Schematic

Schematic comes from the scheme, which could mean plans, plans, charts, etc. We can find reference to this schematic on the internet or in books. It uses software Proteus ISIS. ISIS Proteus Software is software that is commonly used to create a schematic.

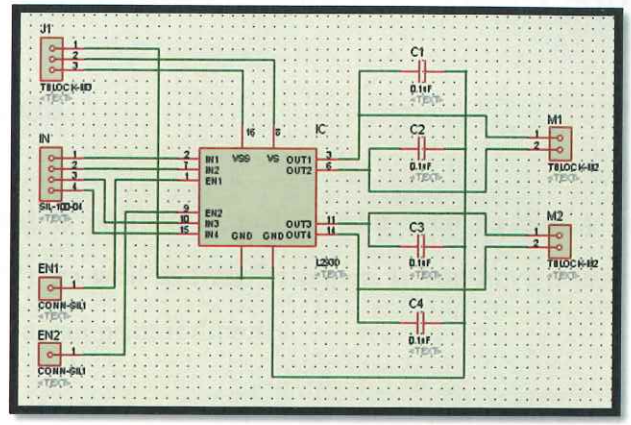


Figure 3.6 Schematic of Motor Driver L293D

3.5.2 PCB Layout Design

After the schematic is completed, the next step is to design the PCB layout. This activity is also carried out using software Proteus Ares by clicking on the icon "to switch board", then the software will automatically display the work to design the PCB. In this segment, it takes creativity and the ability of spatial orientation and field components that can be placed in the appropriate place. In addition, no path is pursued having cross or collide in order to minimize the use of jumper cables.

Although it is quite difficult, but for beginners do not worry and do not be afraid of it, this ability can be trained to design the layout. Perseverance and patience are solely between the main capital in PCB design. For PCB design tutorial we will explain separately in the next post.