CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

In this modern era somehow we are more focused on being a developed country, but to achieve that goal our fundamental needs should be fulfilled easily such as good roads, pollution free surroundings, sanitary and many more. Out of those we have selected one topic which will make the surrounding a better place to live! Hydrosphere covers more than 75 percent of earth's surface either as oceans or as fresh water. Many water reservoirs are polluted, through which water is supplied to fields as well as used to fulfill daily needs, which leads to reduce immune capacity of humans, animals as well as plants. Being a responsible citizen it's our duty to maintain the hygiene. That's how an idea struck to our mind!

1.2 RELEVANCE

The simple mechanism behind our idea is that bot should collect the floating garbage on the water surface and it should move effectively in optimum space. For that we need a skillful labor to operate the machine, but again there might be a greater threat to his life. That's why, we have decided to make a bot automated using controllers and we will connect it via Bluetooth module. In parallel to that, an application will be developed so that anyone could operate the machine easily.

1.3 LITERATURE SURVEY

Tourism is one of the world's fastest growing industries as well as the major source of foreign exchange earnings and employment for many developing countries, and it is increasingly focusing on natural environments. According to "National Green Tribunal" a judgment was declared in late 2015. As we all know Rankala Lake, which is situated in the heart of Kolhapur city. Couple of years back, there was a problem regarding to growing hyacinth (Hyacinth is small water growing plant, which floats on the surface of the water). As it can grow from root of the root of parent hyacinth, it covered almost thirty percent of surface within four months. We will think that at end of the day it is a plant, how it's going to affect us. But, as it covers the water surface it is difficult to mix oxygen which may be harmful for aquatic animals. Also sunlight will not penetrate through it, that's why we thought it is not only essential, but also very important to remove the floating bodies from the surface of water.

1.4 MOTIVATION

After referring a document on Ganga River called "India's Dying Mother" from BBC News, we come to know that the Holy River is polluted in greater extent. A remarkable statement by Swami Chidanand Saraswati "Before we take a bath in Ganga, we need to give Ganga a bath" is heart touching. And we had gone through some reasons which are:

1) Human waste

2) Industrial waste

3) Religious traditions like plenty of funeral activities took place on the bank of Ganga River, which contains flowers, ash , cloths and moreover unburned human bodies .That's why we have decided to clean floating waste on the surface of water.

1.5 AIM OF THE PROJECT

The project aims to design and develop bot , which collect floating waste on water surface of river and lake.

1.6 SCOPE AND OBJECTIVES

Study existing issues in waste collection systems.

Design and develop system to address the issues to solve.

Experiment and verify performance of system for its effectiveness.

1.7 TECHNICAL APPROACH

The fundamental thing that we should take care of is bot has to float easily and it will carry dead load up to the certain extent which is in the form of collected garbage. That's how we made a stable floating frame which is consist of two PVC pipes which were enclosed from both the ends by using end caps. Polymer sheet is mounted on the top of pipes so that garbage collecting trash can and electrical assembly can easily made fix. As polymer sheet is light in weight and can be easily bended, we have attached three wooden strips below the sheet for more stability.

Arrangement of conveyor belt is in such a way that its lower part should sink in water to collect the floating garbage. Horizontal strips were attached on upper surface of conveyor belt so that garbage can trap easily. Conveyor belt is drive by using hundred RPM DC motor.

For driving the conveyor, at the beginning we wanted to complete it by using two propellers for the sake of direction control. But from the basic testing we come to know that our required thrust can be obtained by using +one propeller which was drive on five hundred RPM DC motor, so we dropped the idea of using two propellers for direction control instead we adopted an idea of flap, which can be operated by using servo motor.

For speed optimization we have used pulse width modulation technique, through which we have set five different speed levels. If there is considerable gap in between bot and garbage, it should travel faster to minimize the required time. Also we have made an arrangement of reverse button for more effectiveness.

For controlling all of the operation on the robot we have used a AVR Atmega8 microcontroller .It is a 8 bit microcontroller which has one UART module and 3 PWM channels. This Microcontroller controls the Direction of propeller rotation and also the speed of propeller is controlled by providing the different PWM waveforms to the Motor Driver.

For the easy handling of the robot we have interfaced the robot with Bluetooth through the serial communication that is UART of the ATmega8 controller and we are controlling the robot with a mobile app available on the smart phone.

CHAPTER 2

INTRODUCTION

2.1 Block Diagram -

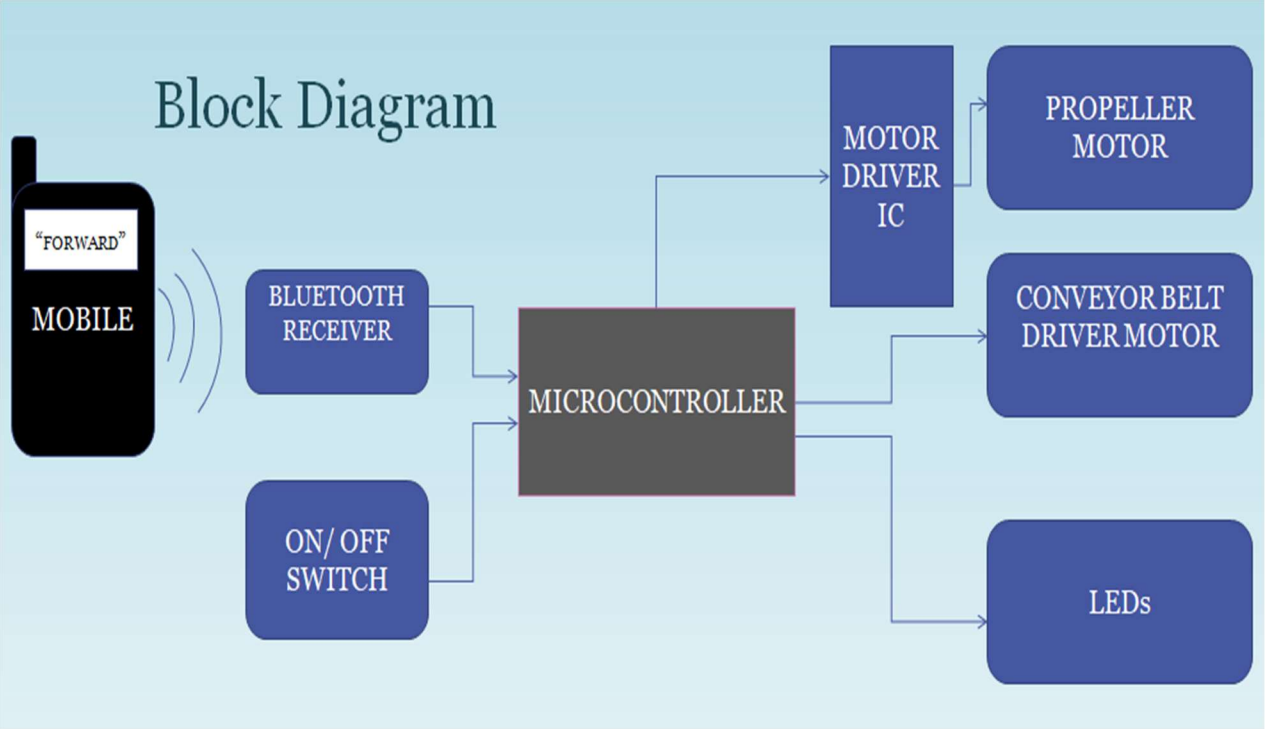


Figure 2.1, Block Diagram of the project.

2.2 BLOCKS AND THEIR EXPLAINATION-

2.2.1 MOBILE PHONE APP:

The prototype is controlled by an android application. This app is built on MIT APP INVENTOR site or else any other app can be downloaded and used for controlling the robot. This app sends an ASCII value of the clicked button, through Bluetooth communication. This app first need to be connected to the Bluetooth module connected to the microcontroller present on the robot. The application has forward, reverse, left, right, 1x, 2x, 3x, 4x and 5x buttons. The

GUI is user friendly and very easy to use.

2.2.2 BLUETOOTH RECEIVER:

HC-06 Bluetooth module is used in the prototype. This module receives the ASCII value of the button clicked and sends this data to the controller using Universal Synchronous Asynchronous Receiver Transmitter data communication protocol. USART is only two pin data communication protocol and is the simplest of all. The Bluetooth receiver has a range of 9 meters. Due to total wireless communication, the bot is more easy to operate within the range of operation.

2.2.3 MICROCONTROLLER:

The microcontroller used in the project is an AVR ATMega8 which is an 8-bit, RISC based controller. We used this controller due to its ease of use and just enough GPIOs. The propeller motor needed to be speed controlled. This is possible due to the PWM outputs of the controller. The controller has 1KB of static RAM and 8KB of flash memory. Some other specifications which we considered were, the controller has USART as well as SPI data communication protocol. The USART protocol is used for the data communication between the controller and Bluetooth module. This protocol has to be followed as the Bluetooth module HC-06 uses USART protocol only for the data communication. So, due to this reason we required to search for the controller which supports the USART protocol.

2.2.4 MOTOR DRIVER IC:

For bi-directional control of the motor, H-bridge is used which has two inputs form the controller and the controller sends either +5V or 0V to the bridge. According to the received inputs from the controller, the bridge is switched and current through the motor changes its direction. But, we needed to control the speed of the propeller motor also, due to this reason we preferred using L293D IC, which is a half- bridge motor driver IC with Enable pins also. The IC has 4 channels which can drive 2 motors bi-directionally. So we feed the PWM output to the enable pin 1 of the driver IC. This ensured proper operation of the propeller motor.

2.2.5 CONVEYOR MOTOR:

The conveyor motor used is a 12V DC motor, with 25 Kg cm torque. It rotates at 100 RPM. The conveyor belt has to be continuously rotated. The belt is coupled to the motor directly

so that no slipping takes place and the belt stays intact.

2.2.6 SERVO MOTOR:

To control the direction of the bot, we have used a flap which is coupled with servo motor. Whenever the user chooses to turn the bot, the flap changes form 0 degrees to 180

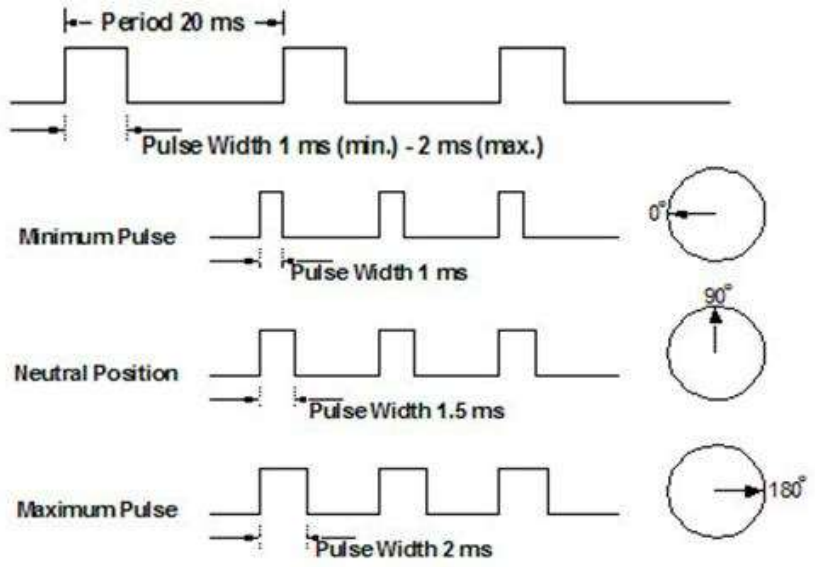


Fig 2.2, Servo motor controlling action

As shown in figure 2.2, when a PWM of 1ms pulse is produced at the GPIO, the servo is set at 0 degrees. When a PWM of 1.5ms pulse is produced, servo rotates at 90 degrees and 2ms pulse rotates the servo plus 90 degrees i.e. a total of 180 degrees.

2.2.7 PROPELLER MOTOR:

To give the bot directions, a 12V DC motor with speed of 500 RPM is used. The speed of the motor is controlled using the PWM output from the microcontroller. A propeller fan is driven by the motor through a belt drive, which is fixed to the frame of the bot. This fan is fully submerged in the water. The propeller is fixed to the body of the bot using a proper mechanical support.

CHAPTER 3

System Design

It includes mechanical design, Electronics (PCB etc.) design of the Robot

3.1 Mechanical Design:

- The Mechanical design was done step by step
- At First an approximate diagram of the idea of the robot, but carrying the necessary details was drawn on paper
- Then we had a discussion about how to practically realize the design.
- Different mechanical parts which were needed were identified such as conveyor belt, acrylic sheet,
  Wooden strips, PVC Pipes.
- The base of the bot was designed again considering it had to carry the weight of the assembly also it should have enough space on it to put the assembly.
- After Practical realization of base of the bot, according to the depth of sinking of PVC pipes in water,
  The height of the conveyor was designed and also the depth of propeller its size and shape and place

3.2 Electronics Design:

- It includes the PCB design of the robot along with the selection of electronics circuitry used on the robot such as motors
- The Motors were selected according to the required torque as well as the speed of the conveyor and the speed of propeller

- The motor driver circuit was selected according to the required characteristics such as PWM and direction control.
- Then the blue tooth module compatible with the Atmega8 microcontroller was selected and a through a compatible app it was interfaced with the atmega8 microcontroller

3.3 Microcontroller Selection:

The main requirements of the bot are PWM control and Bluetooth communication
We went through a number of IC like atmega8, atmega32,pic 18F4550,89C51,LPC2148
And then we thought that atmega8 which would be the best deal. It is a very cheap IC (comparable to others)
It has all the function that we require and designing a PCB for atmega8 IC will be comparatively easy than others.
And the size as well as number of pins on atmega8 IC is less as comparable to others.
The voltage required by that IC can be easily provided by single lipo batteries.

3.4 Motor Selection:

Conveyor Motor: As the conveyor was continuously moving and also its speed should be moderate so we had to use a motor with moderate speed and less power consumption as possible so as the battery would drain slowly
A 12 V dc motor was best option in this case as it has on load current (according to our load) of 500 mA and the RPM of 100.

3.5 Propeller Motor:

The propeller motor had to be fast smooth and also less power consuming as possible also it should be able to move the bot forward with one propeller. so we searched in the market and one 12v DC

motor with 500 RPM was the best deal it had on load current (according to our load) of 300 mA and 500 RPM so it gave good speed to the robot.

3.6 Conveyor material selection:

We searched some fabric shops all over the market and found one material which had better friction and it was light weight so it was used for the conveyor

3.7 Base selection:

for Base design 2 PVC pipes of 6 cm diameter were used and a acrylic sheet which was brought from a polymer pant in dhayri,Pune was used to form the base as it has very less weight and Moderate strength .also wooden strips were attached to the acrylic sheet from beneath to add more strength.

3.8 Motor Driver Selection:

Motor driver was used to drive the propeller motor. As requires maximum current of 500 mA under full load condition motor driver IC named L293D was used as it fits in the current specification

One more reason to select L293d IC is for the PWM compatibility.

Using PWM the propeller motor was given 5 different speed in both direction.

3.9 Servo Motor for Direction change Selection:

Tower Pro 996G servo motor which has high torque as well as it can run in 5 v hence it was selected

for the use

3.10 Propeller selection: Considering the weight of the robot the size of propeller was decided and a EDF blade of that size was bought from a electronics shop.

The couplings for the belt drive and the belt were bought taking in consideration the size of the shaft of the motor as well as the fan and also the depth of the propeller.

3.11 Bluetooth Module Selection:

A bluetooth module named HC-05 was selected because of its compatibility with the AVR atmega8 microcontroller and its ease of use

3.12 Calculations for Battery:

On load current of propeller motor = approx. 300 mA
On load current of conveyor Motor = approx. 500 mA
Microcontroller current = approx. 200 mA (including servo)
Total current requirement of the Robot = 1 A
Total life of battery required was 2 hrs

Hence battery with capacity 2200 mAH was selected

The conveyor belt is connected directly with the 12V battery as it runs continuously.

3.13 Baud rate calculation for USART:

$$Baud\ rate = \frac{fosc}{16(UBRR + 1)}$$

Hence, UBRR equals,

$$UBRR = \frac{fosc}{16Baud\ rate} - 1$$

We selected baud rate = 9600, as the Bluetooth communication module uses 9600 baud rate .

Hence, calculated value becomes,

$$UBRR = \frac{15MHz}{16 * 9600} - 1$$

So, UBRR comes out to be-

$$UBRR = 103$$

3.14 Algorithm of the program:

3.14.1 For Bluetooth Interface:

1. Start
2. Initialize the UART of the atmega8 microcontroller with 9600 BAUD rate and 8 bit frame rate.
3. Constantly poll for data received buffer
4. If data is received then compare with respective characters and then if the condition is satisfied take respective actions (reverse the direction, speed etc.)
5. Continuously poll for the new data received.
6. END

3.14.2 For Servo Motor:

1. Start
2. Give 1500 ms pulse continuously to get the servo at the Centre
3. If the UART receives respective signal then change the pulse duration to 1000ms or 2000ms respectively to change the direction of the servo motor.

3.12.3 For Propeller Motor

1. Start
2. Poll for receiver buffer data of the microcontroller continuously

3. If the respective ASCII value is received then change that specific parameter value in the port pin and keep it as it is until next change is requested.

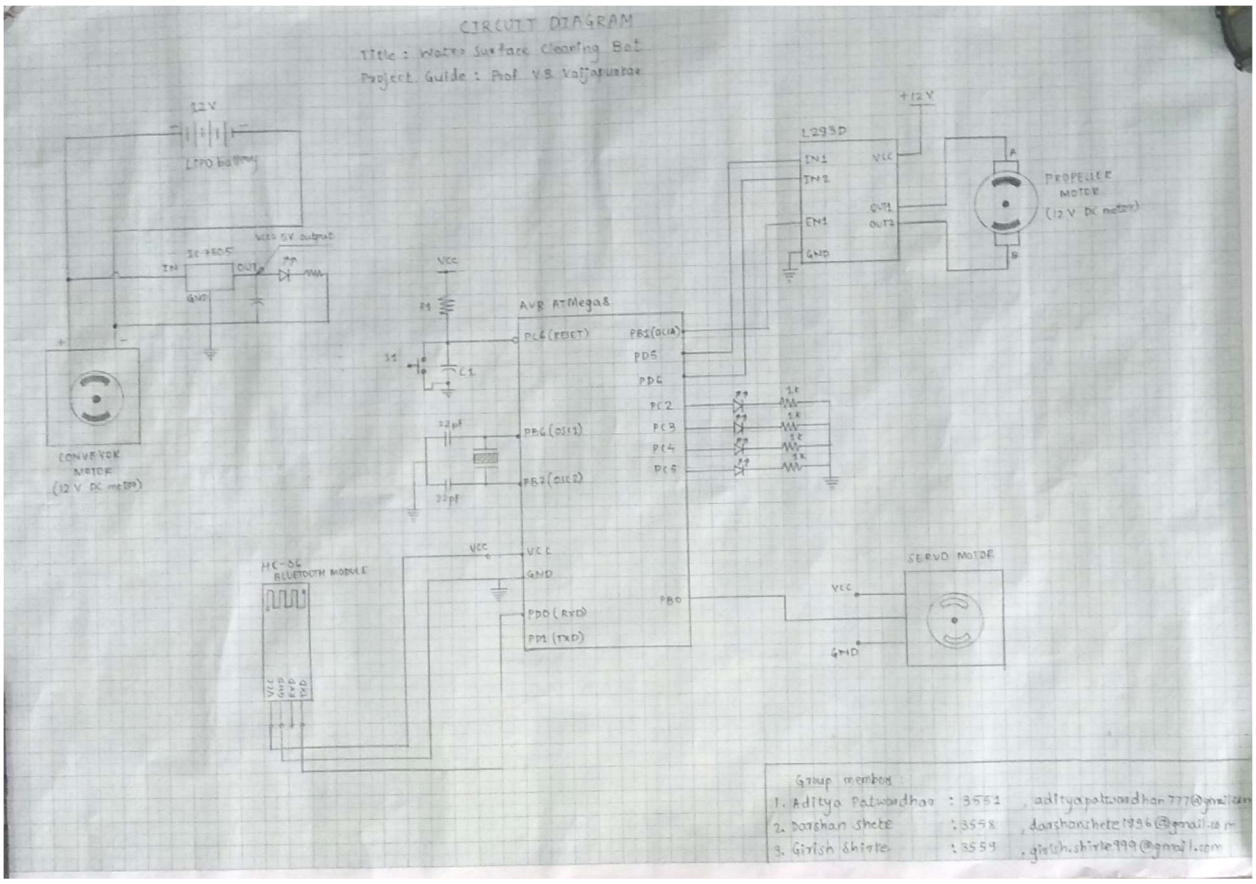


Fig.3.1 It shows an Interfacing Diagram of all the peripherals in the project

CHAPTER 4
Simulation of The Circuit

4.1 Motor driver simulation:

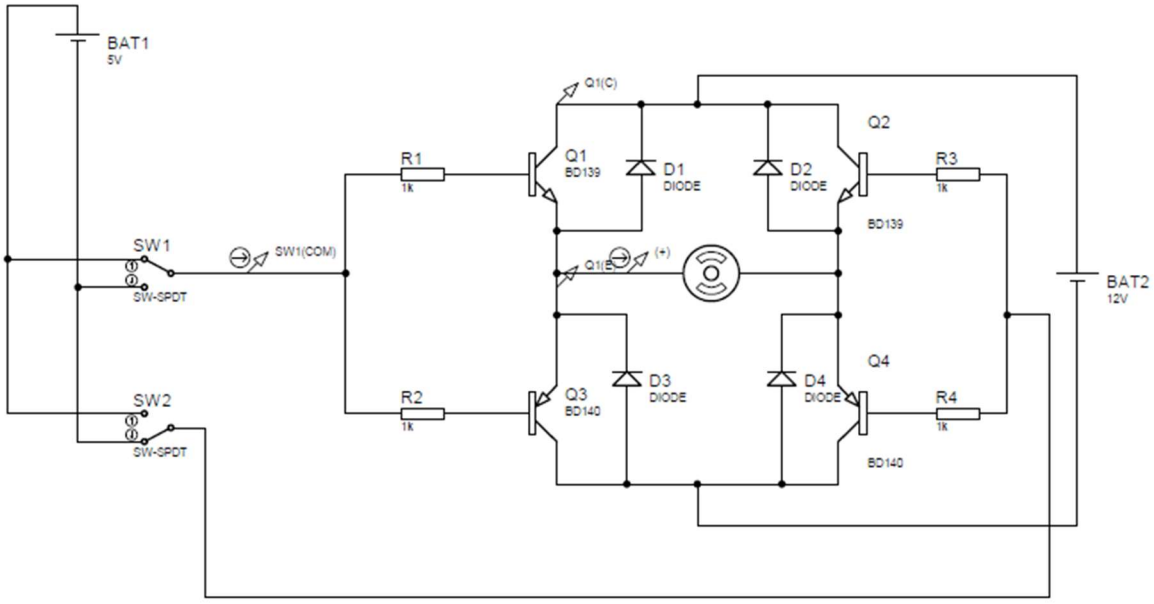


FIGURE 4.1: Motor driver Simulation on Proteus software

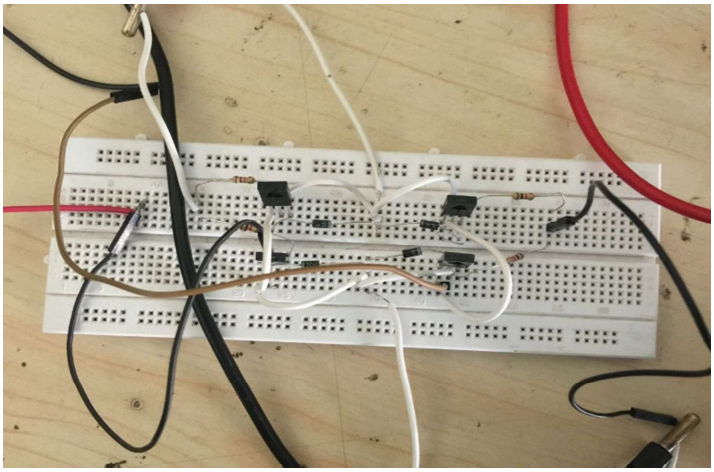


FIGURE 4.2: Mounting of the components on the Breadboard.

For simulation of the motor driver, we designed the circuit on Proteus as shown in fig 4.1, and the picture of actual implemented breadboard is shown in fig 4.2. We used Power transistors BD139 and BD140 to make a H-bridge circuit to drive the propeller motor.

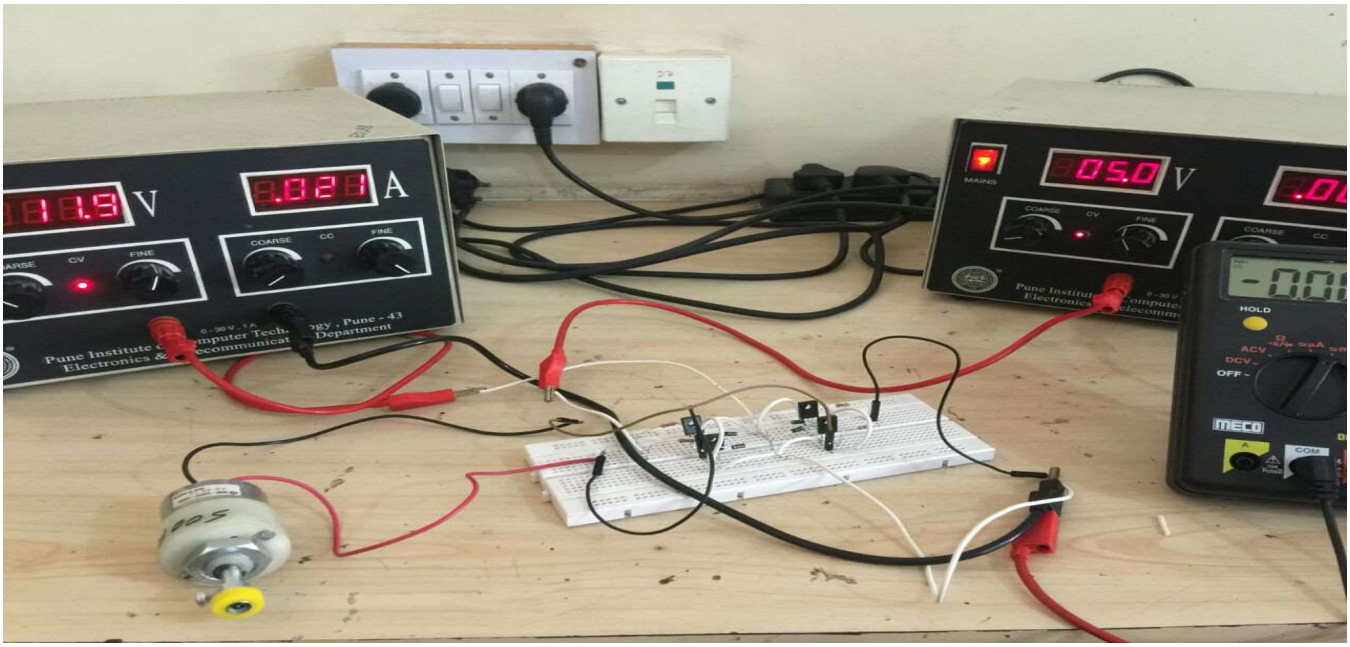
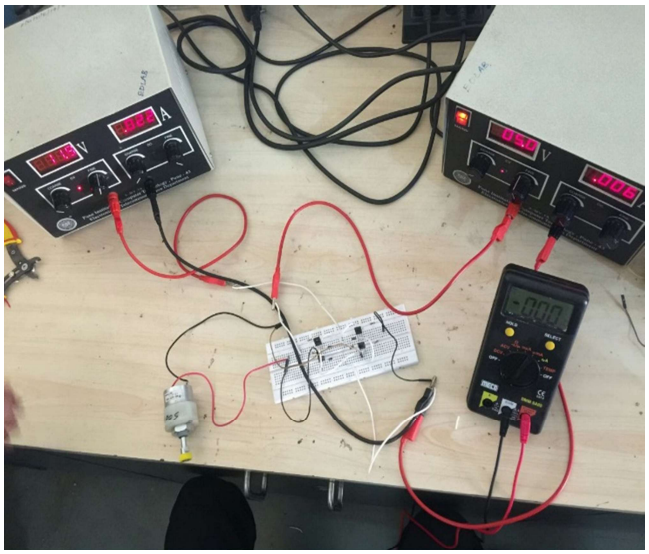
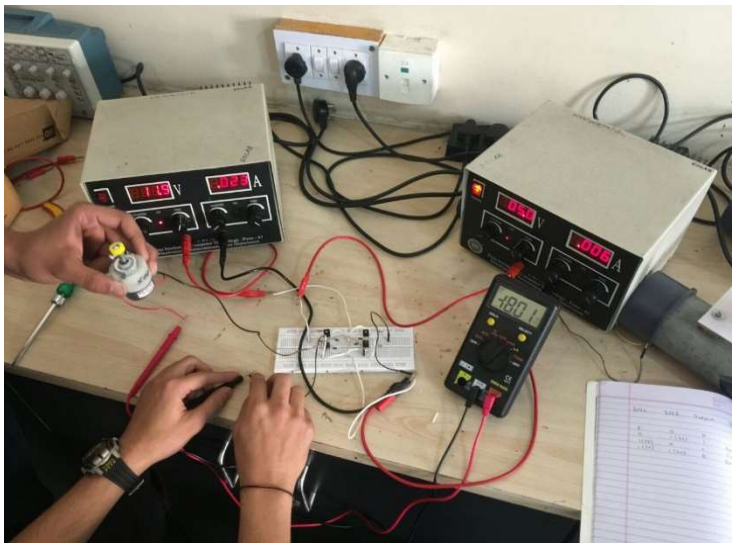


Fig 4.3 It shows working of Motor with the H Bridge Circuit and also the current through the circuit and voltage

FIGURE 4.4: Current and Voltage measurement of the circuit

4.2 PCB layout:





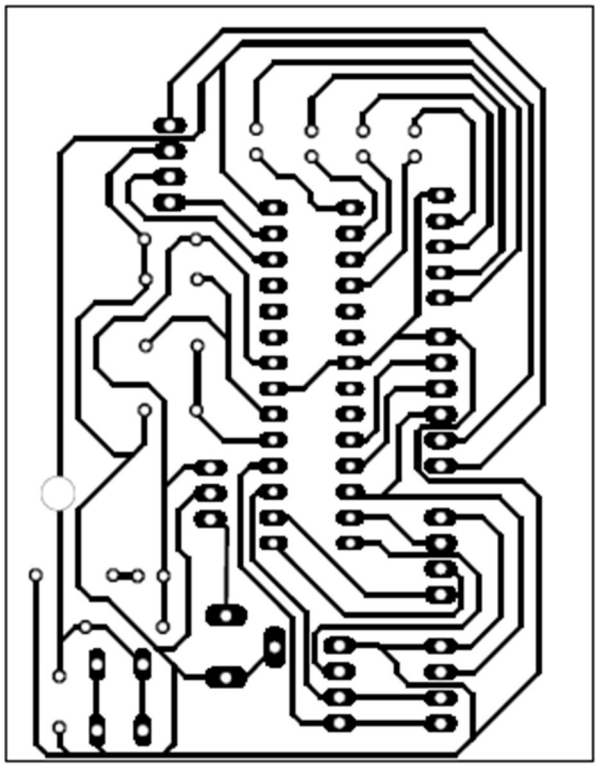


FIGURE 4.5: Complete layout on Eagle software

The above figure (fig 4.5) the layout of the controller board was designed on EAGLE PCB designing software. A free version of the software was used.

4.3 CHANGES IN THE MOTOR CONTROL CIRCUIT –

As decided earlier, we designed the motor driver using the H- bridge circuit. We implemented the circuit on breadboard and also noted the current and voltage readings at no load and at full load applied to the shaft of motor.

But, the problem which we faced when we tested the circuit was, the functioning of the circuit had no defects, but the speed of the propeller motor was too high for the robot. So, to reduce the speed of the bot, we decided to use PWM outputs available in the ATMega8 controller. Also, the motor driver which we implemented could not be used for PWM control of the motor. That is way we decided to use the L293D motor driver IC which has 4 channels, i.e. we can drive two DC motors bi-directionally. Also, if we give the PWM output of the controller to the enable pin of the driver IC, then the speed of the robot could be easy controlled.

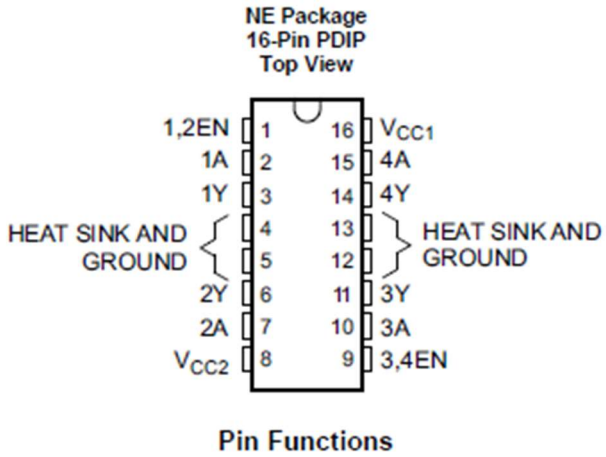


FIGURE 4.6: Pinout of L293D motor driver IC

CHAPTER 5

Results and Discussion

At First just the base of the robot was made using PVC pipes and acrylic sheet.

The bot floated on water just fine.

Then some dead weight of around 1.5 kg was put on the bot for testing and even then bot was floating above the expected level.

Then the electronics circuit was designed for the microcontroller as well as the Motor driver

After testing the motor driver circuit on breadboard the results we found were satisfactory and hence the PCB of microcontroller as well as the motor driver was printed.

After soldering of the components of the PCB it was found that the code was not getting dumped on the microcontroller. After hours of detailed inspection it was found that the fuse bits inside the microcontroller were of different value and hence IC was not readable. Then using an external hardware the fuse bits were changed and then the IC was working just fine

For Servo motor the main problem was the PWM channel. As the microcontroller only has one 16 bit timer and 2 8 bit timers and servo for smooth working need a 16 bit timer but it was used for the motor of the propeller hence conventional method of giving pulse to the servo was used

For conveyor the main problem was the slipping of the belt on the end rods it was solved by fixing the end rods to the shaft using a strong adhesive and thus conveyor was working well.

5.1 Software snapshots-

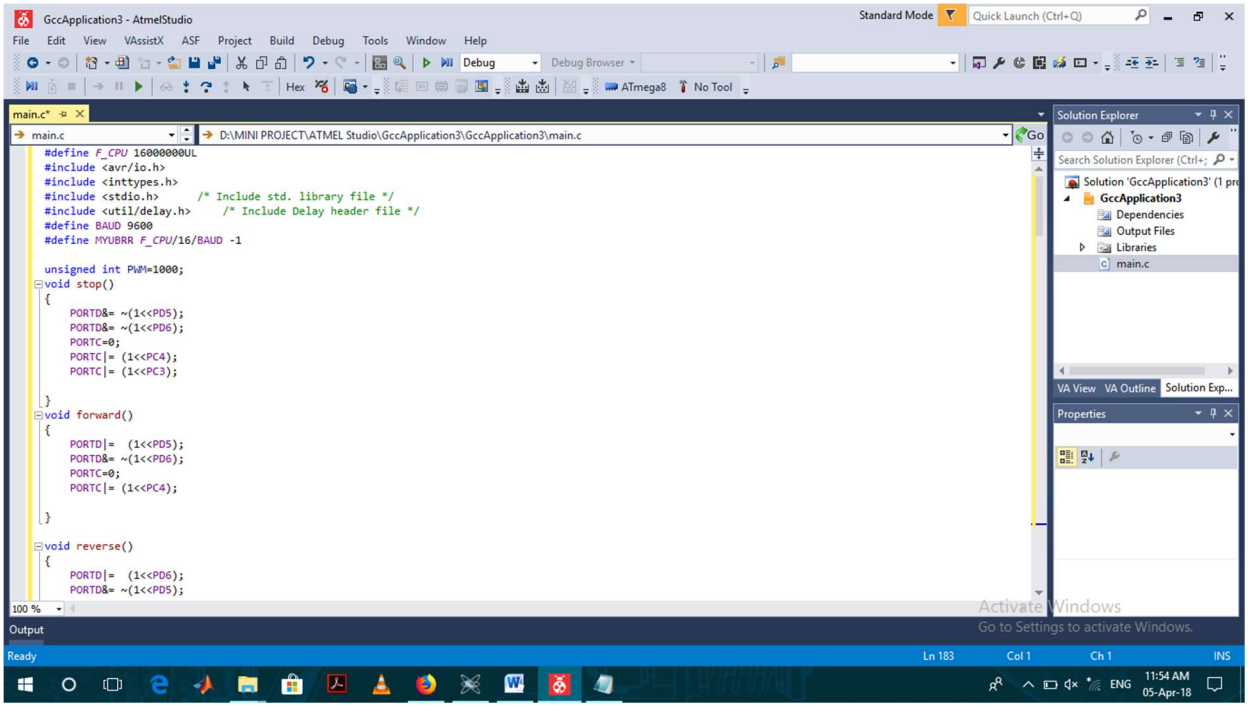


Figure 5.1: Eagle software snapshots

5.2 Snaps of the completed Project:

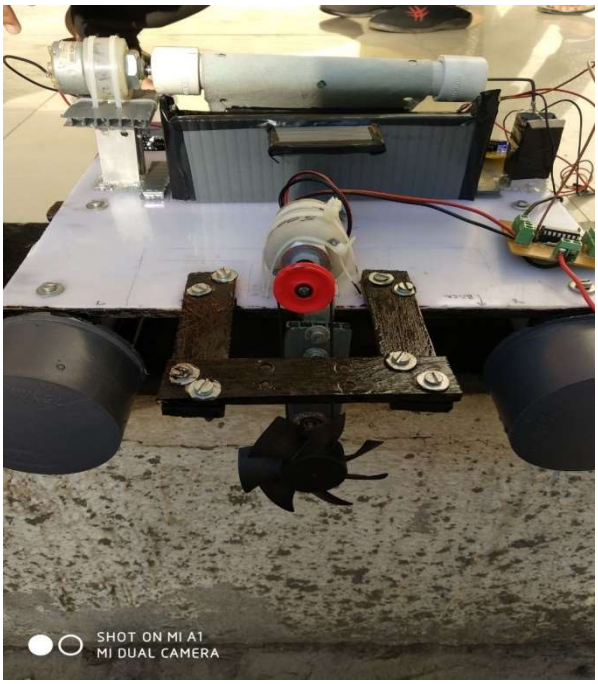


Figure 5.2: Project implementation- First version.

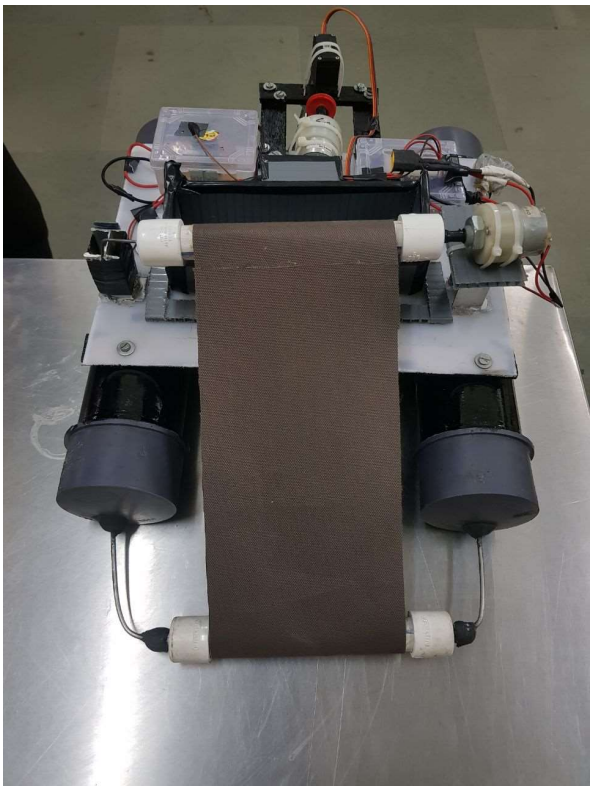


Figure 5.3: Project implementation- Second version

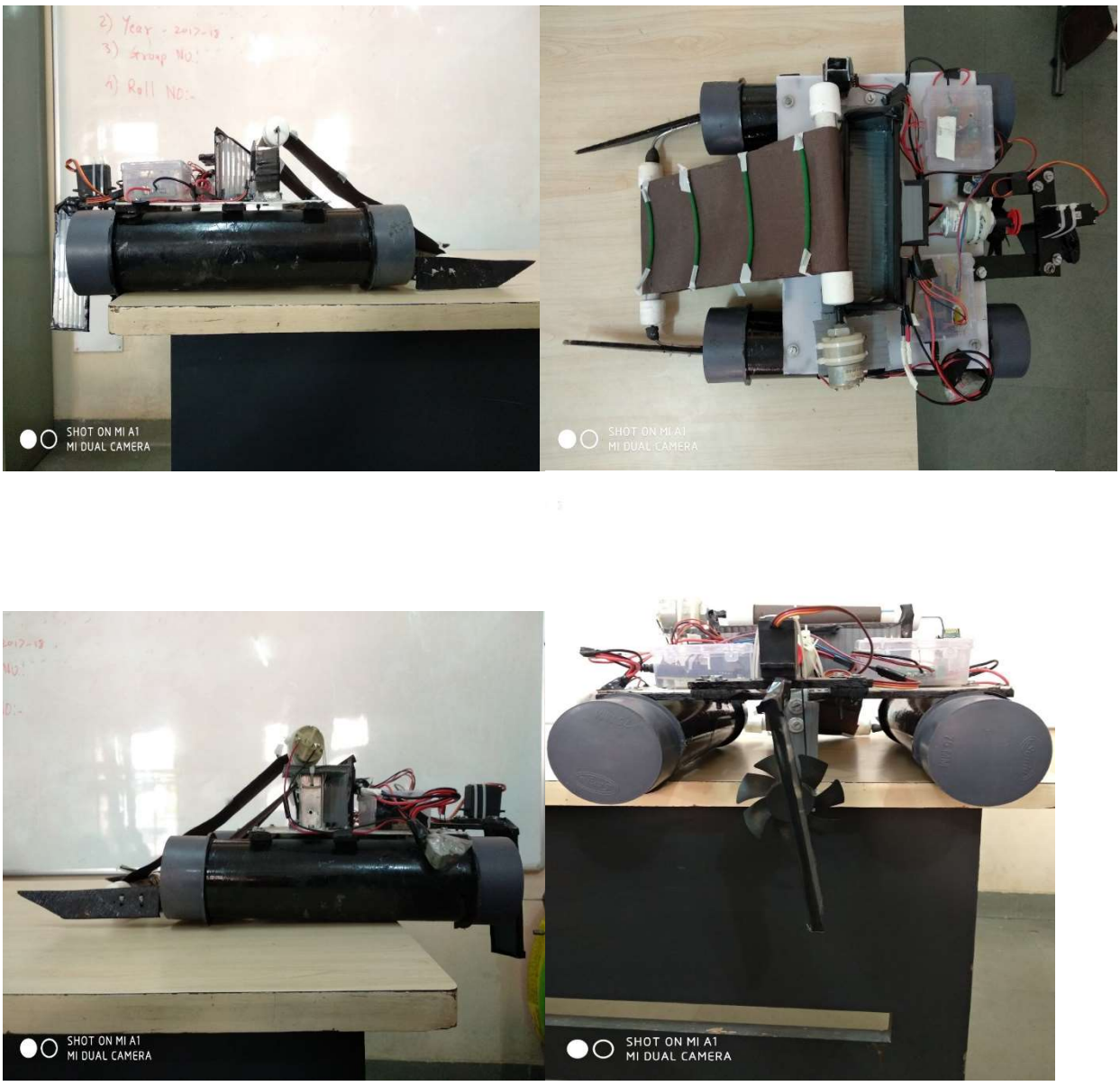


Figure 5.4: Project implementation- Third version

5.3 Achievements of the project-

- After the completion of the project, we were so impressed by our work, because we did not expect that this would actually shape into an impressive product. Thanks to our guide.
- We were selected in top 11 projects in IET's mini project competition held at Cummins Engineering College for Women.
- We were also shortlisted in top 5 mini-projects in PICT.

The proper results obtained from a collaboration of smart work and knowledge give our project an impressive and attractive results, also the outputs were more than expected.

Future Scope

Talking about some of the limitations of our project, due to the size of the robot, proper garbage collection is lagging. Another aspect which concerns us is the conveyor belt which we are thinking of changing and using a metal chain type.

As mentioned before, we are controlling the bot via Bluetooth signals. But even this requires an operator to keep a watch on bot and operate the bot. How about making the bot fully automated! Using 'Digital Image processing' technology, we can definitely achieve this. With the help of on system camera which will capture an image and send it to the controller, where the processing will take place and the exact location of garbage will be detected. The signals will then be sent to the actuators and the garbage will be collected.

After Living in a city , we see loads of Garbage floating on water the ost important future scope of this mini project will be to implement it on the large scale on lakes and stationary waterbodies to help clean the environment and make it a better place

The Future scope of the robot will be to make it completely automatic. We can use an Image sensor on the robot, and use the image processing using a high level processor and then the robot will automatically detect the garbage, go towards it and then process the images and find the location of garbage, go towards the garbage , automatically connect it and then come back to the base station in case if the tank is full or the battery level is going below a threshold or in case of any other failure

BILL OF MATERIALS

- **Mechanical Components-**

Sr. No.	List of the Components and Material used	Cost
1	DC motor 100 rpm	150
2	DC motor 500 rpm	150
3	Servo motor	300
4	PVC pipes (4")	60
5	End caps (4”) X4	80
6	PVC pipes (1")	20
7	End caps (1”) X4	40
8	Conveyor belt	80
9	Polymer sheet (1X1) ft	100
10	Spokes	20
11	Bond tite glue	40

- **Electronic components-**

Sr. No.	List of the Components and Material used	Cost
1	AVR ATMega8 controller IC	150
2	HC-06 Bluetooth module	220
3	Insulated multi-stand wires	120
4	L293D motor driver IC	60
5	PCB-Microcontroller and Motor driver	300
6	Microcontroller PCB components	80
8	Motor Driver PCB components	58
9	Soldering metal	100
10	Glue gun refill	20

Total amount = 1040 + 1108 = Rs 2108/-

References

[1] The Material for base was selected after visiting :

https://van.physics.illinois.edu/qa/listing.php?id=2154

[2] The Microcontroller was selected after comparing different families on this site :

https://www.elprocus.com/difference-between-avr-arm-8051-and-pic-microcontroller/

[3] Programming the controller:

https://www.electroschematics.com/AVR

[4] M.A.Mazidi, "The AVR microcontroller and Embedded coding"

[5] l293d Datasheet: http://www.ti.com/lit/ds/symlink/l293.pdf

[6] AVR Atmega8 Datasheet: *https://www.microchip.com/pdf/ATmega8*