Migrating Responsive Bin

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DECLARATION

I hereby declare that this thesis is based on the results found by myself. Materials of work found by other researcher are mentioned by reference. This Thesis, neither in whole nor in part, has been previously submitted for any degree.

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Abstract

It is an intelligent dustbin based on line follower. It can move along with the path in narrow space .This line follower based robot dustbin can contain certain amount of dust in it. It can be called via Bluetooth using android system in certain range. Nowadays lots android system is developing and the interactions between the robots and android system increasing rapidly. We implemented an android system for the better collaborations between users and the robot. It has a sonar device though which it can detect obstacles and hold that position for a while. The robot has another sonar sensor on top of the bin cover and we can simply move our hand over the sonar on top to open up the cover of the bin. By using the gear motors the robot can able to move faster via following the line. It's very simple and easy to use. This device is cost effective, efficient in using power and user friendly enough to make our daily household works easier.

Keywords: Intelligent dustbin, Obstacles detects, Android, Line follower, Gear motor, robot-user collaboration

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Chapter: 1

Introduction

1.1 Motivation

Lots of integrated circuits few operating systems are updating, besides the interaction between the integrated circuits and these OS are evolving day by day. New ideas are updating and new technologies are implementing; Android and Arduino are one of them. We can't think a day without having android applications, in everywhere there is a basic need starting from utilities to games android became part of our lives. Another interesting is Arduino is developing microprocessor and the combinations of android and Arduino circuit boards are creating the new evolutions for the robotics industries. In robotics, IR sensor is used for detecting the color objects, although it works by using a specific light sensor to detect a select light wavelength in the Infra-Red spectrum. Ultrasonic or sonar sensor is used for detecting the range between indoor and outdoor objects. Ultrasonic or sonar sensors generate high frequency sound waves and estimate the echo which is acknowledged back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object. Sonar sensor has many implementations as like obstacles detections, mapping and navigations and one of the most best implementation is as object identifiers. In our paper, we have discussed about a path finder robot with the obstacle detections, the robot can be used for home or business applications. We have inspired about this project from the Google car and Audi automated car.

We already had seen how a car could drive from one place to another place, when a car needs to stop and how. Nowadays many cars have many features are being installed and developing; autonomous is one of the biggest challenge features which is self-drivable as like human does, follow the way, and better interactions with human.

1.2 Project Overview

The main objective of building this robot is to collect garbage or dust materials from any defined place. As this project could be used in home and business purpose so, there will be some defined areas from where it will collect the garbage and take to a place for unloading these. The whole report is planned in such where every information is discussed in detailed about to build this robot and can be controlled via android devices which can identifies any object causes as obstacles using the sonar sensor and can move one place to another by following the defined path. In this project we have used 2 sonar sensors one is used for detecting any obstacles objects and another is used to open the bin cover. This report is divided into three parts Mechanical, Electrical and Software. On the part one we have discussed about the instrument that we used for building the body, wheels and motors, how we have reassembled. Second part we have discussed in detailed about the electrical parts like UNO, MEGA, motor driver shield and different sensors including how we have implemented the connections among the all parts. On the third part we have deliberated how we have executed the software and the collaborations of Android and Arduino. At the end of this paper we have discussed about the results, limitation and the future evolutions of this project.

Chapter: 2
Background Analysis

2.1 Background study

Nowadays lots of industries using many types of robots and each robot have its own purposes. Some robots can move one place to another which follows a path. At the beginning running a robot with an unknown path was too difficult then researchers have introduced with a name path finder. A path finder robot is basically a robot designed to follow a line or path which is already predefined and predetermined by the user. The path is as simple as a white or black colored line on the floor.

There are many researches about the path finding robots one of these researches also mentioned about path finding robot is used as waiter-service; idea of learning and this idea is used to navigate through an obstacle free path from a starting position to a known goal position on the unknown environment [7].

Another path finder robot is also designed with the RFID based application which stems from no explicit requirements and aims for user group to reach the target within a no familiar or totally unknown campus area without taking any help outside [8].

For some of the path finder used multi sensors to fulfill its main objectives. In our project we have implemented multi sensors for committing multiple works [9]. For finding the path and following it we have used the IR sensor via which detects the black line on white surface with

high contrasted color [1]. The one of the important sensor that we used is obstacles sensor for the predefined and predetermined path.

Basically while following a path face many kinds of obstacles; to avoid or maneuver these we need either image processing which can detect the objects via images or sonic sensors which can detect the range between the objects and the robot itself [10].

According to the statistics it shows that nowadays many robots are using not only for industries but also useful for the small business like restaurant, offices, schools, airport and etc. places and household purposes. For the household robots uses are gradually increasing and by the end of the 2016 it will cross more than 15000 units.

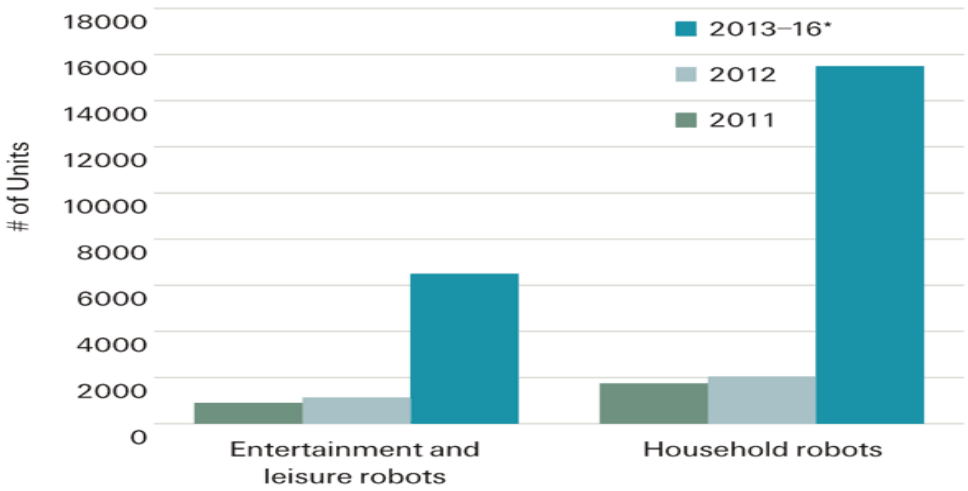

Figure 1: Statistics of household robots

2.2 Related Work

Most of industries are using robots for many purposes path finder is one of them. Especially car industries and tech industries are using the path finding robot to complete the mass amount of works. Recently household robots are being built to serve as business or home applications as like waiter service. Many cars are building with the path finding ideas which can be self-drivable as like Google car, Audi car and Tesla car, the idea that outcome finding the path and follow the path until it reaches its own goal. Nowadays path finding robot is using in Mars operations as to survey the environment on Mars. Several models have been introduced based on a change of techniques along with some limitation with each.

2.3 Research Methodology

This research is basically aimed for implementing the household or business applications robots that is capable to serve any known areas. It can identifies tables, can detect obstacles objects on its own path. It can also detect the hand motion via which user can through any garbage object into the bin till bin cover is open. The whole thesis is done by using the Arduino IDE where path finder, obstacles detection and table detection is done and android application is built to call the bin near to a user table. To verify the completion of the project we have tested the sensors separately and combined with body for several times to evaluate and perfecting the more accuracy we had to change the body structure for several times.

Chapter: 3

System Design

3.1 Overview

The whole work is divided in to 3 major parts 1.Mechanical part, 2. Electrical part, 3.Software part on mechanical part we have deigned the body along Gear motors, sonar sensor and IR sensor. On electrical part we have implemented the Arduino Uno and Mega along with the Motor driver shield and Bluetooth device including the sensors. At the end on software part we have designed the algorithms by using the Arduino IDE and Android application for the user interfaces so user can communicate with the BIN via application. The system that we designed to handle 2 different works 1. Path finder design, 2. Bin control design.

NO.	MECHANICAL	ELECTRICAL	SOFTWARE
I	Body	Arduino Uno	Arduino IDE
II	Gear Motor	Arduino Mega	Android
III	Sonar sensor	Motor driver shield	
IV	IR Sensor	Bluetooth Device	

Fig 2: Implementation Overview

3.2 Block Diagram

User End

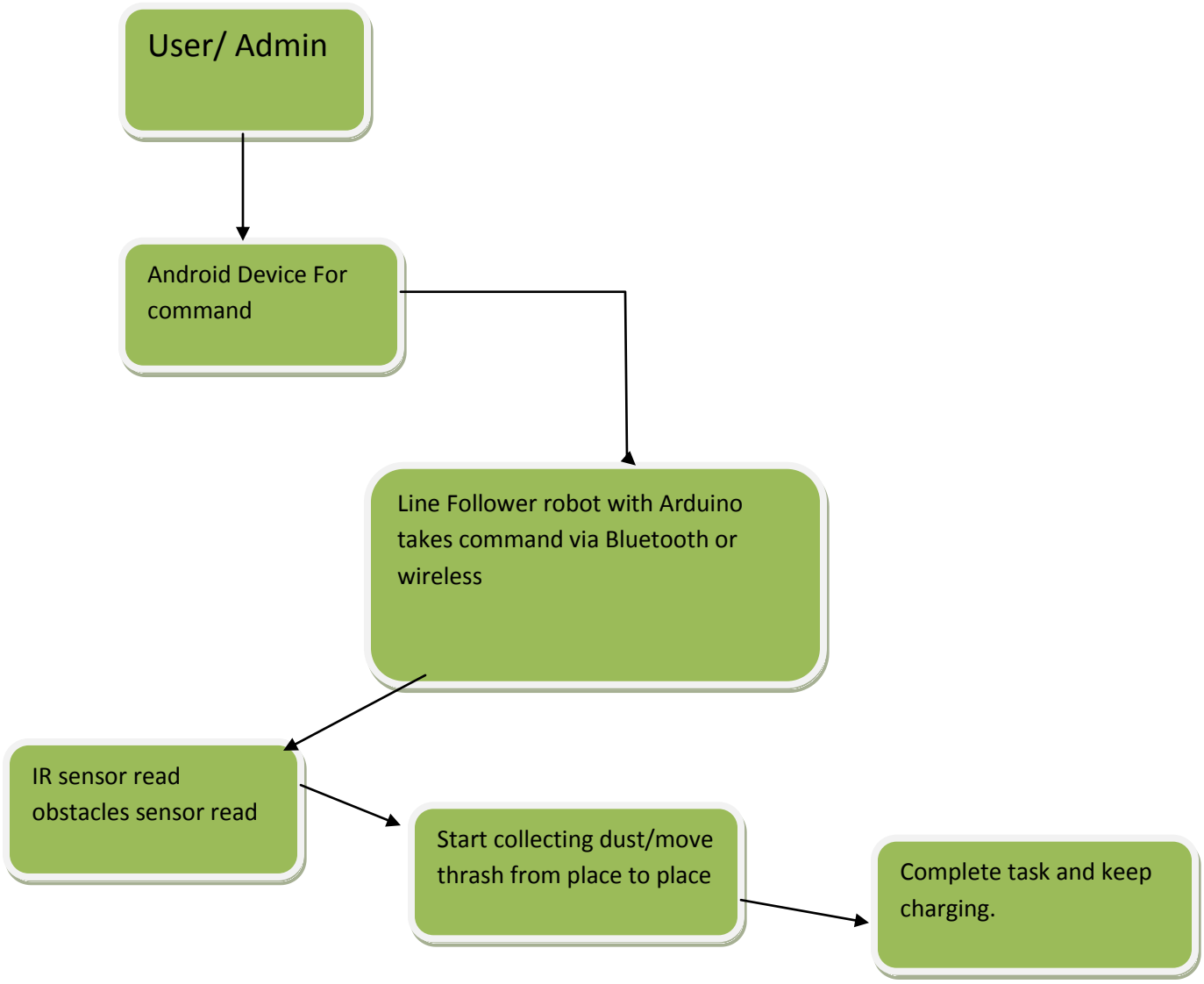

Fig 3: User Control

Hardware End

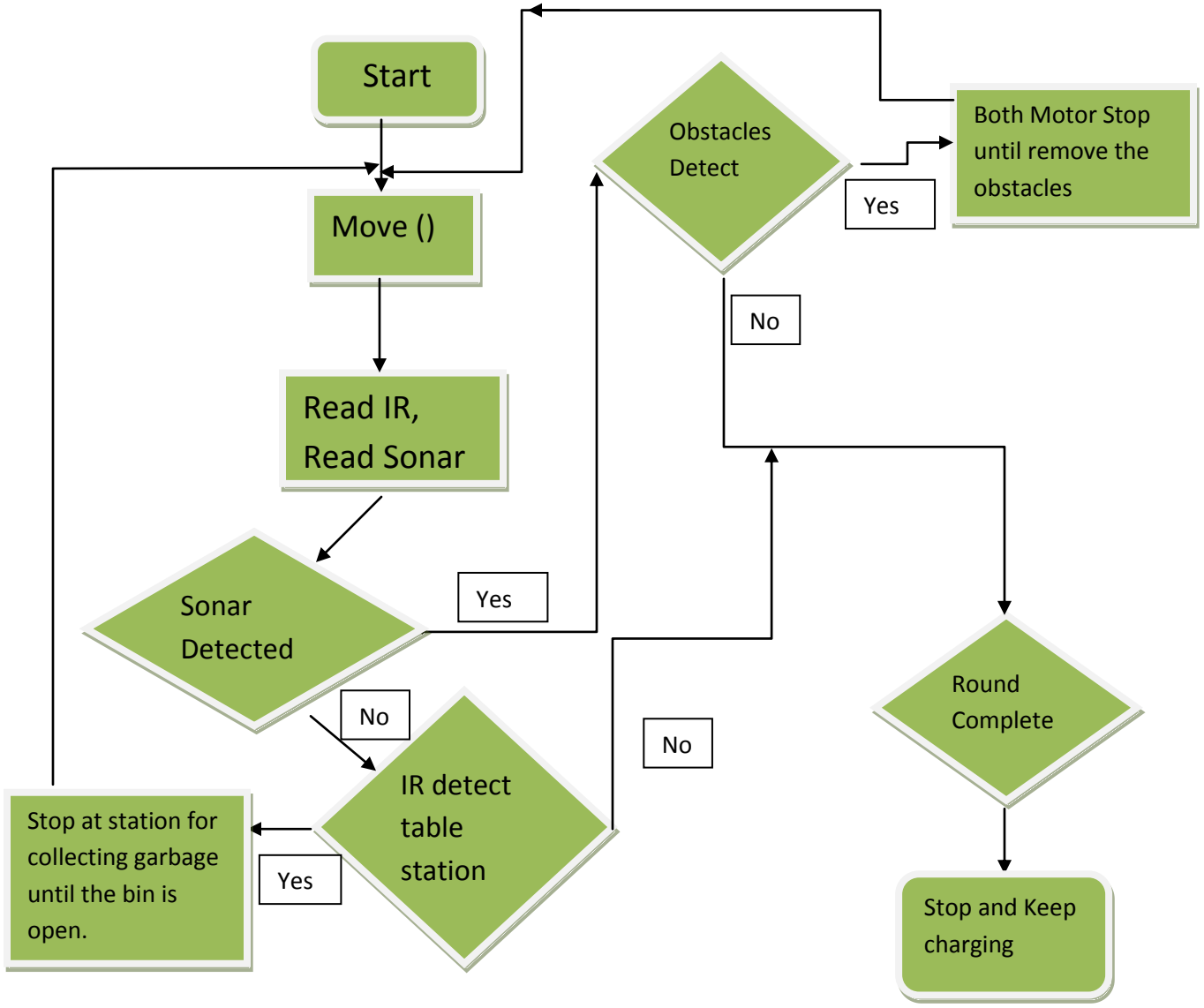

Fig 4: Hardware Control

Both user end and hardware end are connected via the android application with Bluetooth connection. By default when a user make a call from a table the Bluetooth connection look for the bin Bluetooth device to connect. After connecting the bin will locate the table by following its path; the bin will start to move forward, left or right by reading the IR sensor. On the path if there are any obstacles detected by sonar sensor the bin will stop and wait until the obstacle object moved from the path. As there are defined table, the bin will stop from which table are being called by the user, rest of the table location will be ignored. If the bin detects any motion of hand at the top sonar sensor, the bin cover will open for few seconds then user can through some garbage materials into the bin. After few seconds the bin cover will close and start to move; if the bin gets another call from another user it will respond to user as the same thing. After completing the task the bin will rest at its place and keep charging until gets any call.

3.3 Path Finder Control Design

Implementing the prototype is one of the biggest challenges in our project. There are many reasons why it is not easy to implement one of them is perfecting the structure, which helps the rest of the parts to hold. The second is to write the code and choose the appropriate pin for the sensors. We have divided the implementation on 2 parts first is Mega second is Uno.

On the first part we have used Arduino Mega along with the sonar sensor, IR sensor and motor driver shield l298p. IR sensor take the analog reading of black and white color for the path following and motor driver shield is connected with 2 motors which controls the motors movements according to sensing of the path. If full IR sensor detects any white line colored position, 2 motors will stop for few minutes. On the other hand if sonar sensor is used for detecting the obstacles and the distance between the obstacles and the moving objects. HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats or dolphins do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package from 2cm to 400 cm or 1" to 13 feet. If sonar sensor detects any obstacles within its ranges 2 motors will be stop until the obstacle is moved. HC05 Bluetooth module device is connected, so that user can call the bin to users table via android application. The most important benefits of using Bluetooth communication is easy to connect and can work on limited areas. Nowadays almost every cell phone has ability to communicate via Bluetooth communication and many computers have this technology.

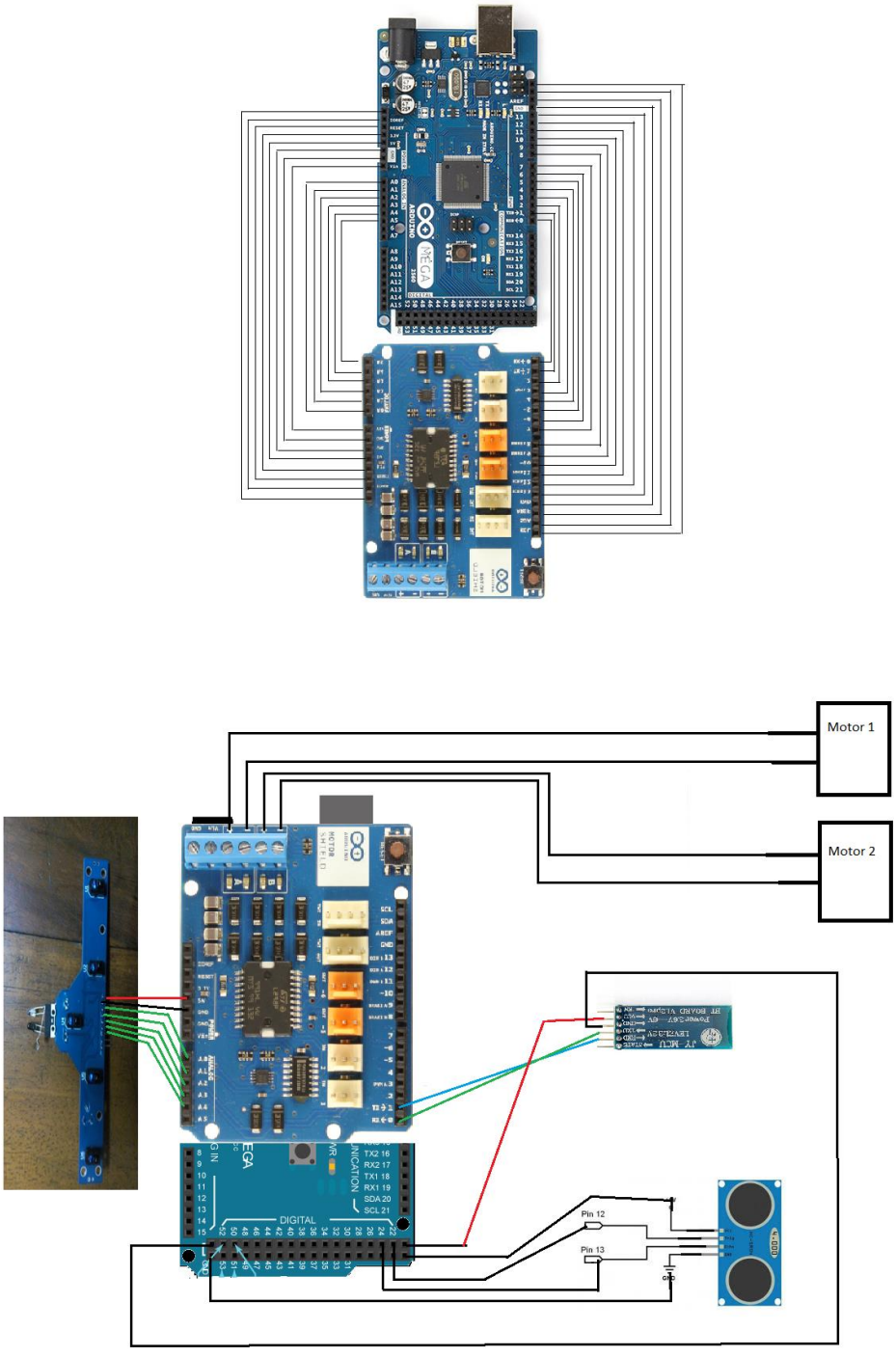

Figure 5: Arduino Mega setup

3.4 Bin Control Design

On this part, we have connected a sonar sensor and servo motor along with Uno. A bin cover is designed so that the servo motor can move the cover easily. The sonar sensor has been placed on the top of the bin for easy to use. It is the same kind of sonar sensor that we used in path finder design for obstacle detection, on here we are using as hand motion detection. We have used a servo motor for opening the bin cover, tower pro servo motor MG995 with metal brush is used which has less weight, can able to lift around 8 kg objects and easy to attach to body. The gear type is metal and motor is coreless. A bread board is used to take the 5V in parallel as we have the multiple devices to connect, provide the 5V on Vcc. After connecting all the devices the code has been uploaded to the Uno. The mechanism is designed like this when user put a hand near to the sonar sensor as like obstacles the cover of the bin will open. After 20-30 sec later the bin will close automatically.

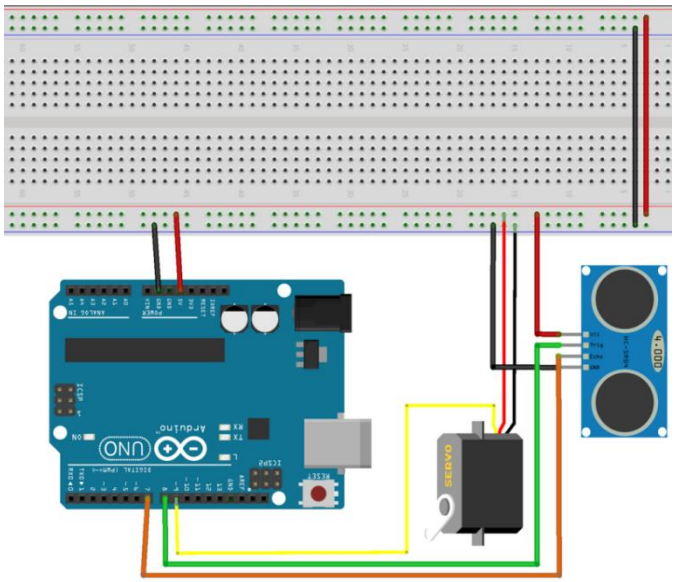

Figure 6: Arduino Uno setup

3.5 Prototype 1

We defined thesis scope and topic. We revised the topic, studied about its benefit and work horizon and then we selected one from many. Three of the group members started the research work. Meeting with the group member had been done on regular basis. We discussed and made the working plans and basic diagrams. Based on the blueprint we have done our first poster presentation and submitted a report including each and every detail. We have designed the 1st prototype with less efficiency. The prototype was made with 2 gear motors and 1 free wheel. The idea that came across of our mind with the 1st prototype is to provide service at restaurants, ground floor of hotels, office floors and university building areas types of places. Our best concern is to make the prototype suitable for the each table for which we had to concern about the height of tables so it will be much easier for the users to operate the machine by sitting on the chair.

Figure 7: Prototype 1

3.6 Prototype 2

Here we started coding program the devices and made a hardware structures. We bought all the equipment thought it was a troublesome job because the equipment are not available everywhere. We start working on line following basics with IR sensors. We had to change the sensor because it wasn't giving us the correct values. We changed few of the components. After implementing all the devices on 1st prototype we came across that it was not giving the perfect readings and not behaving as we wanted. Later we designed another prototype with 2 Gear motors and 2 free wheels. On 2nd prototype we have designed the main board circular shape and made lighter than the 1st one. We had maintained the total heights and change the main board height for the better implementing of IR sensor. With the 2nd prototype it will be much easier to move and can able to turn 360 degree more frequently. The distances of all the wheels are kept same and height of these wheels was maintained. With 2nd prototype our purpose was to make the BIN lighter, smaller and more responsive to the main objectives.

Figure 8: Prototype 2

3.7 Final Prototype

We had implemented everything on the 2nd prototype including tested and debugged the codes. We tested all the wheels wires running through the path and developed table detecting algorithms. We changed the mechanical structure a bit because of the weight and the height of the wheels. We used different surface for testing our project for the perfections and better performance. Our main problem was to run the line follower with better performances due to the weight. Later it worked after changing the few structures. For the opening the bin cover we had to use plastic wood with circular shape which can cover the bin.

After testing the robot we noted down the desired readings, checked the performances and update the few lines of codes due to the environment changes.

All the description in the paper we tested all the wheels wires running through the path and developed table detecting algorithm. We changed the mechanical structure a bit. We changed the opener of the bin. After testing the robot we noted down the desired readings.

Figure 9: Final prototype

Chapter: 4

Experiment Result & Analysis

4.1 Experimental Response

At first we have taken the individual test for each sensor, where all the sensors showed the perfect results. At the beginning the IR sensor took the reading of the black and white line analog readings, the two sonar sensors gave the reading of the distances of the obstacles. We have designed three algorithms for the path finder robot. Firstly we designed the algorithms which can follow the black and white line by reading the IR sensor. Later we designed the algorithm black line over white surface, where IR sensor read the black line to move forward. At the end we designed the algorithm white line over black surface where IR sensor read the white line to move forward and detect tables when full IR sensor detect big white line. Three algorithms are designed for testing the three different environments for the better performance. The sonar sensor is designed when any obstacles object detects around 10-20 cm. While testing on the different environment, the path finder gave different results of IR sensor.

For the bin controlling we have designed one algorithm which give the perfect results on every environment that we tested the path finder. The mechanism is designed like this when user moves a hand near to the sonar sensor as like obstacles the cover of the bin will open and after 20-30 sec later the bin will close automatically.

Figure 10: Path Following with Bin Cover opened & closed

4.2 Results & Analysis

No of Sensors	Sensors	Accuracy Checking		
		Test 1	Test 2	Test 3
1.	IR sensor	65% (didn't follow the line)	70% (detected the black line as expected)	82% (detected white marking station)
2.	Sonar sensor 1 (for object detect)	95% (object detected properly)	97% (object detected and stopped)	97.5% (object detected and stopped)
3.	Sonar sensor 2 (for opening bin)	60% (detected hand, didn't move properly)	95% (detected hand and moved as expected)	98% (detected hand and moved as expected)

Fig 11: Experiment Results

According to the analysis we have seen that all of our sensors giving the perfect reading. For perfecting behavior of the BIN we tested on 3 different environments. The 1st sonar sensor gave 97.5% accuracy which means it can able to detect any object that causes as obstacles to the path. The 2nd sonar sensor gave 98% accuracy which means it can able to detect any hand motion to open the bin cover. IR sensors gave the 82% accuracy; followed the line on three different environments and can successfully detect the white lines for tables. According to the analysis we have found that weight caused problems to our project like could not follow the path correctly, which is why we had to change the base structure three times and had to make our robot much lighter. It is best to use plastic trash bin rather than the steel based trash bin.

Chapter: 5

5.1 Conclusion

In its current form robot is enough capable that it can follow any curve and cycle. We must build a robot that has light weight and high speed because points are awarded based upon the distance covered and the speed of the overall robot. Therefore, we used two speed motors and high sensitivity sensors circuits. Before making this kind of project it is required to relocate the perfect resources and have best information about those parts. Though it has some limitations on physical and mechanical parts but the simple robot is more effective and profitable for people.

Implementing this project based on path finder can make our life easier. It can be modified and upgraded with new features and options regarding its usability. This product is economically cheaper. It's a step creating revolution implementing robots in our household needs and needs of other places.

5.2 Future Direction

In future we can incorporate the new features in our project. These features will enhance the usability of line following robot and enhance the angle of working sector. Through image processing system we can train our robot choosing the dust materials and finding best path to move and table detections. Therefore voice synchronization will make the machine more flexible which will help us to call the robot from a long distance and can able to communicate with robot via voice; it is almost like talking with your own robot. Wireless control will conquer distance and make it more efficient. In Future for recharging the battery it could be possibly to use the wireless battery charger. Moreover this system could be more useful for the large shopping mart, 5 star hotels, restaurants, airports and etc. in future we can implement this system on vacuum cleaner, autonomous waiter. Most importantly after complete the implementations for all these projects we can create and apply new learning algorithms for the autonomous car by taking command from user which can drive self.

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Appendix:

Body

Main mechanical part of our robot is an 8 liter, 2.5kg trash bin. There is a connecting base between the trash and the wheel. At the beginning of making the structure we put a rectangular shaped steel frame below the bin but after studying further we figured out to change the shape of the connecting base. Previously the shape was rectangular and it wastes much space. Then we revised the base and made it circle.

Figure 12: Body parts

The width of the wheel is 30mm and the diameter is 65mm. The diameter of the base is almost 310mm.We have used two free wheel as well in the robot base.

Gear Motor

We have used two gear motor models no DG01D-A130, its weight is around 9g. Its operating speed is 0.12sec for 60 degrees and operating voltage is around 4.2-6V. The temperature range is 0℃ - 55℃ and according to the small specification we have known that this motor is faster can shift 90^0-180^0 very quickly. It is very useful because it consumes lower current and gives high power density starting with low voltage. Without having any load the motor can provide around 200 rpm.

Figure 13: Gear motor

Servo Motor

We have used a servo motor for opening the bin cover. It was attached to outer upper part of the bin cover. It was tower pro servo motor MG995 with metal brush. It's very easy to use that's the reason behind using this one. It has less weight, can able to lift around 8 kg objects and easy to attach to body. The gear type is metal and motor is coreless. The operating voltage is 4.8V and takes 0.20 sec for 60^0 rotations. The range of the rotation is 0^0 -180^0 dual bearing rotation support and can complete a cycle in 20 ms. It has few specifications which are important to our project

.

Figure 14: Servo motor

Sonar Sensor

The HC-SR04 is used for detecting the obstacles and the distance between the obstacles and the moving objects. HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats or dolphins do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package from 2cm to 400 cm or 1" to 13 feet. It operation is not affected by sunlight or black material like sharp rangefinders are although acoustically soft materials like cloth can be difficult to detect. It comes complete with ultrasonic transmitter and receiver module. The operating voltage is 5V DC and working current is 15mA. It's measuring angle which 30 degree and the effectual angle is 15 degree. Sonar sensors generate high frequency sound waves and estimate the echo which is acknowledged back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object.

Figure 15: Sonar senor

IR Sensor

The line array sensor, specially designed for line tracer robots, with 5 IR sensors arranged on a single board easing your line tracing functionality. Sensitivity adjust potentiometers for each sensor, enables to tune them individually and gives digital output 1 and 0 after detecting respectively black and white color. The line is colored in black by following that color the robot will move one place to another. White color is used for the stop, turning right or left. Its supply input voltage is 5V and max current is 100mA. Each phototransistor is connected to a pull-up resistor to form a voltage divider that produces an analog voltage output between 0V and 5V as a function of the reflected IR. Lower output voltage is an indication of greater reflection. The outputs are all independent, but the LEDs are arranged in pairs to halve current consumption.

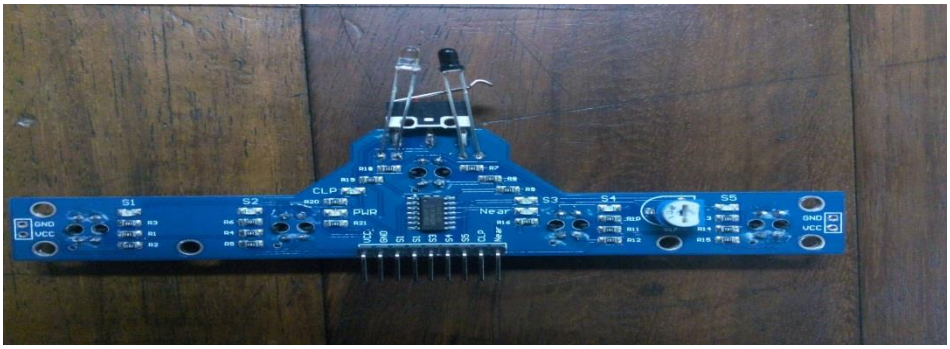

Figure 16: IR sensor

Arduino Mega 2560

Mega used for running the path follower robot via path detections including obstacles detect. It is ATmega2560 microcontroller with 54 Digital I/O Pins, 14 PWM outputs, 16 Analog Inputs, 256k Flash Memory, 16 MHz Clock Speed, a USB connection, a power jack 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 AC to DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila. An USB to serial converter is used which help us to take the reading from all sensors. Its input voltage is 7-12V and operating voltage is 5V.

Figure 17: Arduino mega

Arduino Uno

Uno is used for opening the bin cover via any kind of obstacles detection along with the sonar sensor. Arduino Uno is a microcontroller board based on the ATmega328 which has 14 digital I/O pins of which 6 can be used as PWM outputs, 6 analog inputs, 32 KB flash memory a 16 MHz ceramic resonator, a USB connection, a power jack and a reset button. Instead, it features the Atmega16U2 programmed as a USB to serial converter which helped us to take the readings of all sensors. Its input voltage is 7-12V and operating voltage is 5V. For adding multiple sensor we had to use bread board take 5V in parallel apply that into multiple sensor as in Vcc.

Figure 18: Arduino Uno

Motor Driver Shield

It is used for the running the gear motors and most projects at some point require mobility. This board allows for motor control with Arduino right away. Stack up this shield on controller and drive motors with higher power requirements. Depending on the motor of choice, can make it fast or handle a higher payload. This Arduino Compatible Motor Shield uses L298P chip which allow driving two 7-12V Gear motors with maximum 2A current. Speed control is achieved through conventional PWM which can be obtained from Arduino Mega PWM output Pin 5 and 6. The enable or disable function of the motor control is signaled by Arduino Mega Digital Pin 4 and 7. The Motor shield can be powered directly from Arduino Mega or from external power source. It is strongly encouraged to use external power supply to power the motor shield which helps the gear motor to have more power to run.

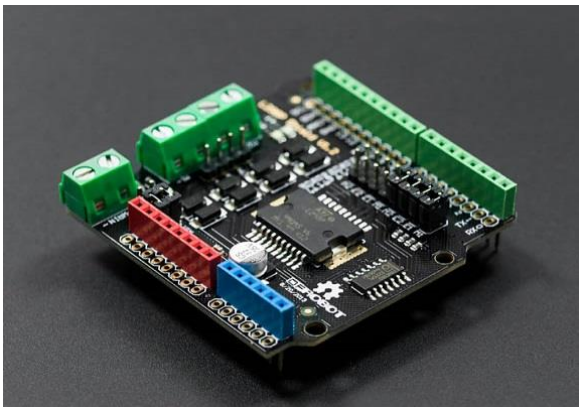

Figure 19: Motor driver shield

Bluetooth Module

It is the technology which helps us to communicate with the different devices via wireless communication; it is as simple as implement secure and simple in size including with low cost. Nowadays almost every cell phone has ability to communicate via Bluetooth communication and many computers have this technology. The most important benefits of using Bluetooth communication is easy to connect and can work on limited areas. On this project we have used the HC05 Bluetooth module and it is used to communicate between the user and the BIN. It is designed for transparent wireless serial connection setup and easy to use the Bluetooth serial port protocol module which is fully qualified 3mbps modulation with 2.4 GHz radio transceiver and baseband. It is also supported the Arduino 9600 baud rate. It uses CSR Blue core 04 External single chip Bluetooth systems with CMOS technology and with Adaptive Frequency Hopping Feature. To use this module user can able to call the bin via android or switching applications. The operating voltage is around 2.2V to 6V.

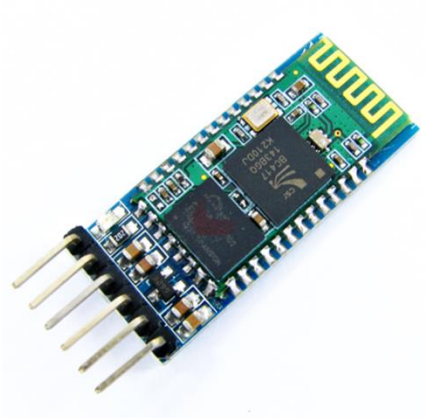

Figure 20: Bluetooth device

Arduino IDE

It is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board and a piece of IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. We had used this IDE for the programming the Arduino UNO and Arduino MEGA including with all kinds of sensors. The most advantage of using this IDE is to monitor the sensors readings while running the projects. All sensors reading could be taken separately and could able to change codes for the better performances. There are some important features like using the library, verifying the code, designs and uploading the code as many times as wanted. On this environment debugging and fixing those bugs are very much easier and the language is used a simplified version of C++, making it easier to learn to program.

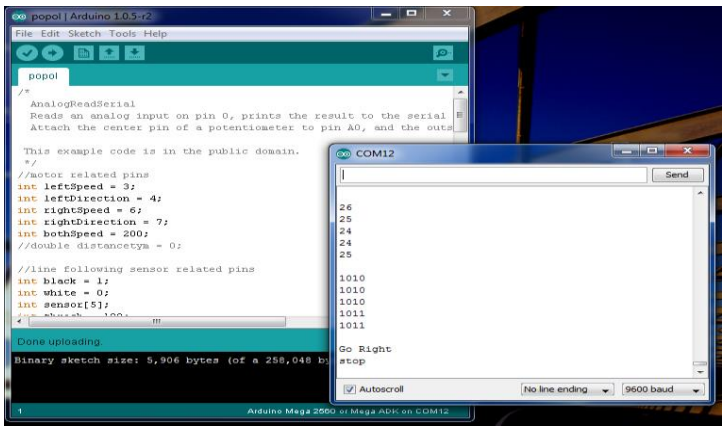

Figure 21: Arduino IDE

Android Application

An android application is designed to operate the whole system of line follower. It is mainly designed for the admin where admin can able to choose the option for the tables. It is programmed in eclipse in java platform which is easier to handle. The application will connect via Bluetooth with line follower HC-05 Bluetooth module just for providing the command of table numbers.

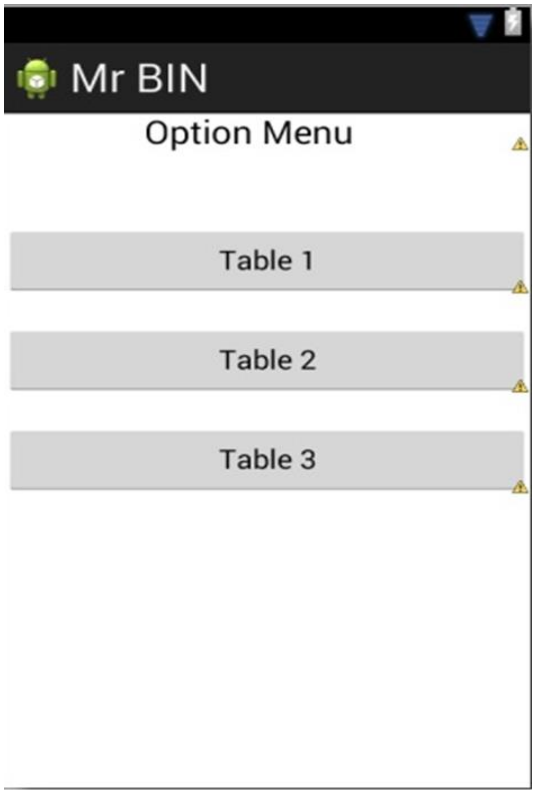

Figure 22: Mobile app UX

Code:

Mega:

```
int leftSpeed = 3;
int leftDirection = 4;
int rightSpeed = 6;
int rightDirection = 7;
int bothSpeed = 200;
double distancetym = 0;
//line following sensor related pins
int black = 1;
int white = 0;
int sensor[5];
int thresh = 25;
int URFOutputPin = 22; // TRIG (Green wire)11
int URFInputPin = 24;  // ECHO (Blue wire)12
double cm = 0;
// the setup routine runs once when you press reset:
void setup() {
  // initialize serial communication at 9600 bits per second:
  Serial.begin(9600);
  pinMode(URFInputPin, INPUT);
```

```
  pinMode(URFOutputPin, OUTPUT);
  pinMode(leftSpeed, OUTPUT);
  pinMode(rightSpeed, OUTPUT);
  pinMode(leftDirection, OUTPUT);
  pinMode(rightDirection, OUTPUT);
}
boolean sonarFound = false;
// the loop routine runs over and over again forever:
void loop() {
  // read the input on analog pin 0:
//  light();
    digitalWrite(URFOutputPin, LOW);
  delayMicroseconds(2);
  digitalWrite(URFOutputPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(URFOutputPin, LOW);
distancetym = pulseIn(URFInputPin, HIGH);
  cm = distancetym/58;
    if(cm>20)
{
  sensorRead();
  goForward();
}else
{
```

```
  Serial.println("stop");
  analogWrite(leftSpeed, 0);
  analogWrite(rightSpeed, 0);
  digitalWrite(leftDirection, LOW);
  digitalWrite(rightDirection, LOW);
}
Serial.print(cm);
Serial.println("CM");
delay(500);
}
void goForward()
{
     if (sensor [1] == 1 && sensor [2] == 1 && sensor [3] == 1) {
       Serial.println("Forward");
       analogWrite(leftSpeed, bothSpeed);
       analogWrite(rightSpeed, bothSpeed);
       digitalWrite(leftDirection, HIGH);
       digitalWrite(rightDirection, HIGH);
     }
     else if (sensor [1] == 0 )
     { goRight();
     }
     else if(sensor [3] == 0) {
       goLeft();
```

```
    }
    if (sensor [0] == 0 && sensor [1] == 0 && sensor [2] == 0 && sensor [3] == 0 && sensor
[4] == 0){
      tableDetection();
    }
}
void goRight()
{
  Serial.println("Go Right");
  analogWrite(leftSpeed, 0);
  analogWrite(rightSpeed, 255);
  digitalWrite(leftDirection, LOW);
  digitalWrite(rightDirection, HIGH);
}
void goLeft()
{
  Serial.println("Go Left");
  analogWrite(leftSpeed, 255);
  analogWrite(rightSpeed, 0);
  digitalWrite(leftDirection, HIGH);
  digitalWrite(rightDirection, LOW);
}
void tableDetection(){
  Serial.println("stop");
```

```
  analogWrite(leftSpeed, 0);
  analogWrite(rightSpeed, 0);
  digitalWrite(leftDirection, LOW);
  digitalWrite(rightDirection, LOW);
  delay(20000);
  analogWrite(leftSpeed, bothSpeed);
  analogWrite(rightSpeed, bothSpeed);
  digitalWrite(leftDirection, HIGH);
  digitalWrite(rightDirection, HIGH);
  }
void sensorRead()
{
  for (int i = 0; i < 5; i++)
  {
    if (analogRead(i) < thresh)
    {
      sensor[i] = black;
    } else {
      sensor[i] = white;
    }
    Serial.println(analogRead(i));
  }
}
```

Uno:

```
 #include <Servo.h>
Servo servoMain;
double distancetym = 0;
int URFOutputPin = 11; // TRIG (Brown wire)11
int URFInputPin = 12;  // ECHO (RED wire)12
//white wire to vcc and orange wire to gnd
double cm = 0;
  void setup() {
  // initialize serial communication at 9600 bits per second:
  Serial.begin(9600);
  pinMode(URFInputPin, INPUT);
  pinMode(URFOutputPin, OUTPUT);
  servoMain.attach(10); // servo on digital pin 10 orange wire to yellow wire
//  red to green wire at vcc and brown to dark blue to gnd
}
void loop() {
  // read the input on analog pin 0:
//  light();
  digitalWrite(URFOutputPin, LOW);
```

```
  delayMicroseconds(2);
  digitalWrite(URFOutputPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(URFOutputPin, LOW);
distancetym = pulseIn(URFInputPin, HIGH);
  cm = distancetym/58;
Serial.print(cm);
Serial.println("CM");
if(cm<20)
{
  servoMain.write(90);
   Serial.println("Opening the Bin");
   delay(5000);
}else
{
  servoMain.write(180);
   Serial.println("Closing the Bin");
}
 delay(500);
}
```