FLOOR POLISH ROBOT

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JUN 2017

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APPROVED BY SUPERVISOR

ACKNOWLEDGEMENT

First and foremost we would like to take this opportunity to express our gratitude to everyone who supported us throughout the course of this project. We would like to say a gratitude to our supportive supervisor PuanNorzilawatiBinti Abdullah for her aspiring guidance, invaluably constructive criticism and friendly advice during the project work. A sincerely grateful to her for sharing her truthful and illuminating views on a number of issues related to the project.

Other than that, I would like to express gratitude towards my parents, and my colleague for kind encouragement, co-operation and their willingness to help me out which help better in completion of this project.

It would not have been possible without the kind support and help of many individuals and organizations. I would like to extend our sincere thanks to all of them.

ABSTRACT

The aim of this report is to design and implement a floor polish robot. The function of floor polish robot is to make polishing process become easier than polishing the floor manually by using sponge. 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. Then, 3 to 4 DC motors is needed to connect with the Arduino and motor driver. In additional, the function of motor driver is to take a low-current control signal and the turn it into a higher-current signal that can drive a motor. After that, the DC motors is connect to two 9V battery as power supply. Moreover, the advantage of using this robot will saves time, it will be very much useful for people with mobility issues to clean the house without any difficulties. Lastly, it is a simple and low cost robot.

ABSTRAK

Tujuan laporan ini adalah untuk mereka bentuk dan melaksanakan robot penggilap lantai. Fungsi robot polish lantai adalah untuk membuat proses penggilapan menjadi lebih mudah daripada menggilap lantai secara manual dengan menggunakan span. Robot ini dikawal oleh modul Bluetooth dan menghantar output kepada Arduino. Seterusnya, robot ini digunakan Arduino UNO untuk beroperasi dan fungsi Arduino mengawal pergerakan robot. Kemudian, 3 hingga 4 motor DC diperlukan untuk menyambung dengan pemandu Arduino dan motor. Tambahan pula, fungsi motor drive adalah untuk mengambil isyarat kawalan semasa yang rendah dan menjadikan ia menjadi isyarat semasa yang lebih tinggi yang boleh memandu motor. Selepas itu, motor DC menyambung kepada dua bateri 9V sebagai bekalan kuasa. Lebih-lebih lagi, kelebihan menggunakan robot ini akan menjimatkan masa, ia akan sangat berguna untuk orang ramai dengan isu mobility untuk membersihkan rumah tanpa sebarang kesulitan.Terakhir, ia adalah robot kos sederhanadan rendah.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTON

Robot is an intelligent device having its own brain fed with computer logic so that it can do the work according to the algorithm designed. The recent year, floor polish robot have taken major attention in robotics research due to their effectiveness in assisting humans in floor polish applications at homes. The floor polish robot build is to make the polishing process become easy. The main objective of this project is to provide a substantial solution to the problem of human work efficiency in polishing the floor manually by using sponge. The concept of this project is the same as Sumo Robot. Building a project that can be control by user and perform the objectives given.

1.2 OBJECTIVE

The three objective need to achieve in the floor polish robot.

- To design and implement a polish cleaner robot prototype.
- To design a mobile floor polish robot by using Arduino UNO and Bluetooth module.
- To design a mobile floor polish robot that can go forward, turn around, reverse and turn left & right

1.3 PROBLEM STATEMENT

Nowadays, the use of robotics in certain places is becoming more popular in recent years. This robot build because of the limited efficiency as it could be very slow as it depends on human expertise to finish the job. Besides that, the purpose of build floor polish robot is want to reduce injuries due to slips on the floor. Many of cases injuries or death is cause by slips on the floor and bad practice in floor cleaning is also major cause of that accidents. The next reason build this floor polish robot can reduces the impact of floor scratches. This robot also can repels dirt and moisture and to protect the floor from damage. Lastly, the purpose of build this robot is to reduce time and human energy on floor polishing job.

1.4 SCOPE AND LIMITATION PROJECT

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

i. To develop floor polish robot is operated on the floor with no obstacles.
ii. To develop floor polish robot is only for indoor.
iii. To develop floor polish robot is only can move in the range of 8m.
iv. To develop floor polish robot that can polish a 50 cm x 50cm ceramic tile.

1.5 CONCLUSION

As the conclusion, the floor polish robot build is to make the polishing process become easy than polishing the floor manually by using sponge. The objective need to achieve in this robot that is to design and implement a polish cleaner robot prototype, to design a mobile floor polish robot by using Arduino UNO and Bluetooth module and to design a mobile floor polish robot that can go forward, turn around, reverse and turn left & right. Beside that, this robot build because of the limited efficiency as it could be very slow as it depends on human expertise to finish the job and need to reduce injuries due to slips on the floor. This project is covered with several limit issues such as this robot can only use in indoor, just can move in the range of 8m, operated on the floor with no obstacles and just can polish 50cm×50cm ceramic tile. Lastly, this robot can reduce time and human energy in process of polishing the floor.

CHAPTER 2

LITERATURE REVIEW

2.1 BACKGROUND OF PROJECT

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 or people. Robot are especially desirable for certain place because, unlike humans, the robot will never get tired. The function of floor polish robot is to make polishing process become easier than polishing the floor manually by using sponge. The robot is control by using Bluetooth module.

2.2 RELATED WORK FOR THE PROJECT

Nowadays, there are many type of cleaner robot in the market. Some of the robots are based on the technical analysis of research work. The paper published by (Manreet Kaur, July 2014) about "Design and Development of Floor Cleaner Robot (Automatic and Manual) used dual mode which are automatic and manual mode. This robot is controlled by AT89S52 microcontroller to operate the hardware and software. Next, this robot contained the function of sweeping and mopping. This robot used RF modules with wireless communication. The range of communication between remote and robot is 50m. For obstacle detection and automatic water sprayer pump, this robot is installed IR sensor. This robot also using four motors for cleaning, water pump and

wheels. The function of dual relay circuit are drive the motors for water pump and another for cleaner. After that, the robot controlled all the operations itself and change the lane in case of hurdle detection and moves back in automatic mode. Moreover, the keypad is used to perform the expected task and to operate robot in manual mode. Thus, RF module also has been used to display the information related to the hurdle detection on LCD in manual mode. The power supply is 12V battery for whole circuit. The drawback in this model is the robot does not have the feature of self-charging.

Meanwhile, the paper published by (Abhishek Pandey, April 2014) was described briefly about the "Technological Survey on Autonomous Home Cleaning Robots." The robot used a microcontroller to detect obstacles and manipulated its direction with the inputs from infrared sensors mounted in front, right and left of the robot or the digital signal processor. So that, the robot can be control easily to avoid collision and sense obstacles around it with the installation of microcontroller. Then, the robot needed 4 IR sensors to install at the front, left, right and the back of robot to detect obstacles. In automatic mode, the microcontroller is programmed to take the decision and change the path of the robot to avoid the obstacles. Thus, a timer is used to set the time limit for the cleaning process. Next, the other systematic cleaner robot was proposed by (Shripad Malavadikar, 2017) about "Automatic Cleaner Robot". This robot is designed to clean the house for the handicapped people having mobility issues without any external help. This project is designed for evaluate cost efficient, light weight, less noisy and low maintenance robotic system. This robot has the opportunities of automatic avoid the obstacles and enable to find its way when it fall from a height. Then, the robot can clean along edges and into other hard-to-reach places. After that, the movement of robot was guided by certain algorithms for path planning and navigation. This robot also installed sensors to detect obstacles. After the robot finished the cleaning process, it will remember its path to go back the docking station. When the battery charge is below a certain percentage, the robot shall start finding its way back to the docking station and get charged before resuming cleaning.

Besides that, the paper proposed by (Vaibhavi Rewatkar, February 2015) about "A Review on Design of Automated Floor Cleaning System" was presented an overview of the importance of automated floor cleaning system in cleaner robot. This robot included many component which are DC motor operated wheels, roller brush,

cleaning mop, the garbage container and obstacle avoidance sensor. The whole circuitry is connected with a 12V rechargeable battery as power supply. Next, this robot also compressed by a special technique of UV germicidal cleaning technology. In additional, ultraviolet germicidal technology is a disinfection method that uses short-wavelength ultraviolet light to kill or inactive microorganisms by destroying nucleic acids and disrupting their DNA, leaving them unable to perform vital cellular functions. Then, this robot has plenty of facilities which are vacuuming, mopping and sanitizing the floor using UV light. In fact, this robot can do various function of floor cleaning like vacuuming, mopping and soaking at the same time. After that, this design of automated floor cleaning system can be used to clean any kind of remote places. When the cleaner robot operated by this system, the motors selected can consume less power so it will be the power saving and cost saving too.

Finally, the project proposed by (Karthick.T, May 2015) about "Simple Autonomous cleaner Robot" was described the conception of autonomous cleaner robot. The aim of this project is to develop an autonomous robot that can move itself without human guidance. Next, this robot consist less power consumption so that it can operate at low power. Then, this robot contained a few electronic components which are the controller board Atmega 2560, ultrasonic sensors, voltage regulator IC and motor driver circuit. This robot also contained mechanical part which is motor with gearbox arrangement. Moreover, the gearbox is refers simply from the term of transmission in mechanics field. After that, the function of ultrasonic sensor is to detect the obstacles. The whole circuitry is connected with a 12V lead acid battery as power supply. This robot was using vacuum cleaning system which is Cyclonic type filtration system. In additional, this system is a method which works under the principle of forced vortex flow and all types of debris will be sucked in through the pipe. Furthermore, the advantage of this robot are save time and save money and the DC battery in this robot can be charged with in an hour and can be used during power outage period.

2.3 COMPONENTS ON BOARD

The function of floor polish robot is to make polishing process become easier than polishing the floor manually by using sponge. 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. Then, 3 to 4 DC motors is needed to connect with the Arduino and motor driver. 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 a 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 act as current amplifier.There are 4 input pins for this L293D Motor Driver IC which are pin 2 and 7 on the left;pin15 and 10 on the right. Then, the left input pins regulate the rotation of DC motor connected across left side and right input pins for motor on the right hand side. After that, VCC pin16 is the power supply for internal operation. The maximum voltage range is from 5V until 36V. VCC also need 5V to internal operation and this voltage not used by L293D. Next, VSS is a separate provision to provide motor supply and this voltage used by L293D to drive the motor. The VSS motor supply provide 9V to operate 9V motor in this project. The maximum voltage for VSS is 36V. The maximum current that can supply by VSS is 600mA per channel.After that, for Pin1 and Pin9 are "Enable" pins, these two pins are connected to positive 5V for the drivers to function. When these two pins pulled low, the outputs will be turned off to stop the motors. Moreover, the Pin4, Pin5, Pin12 and Pin13 connected to microcontroller's ground. Furthermore, Pin3, Pin6, Pin11, and Pin14 are output pins. The Pin3 and Pin6 for first motor, Pin11 and Pin14 for second motor. Lastly, Pin 8 is to power the two motors and connected to a secondary battery. The maximum supply voltage is 36V. (L293D MOTOR DRIVER IC – Tenet Tech, n.d.)

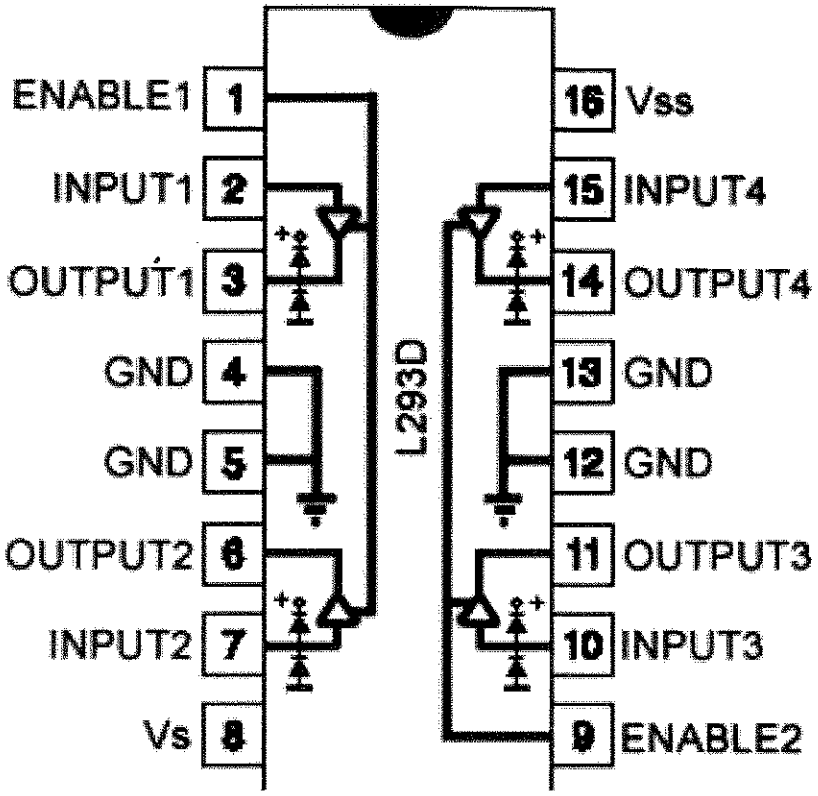


Figure 2.3.1: IC L293D

2.3.2 DC MOTOR

The function of a DC motor is converts direct current electrical power into mechanical power. Next, magnetic fields are the most common types rely on the forces. RPM is one of the most important specifications of a DC motor. Then, RPM means revolutions per minute, is amount of times for the shaft of a DC motor completes a full spin. After that,the no-load speed of a DC motor is the speed that DC motor will turn when nothing is attached to its shaft. The higher the RPM value, the higher the no-load speed of DC motor. Moreover,stall torque is the torque produced on a motor when the output rotational speed is zero. It stalls the shaft of the motor, so that the shaft can spins longer and contain rotational motion. Furthermore, the maximum current specification of a 9V DC motor is 115mA. Lastly, stall torque is a very important specification of a motor when weight on a shaft. (DC Motor Specifications- Explained, n.d.)

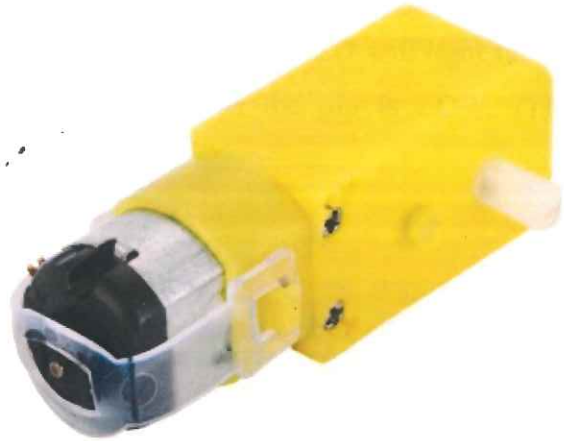


Figure 2.3.2: DC MOTOR

2.3.3 ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega328. The Arduino Uno have 14 digital input or output pins, 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. To start the Arduino, must connect to a computer with a USB cable; power it with a AC to DC adapter or battery. Next, range of external supply voltage that operate the board is 7 to 12V. The board will be unstable when supply less than 7V because the 5V pin supply less than 5V. Hence, the voltage regulator may overheat and damage the board when supply more than 12V. Then, the power pins are VIN, 5V pin, 3V3 and GND. The function of VIN is allow external power source supply the input voltage to Arduino board. The 5V pin is to power the microcontroller and other components on the board. After that, the 3V3 pin is a 3.3V supply that generated by on-board regulator, the maximum current draw is 50mA; GND is ground pin. Moreover, the board has 32KB flash memory, 2 KB SRAM and 1 KB EEPROM. Each 14 digital pins are operated at 5V and can provide or receive maximum of 40mA. Besides that, pin 0 and pin 1 are used to receive(RX) and transmit(TX) TTL serial data, pin 2 and

pin 3 are used to trigger an interrupt on low value, a rising or falling edge, or change in value. Pin 3,5,6,9,10 and 11 is to provide 8-bit Pulse-width modulation output. For support Serial Peripheral Interface communication, pin 10,11,12 and 13 are used. Lastly, pin 13 is connected with LED, the LED will light on when the pin is HIGH value; the LED will light off when the pin is LOW. (The Arduino Uno is a microcontroller board based, n.d.)

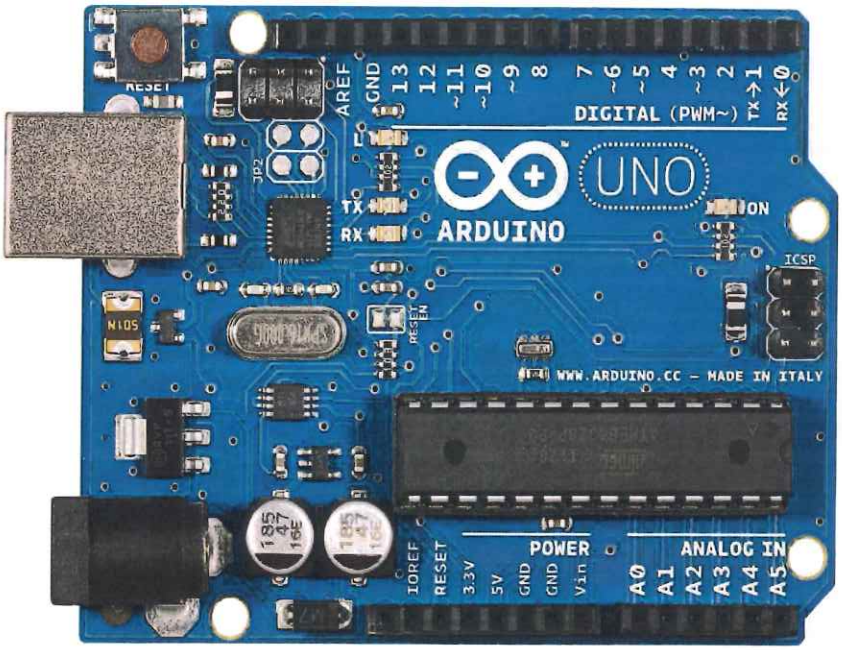


Figure 2.3.3: ARDUINO UNO

2.2.4 POWER SUPPLY(9V BATTERY) WITH CONNECTOR AND STRAP

The 9V battery was introduced for the early transistor radios. Next, it has a rectangular prism shape with rounded edges and a polarized snap connector at the top. This type of battery are commonly used in walkie-talkies, clocks and smoke detectors. Then, the battery has both terminals in a snap connector on one end. The smaller circular (male) terminal is positive. Meanwhile, the larger hexagonal or octagonal (female) terminal is negative. This type of battery also can connected to each other in series form to provide higher voltages. After that, a problem with this style of connector is that it is very easy to connect two batteries together in a short circuit. This situation will cause the both batteries discharge quickly, generate heat and possibly causes a fire. So, the function of strap are reduce the potential of short circuit,

insulates and shields the battery snap-on connector contact and prevents dust, dirt or physical damage. Lastly, the strap provide excellent strength and low contact resistance, the wire also soldered to increase reliability.(Energizer Alkaline 522, n.d.)

Figure 2.3.4: 9V BATTERY WITH CONNECTOR AND STRAP

2.2.5 JUMPER WIRE

A jumper wire is an electrical wire with a connector or pin at each end. Next, the function of jumper wire is used to interconnect the components of a breadboard, other prototype and test circuit internally or with other equipment and components without soldering. Then, individual jump wires are fitted by insert the end connectors into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment. After that, the categories of jumper wire are male to female, female to female and male to male. In additional, jumper wire is different in color and size which is depends on the uses. In breadboard, jump wire is used to establish connections between the central micro controller and other devices such as button and sensor. Lastly, the jumper wire should always be placed on the component side of a circuit board during assembly. (Jump wire, n.d.)

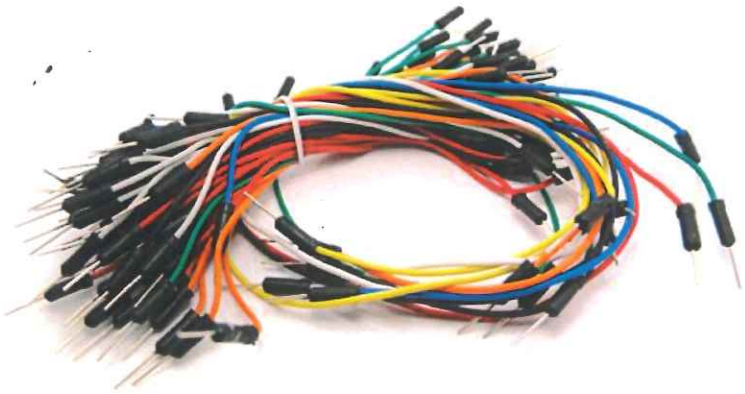


Figure 2.2.5: JUMPER WIRE

2.2.6 HC-06 BLUETOOTH MODULE

HC-06 Bluetooth module is a Bluetooth SPP (Serial Port Protocol) module which is designed for transparent wireless serial connection setup. The package size is 28mm times 15mm times 2.35mm. The communication is easy to interface with controller or PC.There is only point to point communication for modules, but the adapter can communicate with multi-modules. Next, pin 12 is VCC pin of the module, a voltage supply for logic, the standard voltage is 3.3V, connected to the 5V pin of Arduino microcontroller; pin 13 and 22 are GND pin, connected to the GND of Arduino microcontroller; pin 1 is TXD, the serial output of the module and connected to the RX of Arduinomicrocontroller; pin 2 is RXD pin, the serial input of the module and connected to the TX of Arduinomicrocontroller. Then, pin 26 is KEY, for master abandons memory. For master device, this PIN will empty the formation about pairing. After emptying, master device will search another slaver and remember the new address. After power on again, the master device will only search this address. After that, pin 11 is RESET pin, this pin will be active when the input in low level and connected to air. Lastly, pin 24 is LED also called as working mode indicator. The red

LED will blinking if paired with device. After paired with device, this pin will achieve high output level.(HC Serial Bluetooth Products User Instructional Manual, n.d.)

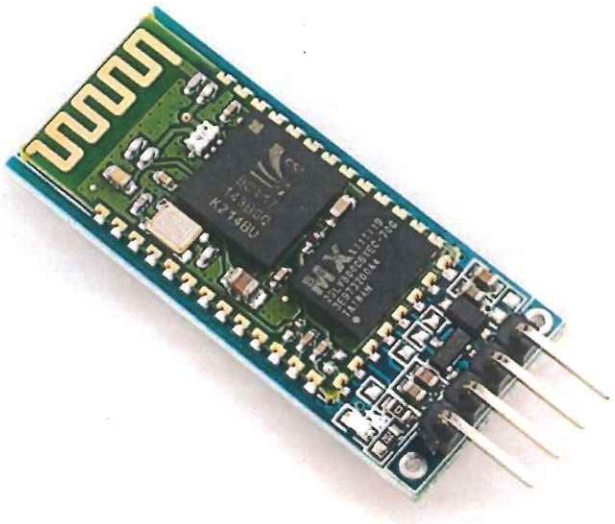


Figure 2.2.6: HC-06 BLUETOOTH MODULE

2.2.7 KCD1-101 10 AMP ROCKER SWITCH

KCD1-101 miniature rocker switch offer a high switching current in a compact design. It is a snap-in mounted rocker switch and contain high mechanical life in a rugged nylon 66 housing. Next, it has a high quality for long life at heavy loads and industry-standard mounting dimensions. The project used this switch for the function of switch on and switch off. Then, this rocker switches also can be used in a variety of applications, example: water dispenser and extension socket and so on. After that, the switch terminal is brass with sliver plated and the switch operation is on-off. This

switch have two different rating, 10A with 125 AC voltage and 6A with 250 AC voltage. (KCD1-101 10 Amp Rocker Switch-Daier, n.d.)

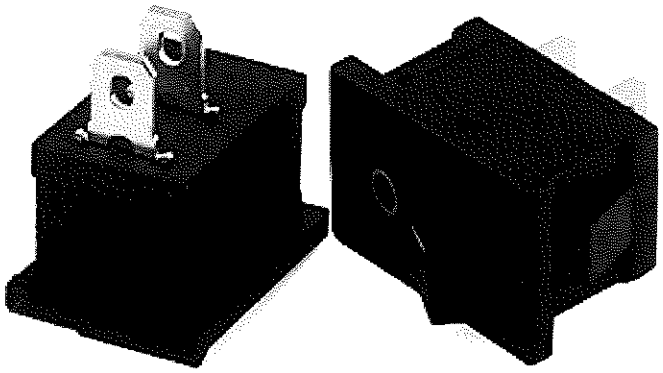


Figure 2.2.7: KCD1-101 10 AMP ROCKER SWITCH

2.3 CONCLUSION

As the conclusion,some of the robots are based on the technical analysis of research work. The idea of building floor polish robot was come from the discussion with group and analyzed several research paper. Next, the components are very important for a robot. Then, each component has own characteristic, feature, limitation and function. In this project, the robot is controlled by the Bluetooth module. After that, the Bluetooth module sends the output to Arduino board. Moreover, the robot is used Arduino board to control the movement of robot. DC motors is used to connect with the Arduino board and motor driver. In additional, DC motor Tamiya has been added to spin the sponge that attach under it as polish function. Furthermore, a switch has been added to switch on and switch off the spinning sponge. Lastly, the importance of literature review is providing comparisons for own research findings and identifying the method used in previous research on the topic.

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 remote floor polish are in two ways which is by using hardware and also software.

The hardware consists of Arduino Uno, Bluetooth module, three geared DC motors, a motor driver 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 (L293D). A sponge/brush will be attach to one of the motor for the purpose of polishing the floor. The Bluetooth module is used to transmit the commands from the mobile phone. Our system can be started and stopped by the mobile phones.

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 Arduino Bluetooth App. 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 polishing the floor with such efficient. This project will be very useful for people that have difficulties of cleaning.

3.2 BLOCK DIAGRAM FOR HARDWARE

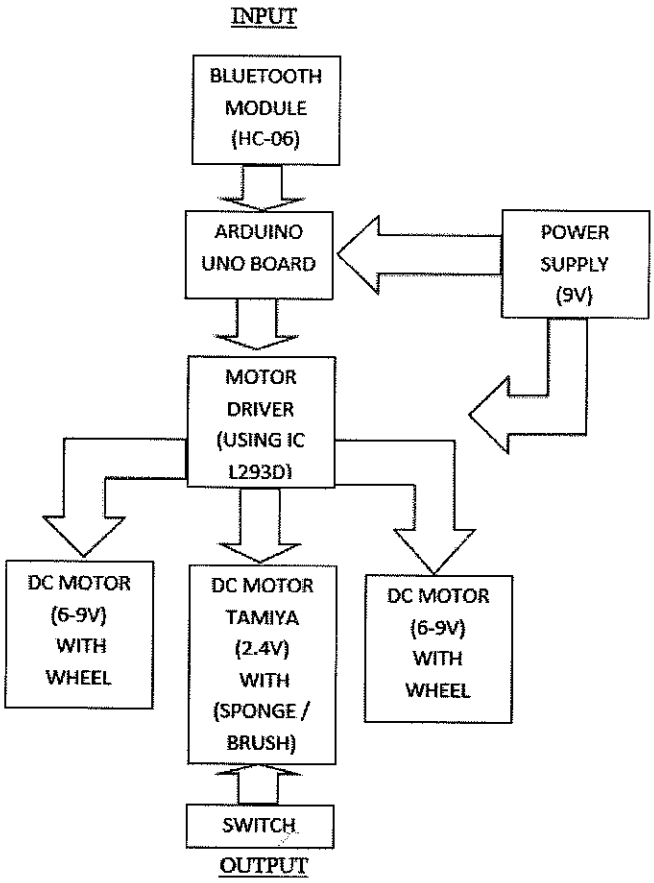


Figure 3.2: Block Diagram

The block diagram above shows the operation of mobile floor polish robot, which consists of a Bluetooth module, Arduino Uno Bord, power supply 9 volts, 2 DC Motor (6 until 9 volts each), DC Motor Tamiya (2.4V) with sponge or brush, and Motor Driver using IC L293D. The project is control via mobile phone by an app called Arduino Bluetooth App. 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 motor Tamiya will start function. Meanwhile, the DC motor Tamiya is used to rotate the sponge that attach on it. When the connection is successful, the robot will start to work.

3.3 FLOW CHART FOR HARDWARE

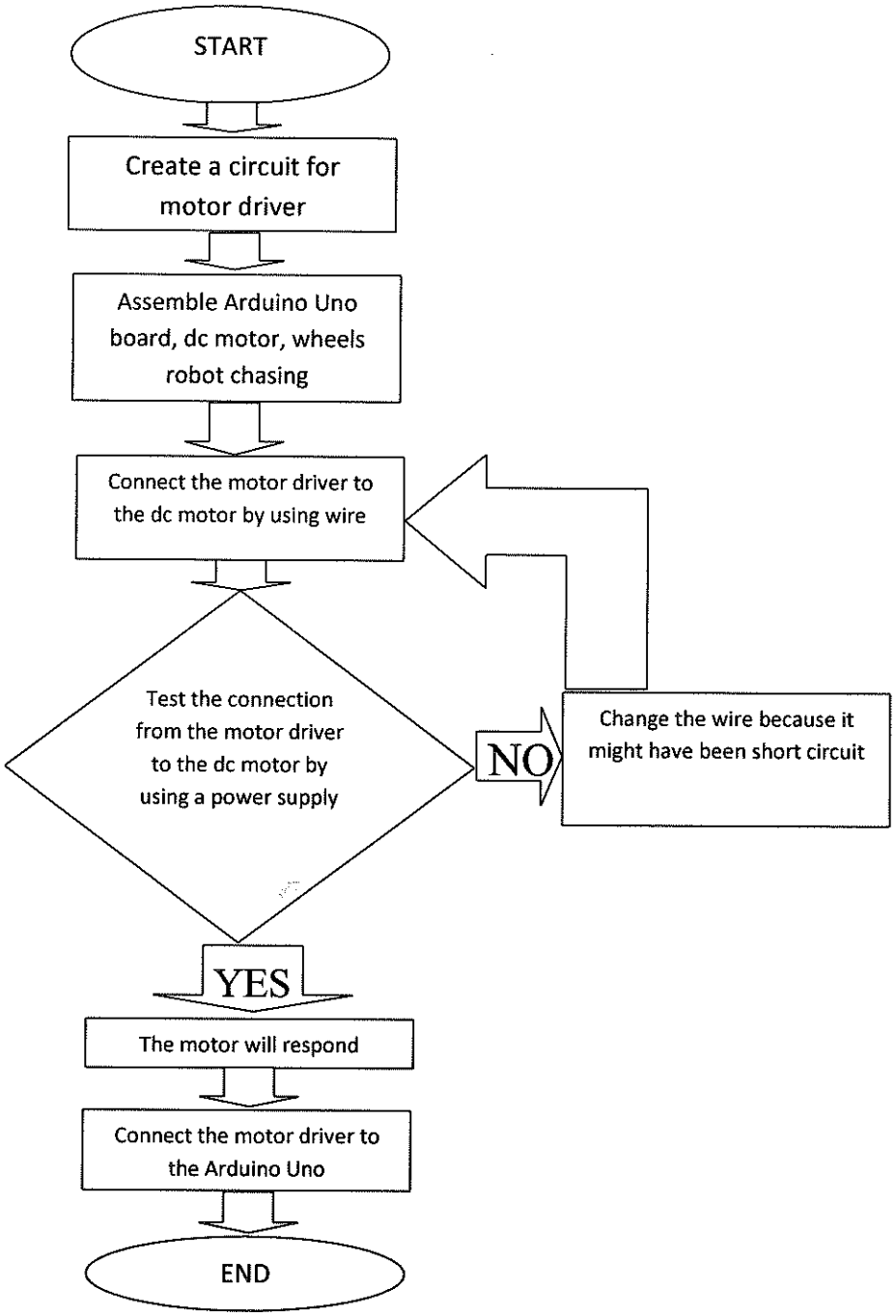


Figure.3.3: Flow Chart for Hardware

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

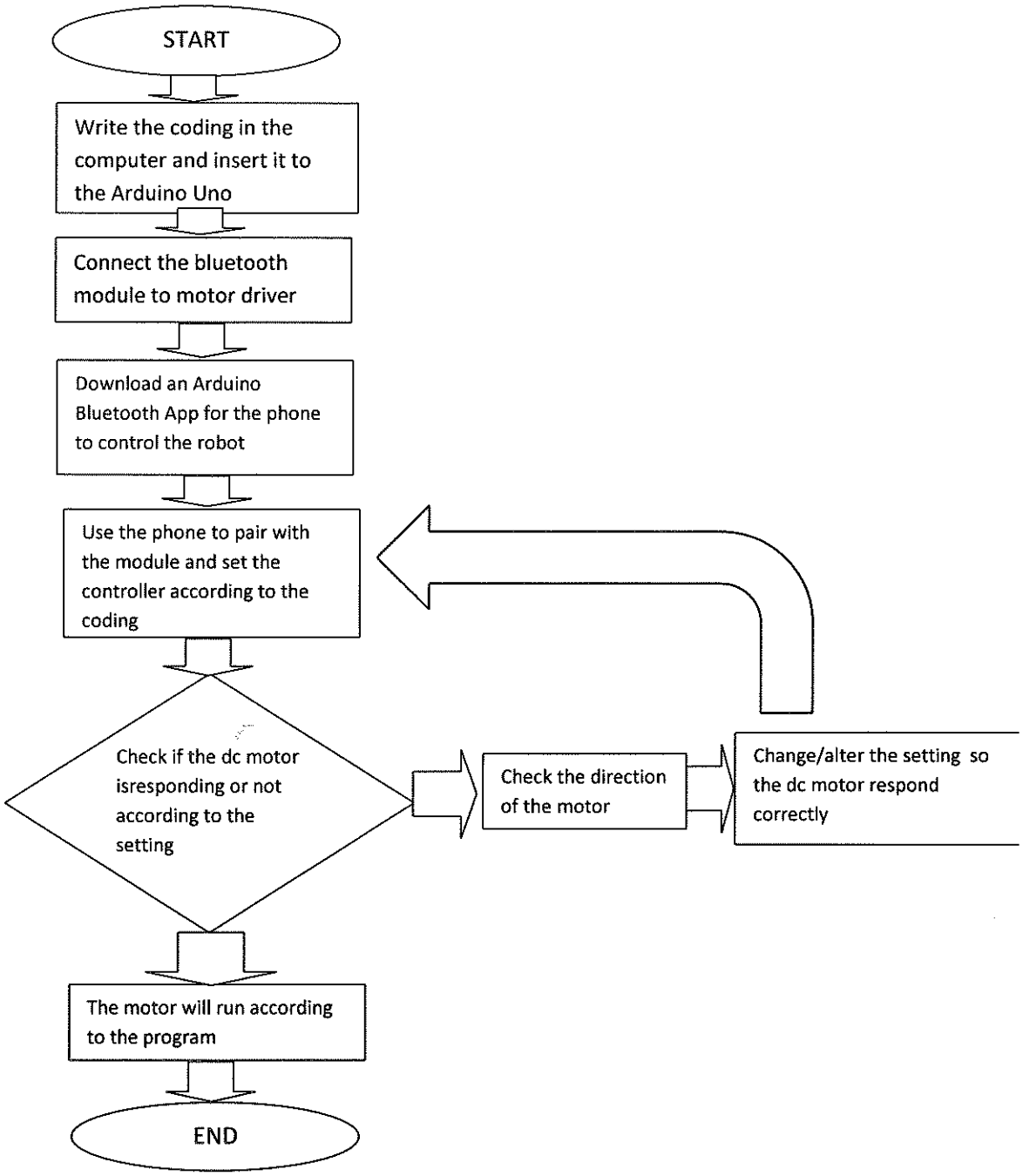


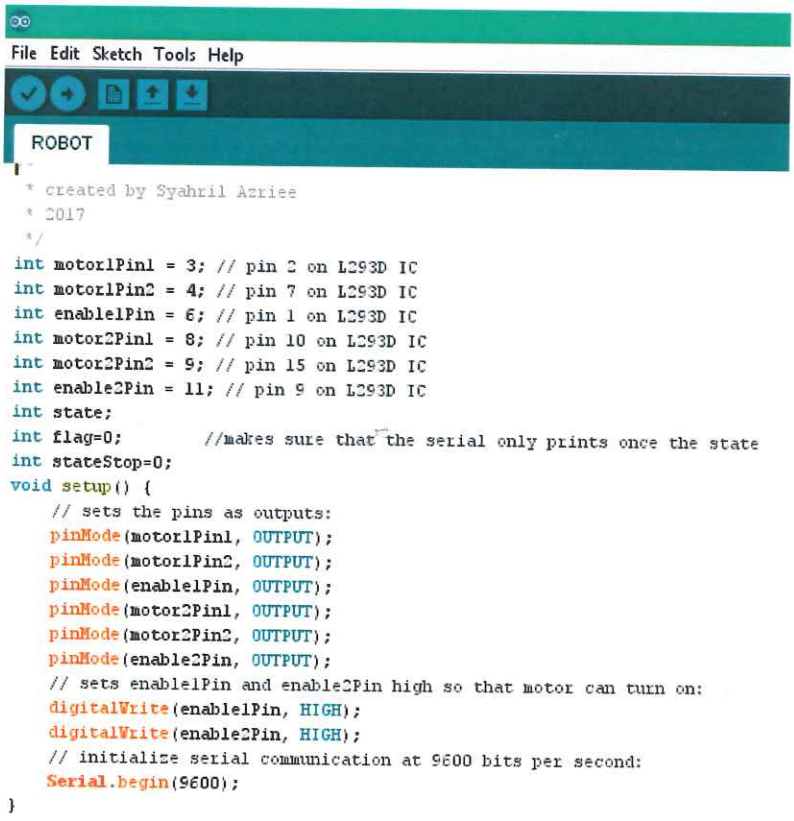
Figure.3.4 :Flow Chart for Software

The figure above shows the flow chart for the software. The user most write the coding and insert it to the rduino Uno. Then conect the blutooth module with the motor driver. Next,downlod the Arduino Bluetooth App to control the robot. After that use the phone to pair with the module. While controlling the robot, check if the dc motor is responding or not. When there's a problem, the user must troubleshoot checking the direction of the motor rotates and change the control setting. After solving the problem the robot can run according to the program.

3.5 CODING

Part of the job of the IDE is to take the human readable *code* and translate it into machine-readable *code*to be executed by the *Arduino*. This process is called compiling. The process of compiling is seamless to the user. All you have to do is press a button. This part of the methodology shows the coding of the project and the steps of creating it. The figure below is use as a reference for the coding from the website:

https://randomnerdtutorials.com/arduino-control-2-dc-motors-via-bluetooth/



```
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;
        }
        delay(1500);
        state=3;
        stateStop=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;
        }
        delay(1500);
        state=3;
        stateStop=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;
        }
    }
    //For debugging purpose
    //Serial.println(state);
}
```

Figure 3.5: Coding for Project

3.6 PCB LAYOUT PREPARATION

The figure below shows the schematic diagram as a reference to create the PCB layout for the project. The user used a software called Livewire to design the layout design of the project. The PCB Wizard is then use to designed a printed circuit board (PCB). The figure below is a reference from the website:

https://randomnerdtutorials.com/arduino-control-2-dc-motors-via-bluetooth/

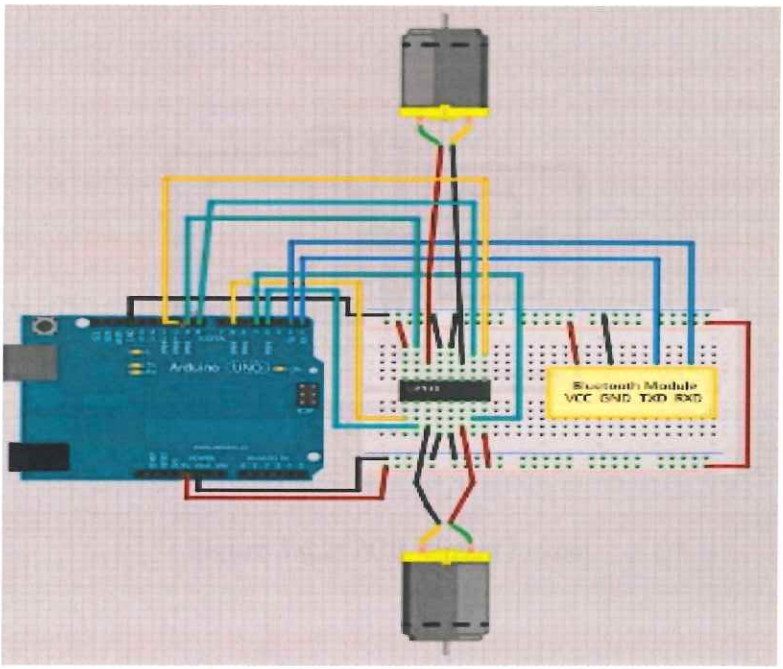


Figure 3.6: Schematic Circuit