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DEE 6092 – PROJECT 2

SMART COURIER ROBOT



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Apart from that, we want to thank all our friends for helping us to finish this progress of project. They have also helped us by giving an extra ideas for our project. The discussion about our project is a meaningful and useful moment it is because we have gathered a lot of ideas. Our mind are also open after gathered a lot of idea to make the project. Besides that we want to thank to our parents for encourage us on this project. They support us very well for this project because they give some money to buy the important material and component for our project.

At the end, I offer my regards and blessings to my colleagues and all of those who supported us in any respect during the completion of the project.

ABSTRACT

The name of my project is Smart Courier Robot. We usually create that use electric, electronic and mechanical movement. This product can make also our daily life become more easily to bring goods in flat road. Courierbot or know as Smart Courier Robot is a robot that moves using Cytron Bluetooth Module. While, Courierbot can also be controlled by using Arduino BT Joystick. Additionally, in this project we also use G15 Driver to drive servo cube that provide 360⁰ endless electrical rotation by using potentiometer to lead itself to solve some application such as to motorize a mobile robot. Finally, it is very easy to use, economical and sufficient for this project. Base on the circuit, that have uses the power of the battery to maintain the robot move.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND PROJECT

Smart courier robot is the robot that being program to carry the goods such as documents, books and file that controlled by Arduino BT Joystick. The courier can be saw in many aspect in this life. But, this product only delivery in small and flat road. The robot is capable machine to carry out the complex series of actions automatically that has been create by programmable with Arduino IDE software. Robot and courier has been combine to create a robot that can transport the goods or other things by using flat road.

This project is only a prototype. The weight capacity for this product is about 500g. In this project I'm using G15 Driver to drive servo cube that provide 360⁰ endless electrical rotation by using potentiometer to lead itself to solve some application such as to motorize a mobile robot. To make this product move I' m using Cytron Bluetooth Module and make it connect with Arduino BT Joystick that can be install in play store and control using Cell Phone. A good way to give a "third wheel", I'm using Tamiya's Steel ball caster. In addition, to make this robot move, I'm using LiPo 11.1V 1300mAH and 2-3 Cell LIPO Balance Charger that able to charge 2s or 3s LiPo battery pack and accepts 240V AC directly and DC power supply is not needed. To make the base, I'm using the robot base.

Finally, it is very easy to use, economical and sufficient for this project.

1.2 PROBLEM STATEMENT

- Student and lecture always carry things in large quantities.
- Canteen worker always pick-up goods such as plates and cups to the same place repeatedly.

1.3 OBJECTIVE

- To send the goods such document, books, and files from another place to another place in flat roads.
- To reduce human labour

1.4 SCOPE OF STUDY

In basic robotic we design machines to do the specified tasks and in the advanced version of it robots are designed to be adaptive, that is, respond according to the changing environment and even autonomous, that is, capable to make decisions on their own. While designing a robot the most important thing to be taken in consideration is, obviously, the function to be performed. Here comes into play the discussion about the scope of the robot and robotics. Robot have basic levels of complexity and each level has it scope for performing the requisite function. The levels of complexity of robots is defined by the members used in its lambs, number of lambs, number of actuators and sensor used and for advanced robots the type and number of microprocessor and microcontroller used. Each increasing component adds to the scope of functionality of a robot. With every joint added, the degrees of freedom in which a robot can work increases and with the quality of the microprocessors and microcontrollers the accuracy and effectiveness with which a robot can work in enhanced. In addition, the robot is also used in a horizontal place.

1.4.1 Software

In order to work with this project, first the right of software implementation needs to be identified. The preliminary works for software searching are:

- i. Learn the usage of the assembly language and it criteria based on the project objectives.
- ii. Identified the software that will be used to load the program to the Arduino
- iii. Check and explore the entire menu in the software used in order to achieve the project objectives.

1.4.2 Hardware

For the hardware part, there are several works that has been done before proceed to the project requirements.

- i. Designing a car with a container to put things
- ii. Searching for material that will be use such as plastic board
- iii. Built the prototype according to the design and the project requirements.

CHAPTER 2

LITERATURE REVIEW

2.1 PROJECT DESCRIPTION

The levels of complexity of robots is defined by the members used in its lambs, number of lambs, number of actuators and sensor used and for advanced robots the type and number of microprocessor and microcontroller used. Each increasing component adds to the scope of functionality of a robot. With every joint added, the degrees of freedom in which a robot can work increases and with the quality of the microprocessors and microcontrollers the accuracy and effectiveness with which a robot can work in enhanced. (Erica Naone, February 22, 2011). Excellent quantity for a reasonable price. Very good soldering. Great for project (wyvern, February 19, 2013).

Great price, endless possibilities. Got one to build a RFID garage door opener, and ended up with five more UNO boards!! This is so much fun to tinker with, it's addictive. I would wholeheartedly encourage parents to purchase the starter kit for their engineers to be (Frondes Mclows, March 7, 2013). Another Great Product. The new ATmega8U2 USB chip looks to be a bit faster then the older FTDI chip but its a lot harder to reprogram if needed. Other then that I have been using this board for projects for a few months now with no problems (Maria Sentagos, June 17, 2014).

2.2 DEVICE USED

1. CUBE SERVO (MOTOR)



G15 Cube Servo is a modular smart serial servo which incorporates gear reducer, precision high torque DC motor and control circuitry with networking functionality. It is made with high quality engineering plastic to provide high necessary strength and is able to sustain high external force up to 15 kg.cm holding torque. G15 provides 360° endless electrical rotation by using potentiometer to lead itself to solve some application such as to motorize a mobile robot. G15 also has LED indicator to show the status of the servo. The unique cubical design of G15 gives the highest flexibility in robotics model construction. By incorporating slid able slots and latches, G15 are able to eliminate the screws and nuts during the construction. This patented joining method enable user to connect a G15 to another G15 even easier and faster without any single screw.

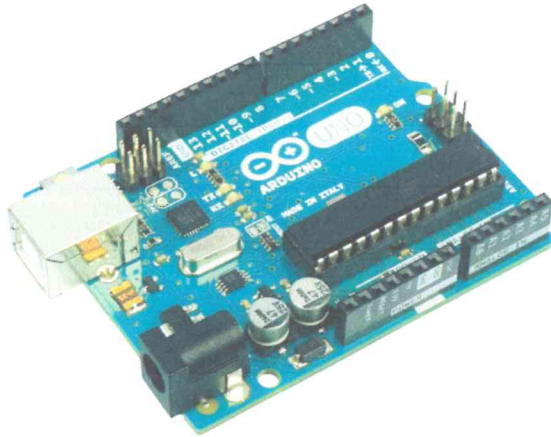
Features:

- Modular type robotic servo
- Cubical outlook and center output shaft to give highest flexibility during robotic model construction
- Five slide-able slots in different orientation
- Screw-less mounting method
- 360° endless electrical rotation (1088 steps)
- Daisy chain connection wiring among the G15 cube servos (each G15 cube servo has its own unique ID)
- Serial communication, Half-duplex Asynchronous (max speed up to 500k bps), TTL level, command packet
- Rotation speed or time to reach the desired position can be set
- Able to feedback its angular position, angular speed, current load, temperature and supply voltage
- Auto shutdown if overload, supply voltage error or high temperature is detected (user define the value)
- LED indicator to shows the status of the servo
- Built-in microcontroller built-in to handle all controls
- Origin: Malaysia

Specification:

- Voltage: 6.5 - 17.8VDC
- Holding Torque: 15kg.cm (at 12V)
- Rated Torque: 12kg.cm (at 12V)
- Speed: 63RPM (no load at 12V)
- Gear ratio: 194:1
- Current:1.5A (max. at 12V)
- Weight: 63g
- Degree of rotation: 360⁰ continuous
- Communication: Half Duplex Serial
- RoHS Compliant: Yes

2. ARDUNO UNO



Arduino is an open-source physical computing platform based on a simple i/o board and a development environment that implements the Processing/Wiring language. Arduino can be used to develop stand-alone interactive objects or can be connected to software on your computer (e.g. Flash, Processing, MaxMSP). The open-source IDE can be downloaded for free (currently for Mac OS X, Windows, and Linux).

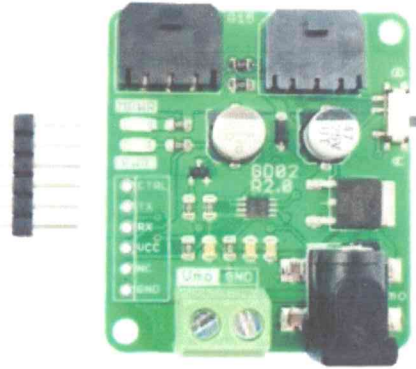
The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip.

Features:

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

3. G15 Driver



G15 Driver (GD02) is used to drive G15 Cube Servo. It is a Full to Half Duplex Communication Converter board. It converts UART full duplex communication to half-duplex single line communication which is required by G15 Cube Servo. GD02 has two ports for the Cube Servo. G15 Cube servo is a serial controlled servo motor which can be daisy chained. G02 has a separated port connector for motor's power supply. GD02 offers simple and easy way to user to control G15 Cube Servo with UART communication from any microcontroller board.

Specifications:

- UART Voltage: 3.3V or 5V
- Motor Voltage: 7-15VDC
- Maximum Continuous Current: 8A

G15 driver comes with:

- 2 x G15 Cube Servo ports (can be daisy chained to more servos)
- External power terminal for Cube Servo.
- 2 LEDs as logic power and servo power indicators.
- 3.3V and 5V signals compatible.
- Module Size: 32 × 24 × 9mm

4. 2-3 Cell LIPO Balance Charger

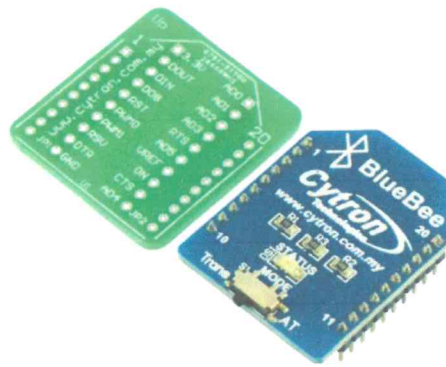


This compact and lightweight charger is able to charge 2s or 3s LiPo battery pack. There are separated balance ports for each type of battery pack. This charger also accepts 240V AC directly and DC power supply is not needed. Please read the user manual carefully before using it.

Specification:

- Input Voltage: 110-240VAC
- Display: 3x Bicolour LED
- Charging Current: 700mA
- UK standard power plug
- Size 100mm x 60mm x 35mm
- Weight: 180g

5. Cytron Bluetooth Module



This BlueBee wireless module is new product from Cytron Technologies, utilizing the XBee form factor, BlueBee is compatible with XBee adapter such as SKXBee (without module), XBee breakout board and Arduino-XBee shield. Though the form factor (pin out) is compatible with XBee module, BlueBee uses Bluetooth Technology. It is compact in size, the pinout is compatible with XBee which is suitable for all kinds of microcontroller systems that have 3.3V power out, the module utilize AT commands to set baud rate and other parameters. The BlueBee module comes with an on-board antenna, the antenna provides better signal quality. It acts like a transparent serial port, which works with a variety of Bluetooth adapter and Bluetooth phone. However, it only provides SPP (Serial Port Profile) where it becomes serial COM port once it establish connection with master Bluetooth. BlueBee module's baudrate can modified using XBEE adapter. You can use SKXBEE-BOARD or XBEE Arduino controller receives the base plug, enabling Bluetooth wireless control.

Specifications:

- Bluetooth chip: CSR BC04 Chipset
- Bluetooth protocol: Bluetooth Specification v2.0 + EDR
- Operating frequency: 2.4 ~ 2.48GHz unlicensed ISM band
- Modulation: GFSK (Gaussian Frequency Shift Keying)
- Transmit Power: $\leq 4\text{dBm}$, Class 2
- Transmission distance: 20 ~ 30m in free space
- Sensitivity: $\leq -84\text{dBm}$ at 0.1% BER
- Transfer rate: Asynchronous: 2.1Mbps (Max) / 160 kbps; Synchronous: 1Mbps/1Mbps
- Safety features: Authentication and encryption
- Can be configured as master or slave node. Default is slave mode.
- Support profiles: Bluetooth serial port
- Serial port settings: 1200 ~ 1382400 / N / 8 / 1
- Baud rate default: 9600 bps(Serial Port Profile, transparent mode)
- Baud rate default: 38400 bps in AT mode.
- Pair Number/ID: 1234
- Input Voltage: +3.3 DC/50mA
- Operating temperature: $-20\text{ }^{\circ}\text{C} \sim +55\text{ }^{\circ}\text{C}$
- Module Size: $32 \times 24 \times 9\text{mm}$

6. Tamiya Ball Castor (2pcs)

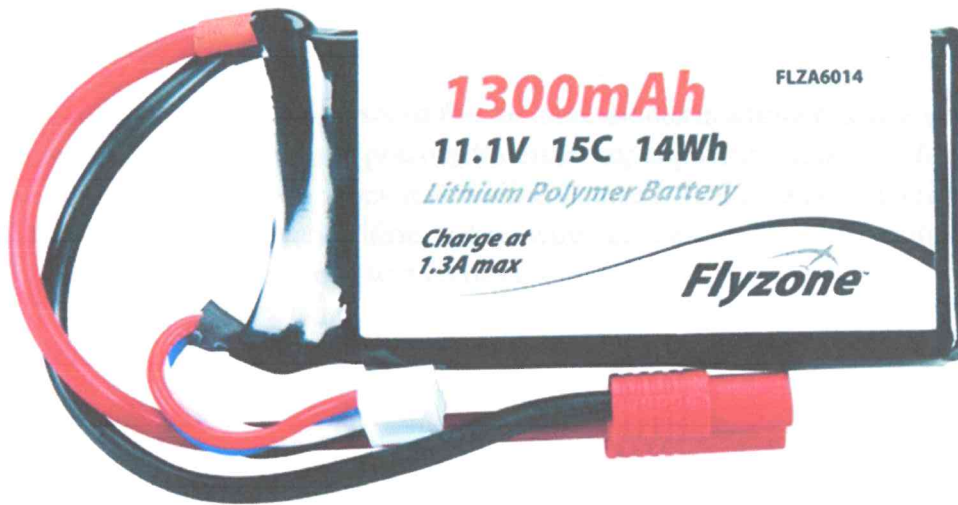


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12mm diameter Selectable height (25mm and 35mm) Plastic casing Light application Comes in 2pcs/set

- 12mm diameter
- Selectable height (25mm and 35mm)
- Plastic casing
- Light application
- Comes in 2pcs/set

7. LiPo 11.1V 1300mAh



Lithium Polymer (LiPo) rechargeable battery was initially designed for RC toys but eventually become so popular in robotic sector due to its small-size and lightweight. But it is relatively hard to maintain and may explode if being misused.

Specification:

- Ordinary Voltage: 11.1V
- Fully-charge Voltage: 12.6V
- Capacity: 2200mAh
- Discharge rate: 30C
- Able to use for most of the 12V controllers, motors or any other appliances
- **Must** charge with designated LiPo Battery Charger

2.3 FUNCTION OF COMPONENT

1) BRIDGE RECTIFIER

A bridge rectifier is an arrangement of four or more diodes in a bridge circuit configuration which provides the same output polarity for either input polarity. It is used for converting an alternating current (AC) input into a direct current (DC) output. A bridge rectifier provides full-wave rectification from a two-wire AC input, therefore resulting in lower weight and cost when compared to a rectifier with a 3-wire input from a transformer with a center-tapped secondary winding.

2) CAPACITOR

A capacitor is a passive electronic component that stores energy in the form of an electrostatic field. In the most simple form, a capacitor consists of two conducting plates separated by an insulating material called a dielectric. Capacitance is directly proportional to the surface area of the plate, and is inversely proportional to the separation between the plates. Capacitance also depends on the dielectric constant of the material separating the plates.

3) DIODE

Active Electronic Components Diode is made of a semiconductor material and has a function to send electric current to one direction but prevent electric current from the opposite direction. Therefore, it is often used as a rectifier diode in series Electronics. Diodes in general have two electrodes (terminals) are Anode (+) and cathode (-) and has a working principle based on the technology of semiconductor junction can drain current of the p-type side (anode) to the n-type (cathode) but cannot flow in the opposite direction.

4) IC 7805/7812

The **78xx** (sometimes **L78xx**, **LM78xx**, **MC78xx**...) is a family of self-contained fixed linear voltage regulator integrated circuit. The 78xx family is commonly used in electronic circuits requiring a regulated power supply due to their ease-of-use and low cost. For ICs within the family, the xx is replaced with two digits, indicating the output voltage (for example, the 7805 has a 5volt output, while the 7812 produces 12 volts). The 78xx line are positive voltage regulators: they produce a voltage that is positive relative to a common ground. There is a related line of **79xx** devices which are complementary negative voltage regulators. 78xx and 79xx ICs can be used in combination to provide positive and negative supply voltages in the same circuit.

2.4 PCB EAGLE

EAGLE's board designer is where a good portion of the magic happens. It's here where the dimensions of the board come together, parts are arranged, and connected by copper traces. In the board editor, the conceptual, idealized schematic you've designed becomes a precisely dimensioned and routed PCB. In this tutorial we'll cover every step in EAGLE PCB design: from placing parts, to routing them, to generating gerber files to send to a fab house. We'll also go over the basics of EAGLE's board editor, beginning with explaining how the layers in EAGLE match up to the layers of a PCB.

The software is supplied on a CD-ROM and requires Microsoft Windows 95, 98, Me, NT 4.0(with SP6), 2000, XP, Vista or 7. User guide and instruction are included with the software.

PCB Eagle Standard :-

- Large database of components
- Schematic design and capture
- Manual PCB design
- Single sided auto-routing
- User-defined components
- Copper pour
- Bill of materials report generation
- Gerber and N.C drilling export
- Integrated publishing with next, graphics and spell-checking support
- Import circuit from Livewire

2.5 Arduino Software

The open-source Arduino Software (IDE) makes it easy to write code and upload it into a board . It runs on Windows , MacOS , and Linux . The environment is written in Java and based on Processing and other open-source software

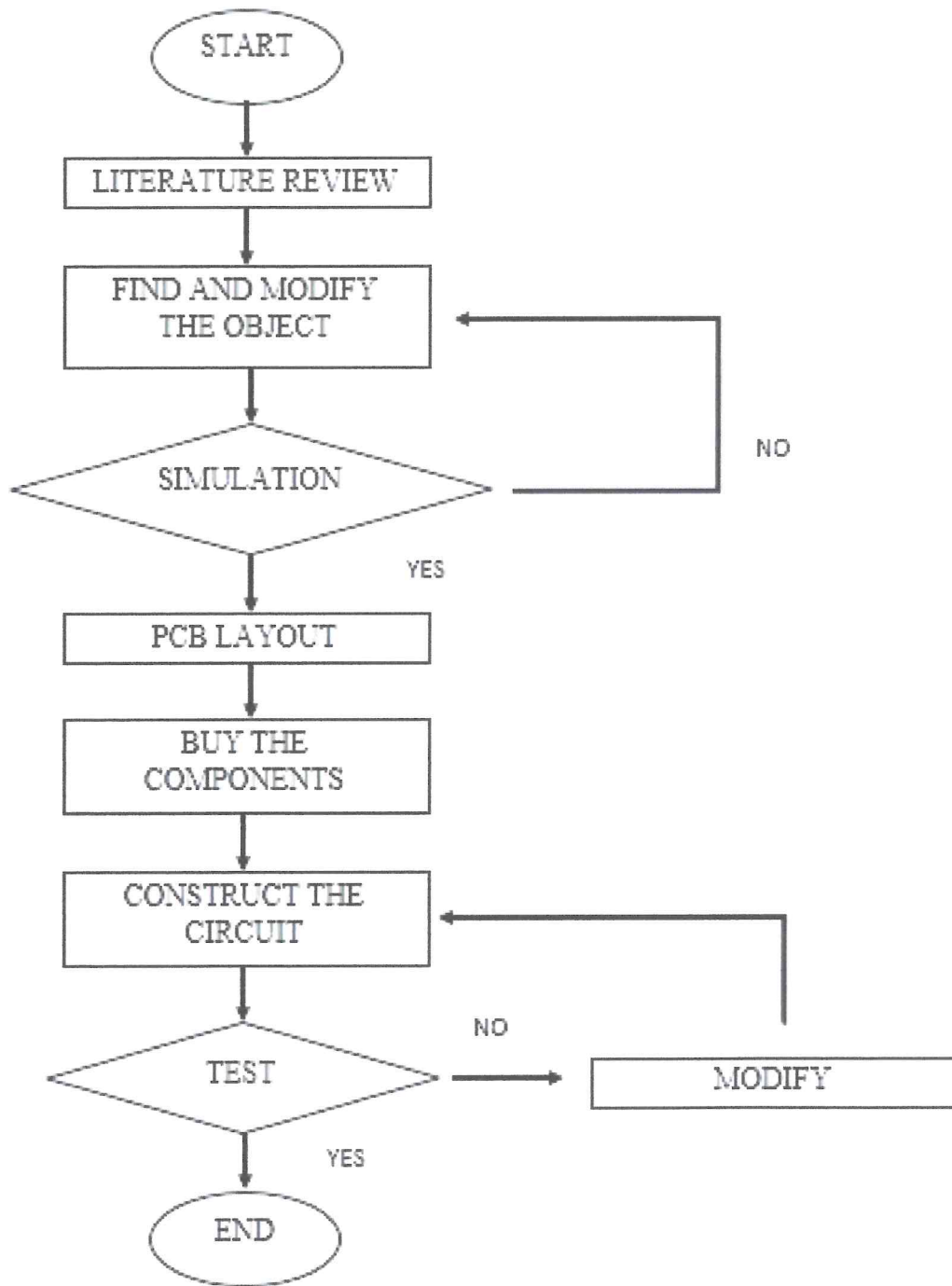
CHAPTER 3

METHODOLOGY

3.1 FLOW CHART PLAN OF PROJECT

A flowchart is a formalized graphic representation of a logic sequence, work or manufacturing process, organization chart, or similar formalized structure. The purpose of a flow chart is to provide people with a common language or reference point when dealing with a project or process.

3.1.1 FLOW CHART OF PROJECT PLANNING



3.2 MILESTONE TABLE

Other than that, we will explain about planning job table. According to planning job table topic, we will show our Gantt during development this project. Gantt chart also known as milestone table that is use to show time start and end time for project. the duration of each job or task can be display in Gant chart has become a common technique for represent the phase and activities of a project work breakdown structure, so they can be understood by a wide audience.

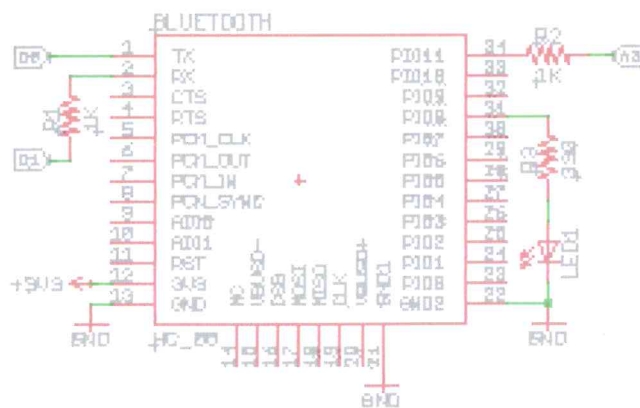
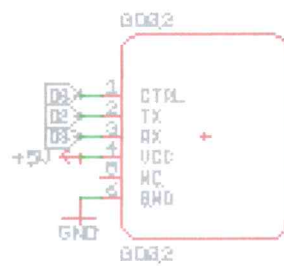
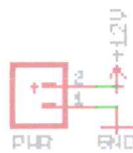
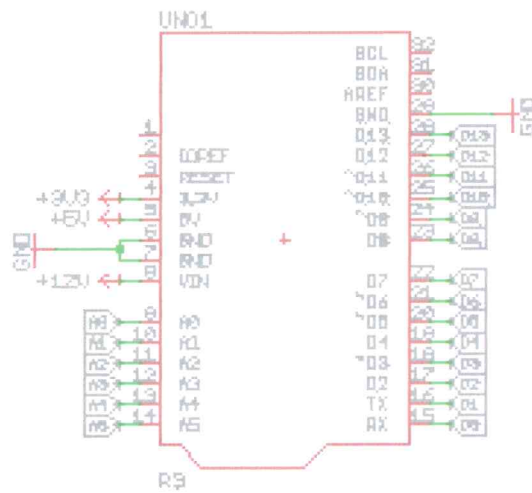
PROJECT PROGRESS	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10	WEEK 11	WEEK 12	WEEK 13	WEEK 14	WEEK 15
Finding Project	█	█	█	█	█									
Project Research						█	█	█	█					
Making Circuit										█	█	█		
Sketch Program Development													█	█
Testing The Circuit													█	█
Final Model Development														█

Table 3.2.1: Project 1 Progress

Project Progress	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15
Project Ideas	█	█	█	█	█	█	█	█							
Finishing Circuit			█	█	█										
Study Coding for Arduino			█	█	█	█	█	█							
Testing					█	█	█	█	█	█					
Troubleshooting									█	█	█	█			
Prototype										█	█	█			
Final Report											█	█	█		
Supervisor Presentation														█	
Project Presentation															█

Table 3.2.2: Project 2 Progress

3.3 CIRCUIT OF COURIER ROBOT



3.4 HARDWARE DEVELOPMENT

This will explain about the development process of the project

3.4.1 ETCHING PROCESS

Etching process depend on how littering circuit. There are different ways of it. In this project we print the circuit on photopaper and stick it with masking tape on PCB board. The way we use is by using laminating machine . Then we put the board in the machine for 6-7 times or do the laminating repeated step 10 time to make sure the layout is attached to the board . After that we put the board in cold water so that the photo paper come out easily . Finally the board is put in the etching machine to remove the useless copper from board .

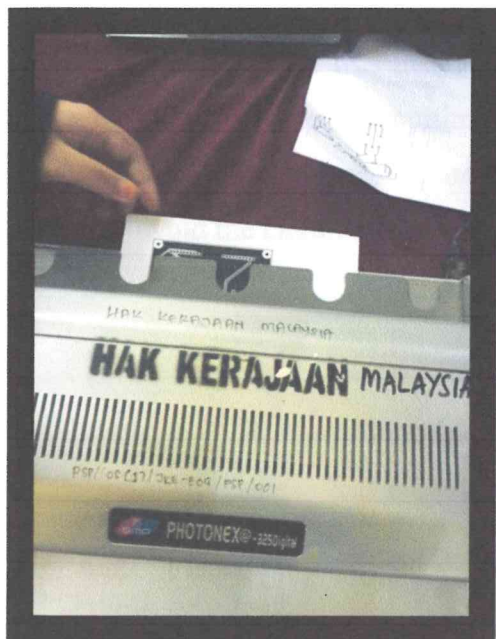


Figure 3.4.1.1 : Laminating Process



**Figure 3.4.1.2 : Remove copper from board
with ferric chloride**

3.4.2 DRILLING PROCESS

Prior to drill hole, the source terminal or point marked hole using a center punch. The selection of the drill should be appropriate to the size of the component to be installed.

The process of punching holes in the PCB board is intended to include components before soldering. When drilling holes, points “drill” should penetrate completely into the black of the PCB. Eye “drill” is used dependent on the size of the head of the component and use the appropriate size so that the resulting hole is not too big or too small. Before starting process of drilling, hole to be drilled shall be marked.

3.4.3 INSERT THE COMPONENT

Foot of component was inserted into the drilled hole . Components that are installed must be inspected prior to use multimeter to find out whether These components are in good condition or not .This process quite important because we should insert the component correctly to avoid the circuit failure .



3.4.4 SOLDERING

Steps to solder :

- i. Quickly remove the tip of the soldering iron from heat up the soldering iron for 5 – 10 minutes , allowing the iron to reach maximum operating temperature . Apply a small amount of solder to the tip and rotate so the entire tip becomes lightly covered with a thin layer of solder .
- ii. Connect the two surface to be soldered together so the metal parts are touching . If soldering wires, simply twist the two wire ends so they don't pull apart while being soldered.
- iii. Touch the hot tip of the soldering iron to all metal parts touching so they are evenly heated. Allow the surface to heat for 3-5 seconds, then touch the tip of the solder to the heated metal objects , not directly to the tip of soldering iron .
- iv. Wipe the soldered surface and the tip of the iron on a wet sponge immediately to remove solder. Wiping the solder off the tip will prevent it from burning and forming a black coat on the soldering iron tip
- v. Allow the solder to joint and cool for several minutes before applying power to the wires or the device soldered