BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

EEE 318 (January 2023)

EEE 318 – Control Systems Laboratory

Final Project Report

Section: B1 Group: 06

Automatic Garbage Collection through Line Follower Robot

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Academic Honesty Statement:

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"In signing this statement, We hereby certify that the work on this project is our own and that we have not copied the work of any other students (past or present), and cited all relevant sources while completing this project. We understand that if we fail to honor this agreement, We will each receive a score of ZERO for this project and be subject to failure of this course."

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1 Abstract

The sensor based black line follower robots are one of the most basic robots used to follow black line on white background or vice versa. These robots may be used in various industrial and domestic applications such as to carry goods, floor cleaning, delivery services and transportation. In our project we will use a line follower robot to collect garbage so that

1. It can collect garbage quickly and efficiently.
2. It can be used to accomplish dedicated and repetitive actions with speed, precision and endurance.
3. It can control any overflow in the waste disposal areas.
4. It can be used to control pollution and disease.

We have used two types of sensors for detecting the black line and garbage/obstacle. One type of sensor is IR sensor which will sense the black path and rearrange its direction. Another one is ultrasonic sensor to detect garbage in front of the LFR so that it can collect the trash and carry it upto the destination. And all these sensing, following, collecting and carrying will be controlled by the programs installed by an Arduino. This is the basic principle of our project.

2 Introduction

There are so many challenges in designing a line follower robot for trash collection. We can divide the complexities as:

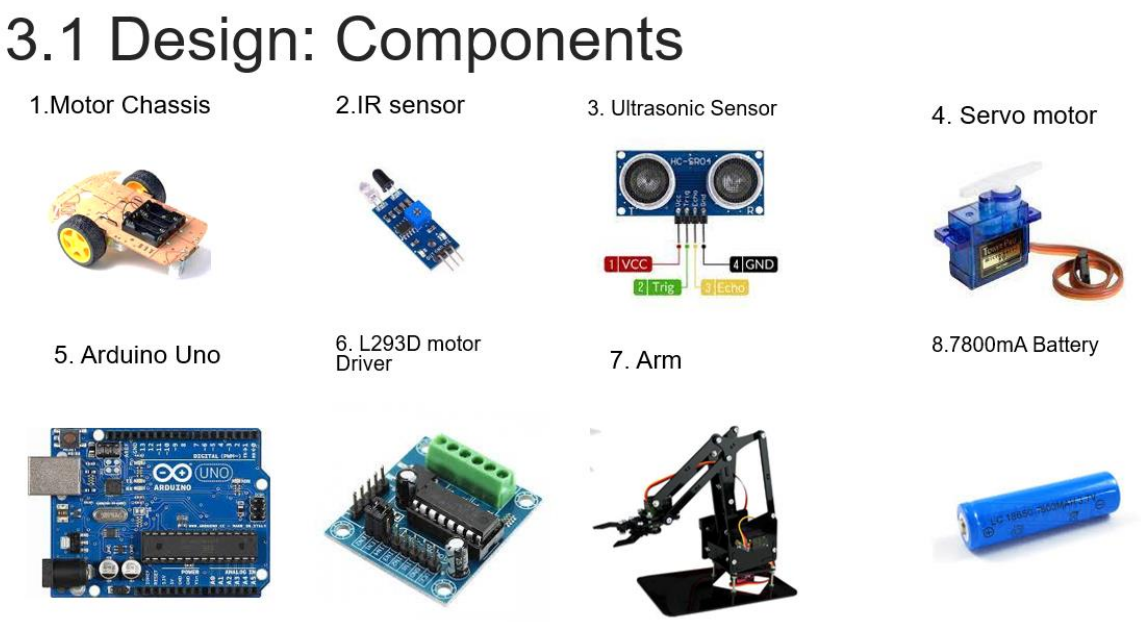
1.Sensing the accurate path and trash simultaneously
2.Developing a sensor circuit and convert the analog output to digital (ADC).
3.Designing a driver circuit to control the actuators.
4.Setting up the actuators (motor and wheel).
5.Assembling the chassis and body.
6.Making a central control unit (Arduino) as a processer.

Alternative solutions of different portions:

1.Metalic arm would have been better.
2.Image processing based garbage collection could be the best way.
3.PID controller on LFR would increase sustainability and reduce oscillation.
4.Arm design from scratch could be better.
5.Use of high voltage lipo battery could solve the problem of voltage fluctuation.

3 Design

3.1 Problem Formulation



3.1.1 Identification of Scope

Scope means goals, objectives, planning and opportunities that we will implement. So, here we write them elaborately.

Objectives:

1.To automize waste and trash management using a LFR.
2.To design and develop an idea for large scale implementation.

Plannings:

1.To design a line follower robot at first with IR sensor, motor driver, motor and actuator, chasis and body.
2. To design the arm with accurate degrees of freedom, motor, screw, code and instructions.
3. Assemble the arm setup with the LFR setting and check the performance and make necessary adjustments.

Opportunities:

1.Massive scopes to be used in factory and industry for waste management.
2. Huge opportunities in hospitals and clinics.
3. Automization and robotization of waste management can easily be implemented as a part of AI, VR and other revolutionary experiments.

3.1.2 Literature Review

Literature review means identifying the main points/objectives of any project and provide own thinking/idea/innovation/opinion adjacent to it.

Main objectives:

1.To automize waste and trash management using a LFR.
2.To design and develop an idea for large scale implementation.

Basics Plannings of these objectives:

1.To design a line follower robot at first with IR sensor, motor driver, motor and actuator, chasis and body.
2. To design the arm with accurate degrees of freedom, motor, screw, code and instructions.
3. Assemble the arm setup with the LFR setting and check the performance and make necessary adjustments.

Our own thoughts/opinions:

1.Designing the arm of the LFR from scratch and rebuilding can provide better actuation, control and movement.
2.Designning a PID controller for the LFR will decrease vibration, smooth the motion and increase sustainability.
3.Addition of image processing for garbage detection could be the best way for automatic trash collection.
4. More complex and sophisticated design with image processing-based garbage collection mechanism would not require any line for following to collect trash.

3.1.3 Formulation of Problem

Our problem can be divided into three major portions:

1.Designing the LFR without arm
2. Setting and operating the arm separately
3. Assemble the arm with the LFR and make them to work simultaneously

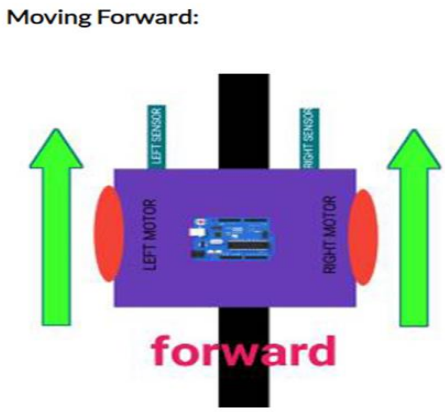
3.1.4 Analysis

1.IR sensors need to be calibrated frequently as they malfunction sometimes.
2.Ultrasonic sensors also fluctuate sometimes and show garbage results sometimes.
3.Use of two batteries as power supply could not drive all the servo motors connected to the arms. So, constant dc source with high current is been better.
4.The reference position, default position and variable position of arm control trash collection is done by calibrating the angles frequently and have been set to an optimum value.

3.2 Design Method

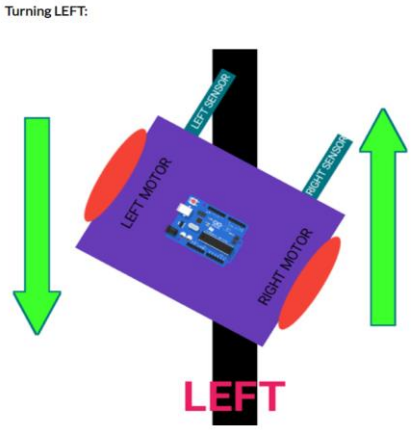
Design, Navigation and working of LFR:

Step 1: Forward motion



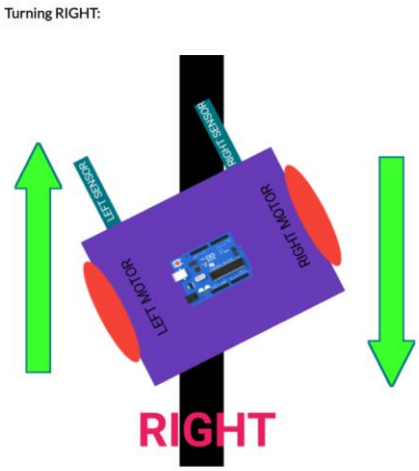
IRleft and IRright are the outputs of IR sensor.
When IRleft=IRright=LOW means both are sensing white lines then, both the motors will be turned on in the same or forward direction with predefined speed

Step 2: Left motion



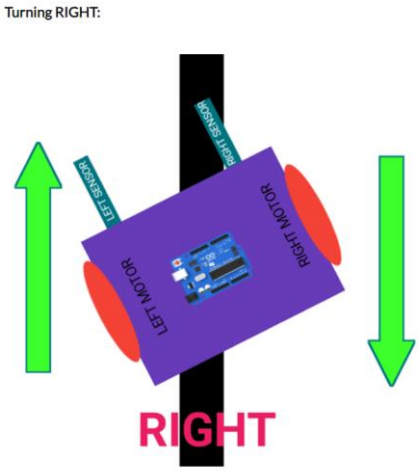
When IRleft=HIGH and IRright=LOW means left is sensing black and right is sensing white. So, left motor speed will be reversed and right motor speed will be forward. Thus, the LFR will turn left.

Step 3: Right motion



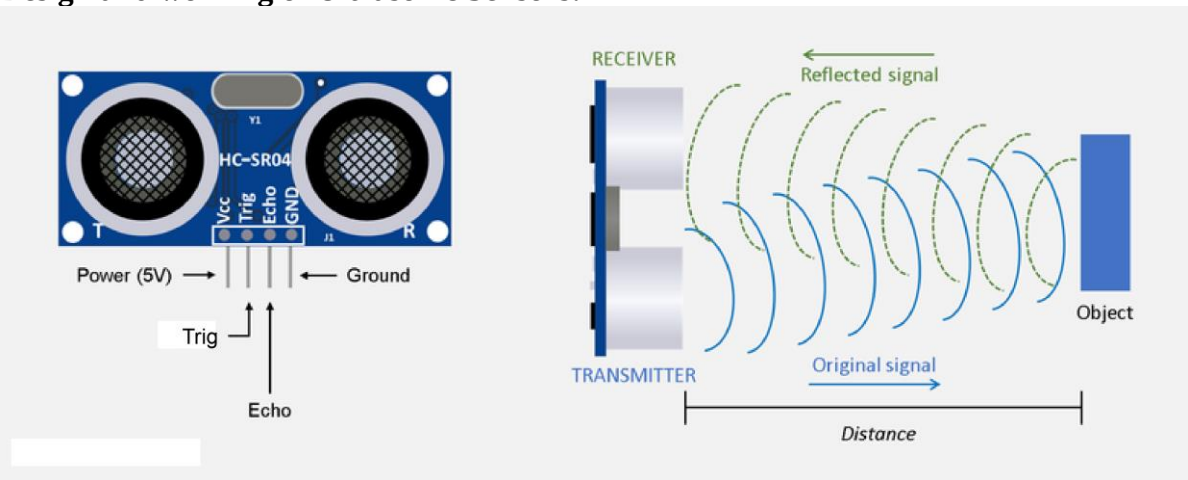
When IRleft=LOW and IRright=HIGH means left is sensing white and right is sensing black. So, right motor speed will be reversed and left motor speed will be forward. Thus, the LFR will turn right.

Step 4: Stop motion



When IRleft=IRright=HIGH means both are sensing black lines then, both the motors will be turned off in by assigning zero speed.

Design and working of Ultrasonic Sensors:



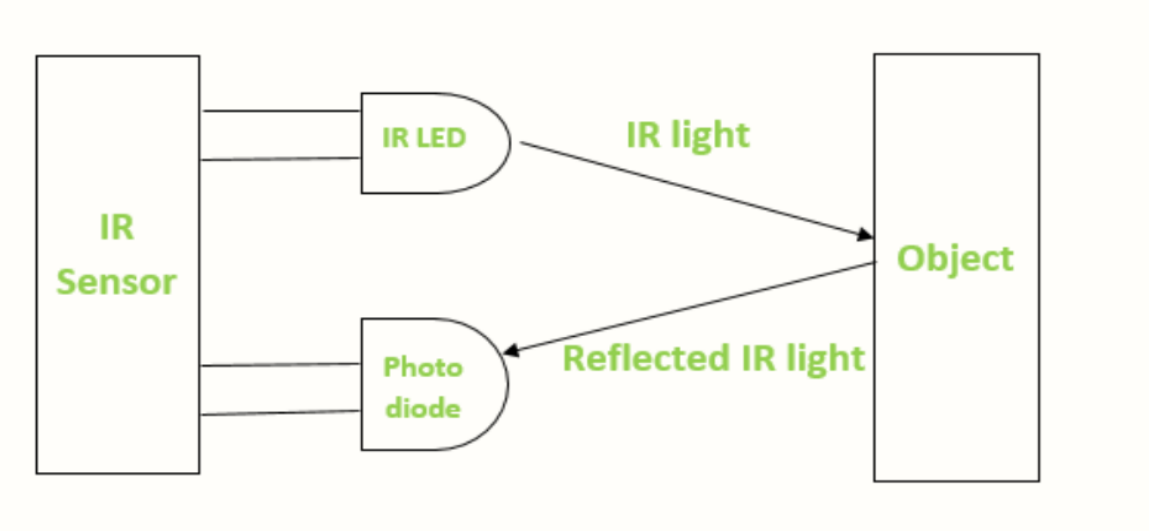
Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human

hearing. The transducer of the sensor acts as a microphone to receive (echo pin) and send the ultrasonic sound (trig pin). Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound.
The working principle of this module is simple. It sends an ultrasonic pulse out at 40kHz which travels through the air and if there is an obstacle or object, it will bounce back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated.
Equation of measuring distance=

```
distance = duration * 0.034 / 2;
```

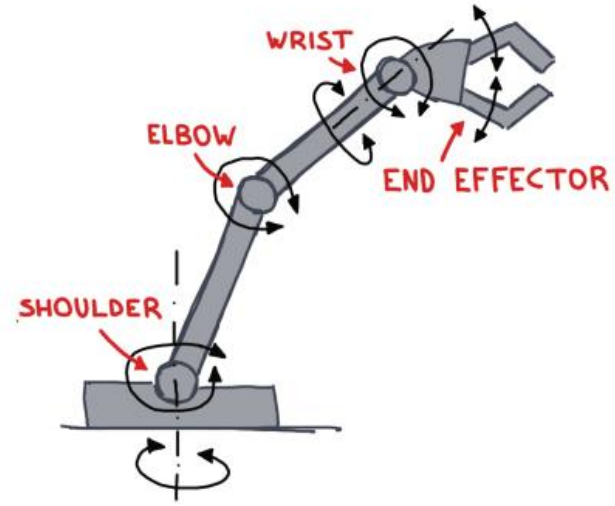
A threshold value of distance can be set by the Ultrasonic sensor for sensing garbage and collecting trash.

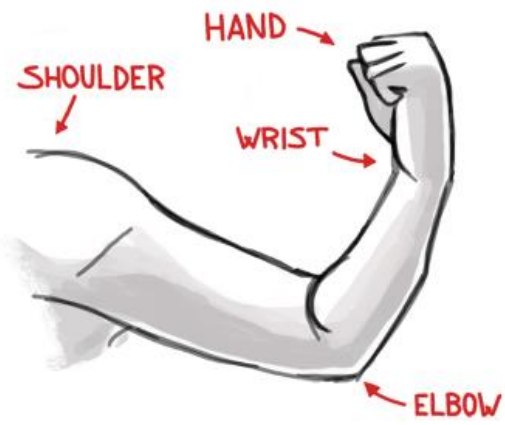
Design and working of IR Sensors:



IR sensor is an electronic device, that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations.
The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode. Photodiode is sensitive to IR light of the same wavelength which is emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

Design and working of Robotic Arm:
A basic picture of our designed robotic arm is given below:





Shoulder denotes Servo motor 1
Elbow denotes Servo motor 2
Wrist denotes Servo motor 3
Grip denotes Servo motor 4

Servo motor 1:
Servo motor 1 rotates the base of the platform. The reference angle, initial angle and the destination angle is set by continuous calibration.
The reference angle is set by motor connection. Initial angle is set to 90 degree by calibration. When an object is inside the threshold value of ultrasonic sensor, firstly Servo motor 1 goes from 90 degree to 0 degree.
After successful collection of trash, it will rotate from 0 degree to 180 degree so that it can put the trash in the basket behind.
Again, after successful trash placement, it goes back to it's initial position 90 degree.

Servo motor 2:
Servo motor 2 rotates the upper portion of the base. The reference angle, initial angle and the destination angle is set by continuous calibration.
The reference angle is set by motor connection. Initial angle is set to 70 degree by calibration. When Servo motor1 reaches from 90 to 0 degree, firstly Servo motor 2 goes from 70 degree to 130 degree to grab the object sensed. Servo motor 2 goes down if angle increases and it goes up if angle decreases.
After successful collection of trash, it will rotate from 130 degree to 70 degree so that it can help put the trash in the basket behind.

Servo motor 3:
Servo motor 3 rotates the upper portion of Servo motor 2. The reference angle, initial angle and the destination angle is set by continuous calibration.
The reference angle is set by motor connection. Initial angle is set to 100 degree by calibration. When Servo motor2 reaches from 70 to 130 degree, firstly Servo motor 3 goes from 100 degree to 170 degree to grab the object sensed. Servo motor 3 goes up if angle increases and it goes down if angle decreases.

After successful placement of trash, it will rotate from 170 degree to 100 degree so that it can help to reset the whole position.

Servo motor 4:

Servo motor 4 controls the fingers of the arm. The reference angle, initial angle and the destination angle is set by continuous calibration.

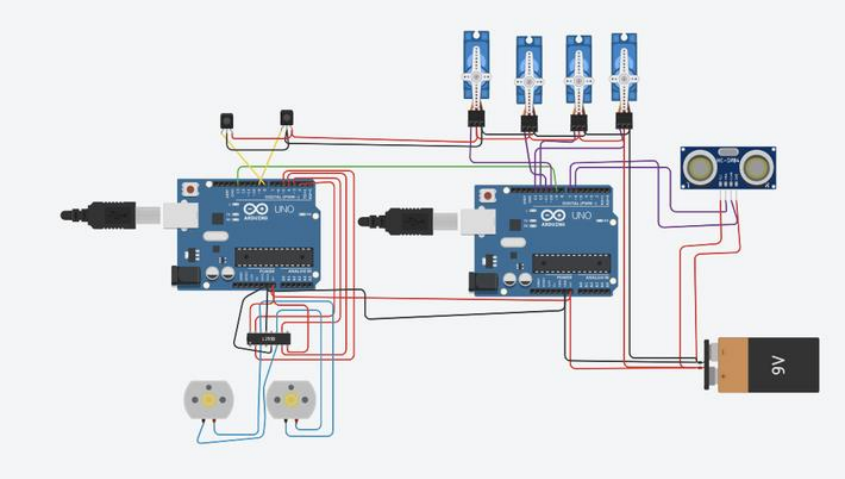
The reference angle is set by motor connection. Initial angle is set to 80 degree by calibration. When Servo motor4 reaches close to trash, firstly Servo motor 4 goes from 80 degree to 130 degree to grab the object sensed and closes the arm. Servo motor 4 closes grip if angle increases and it opens the grip if angle decreases.

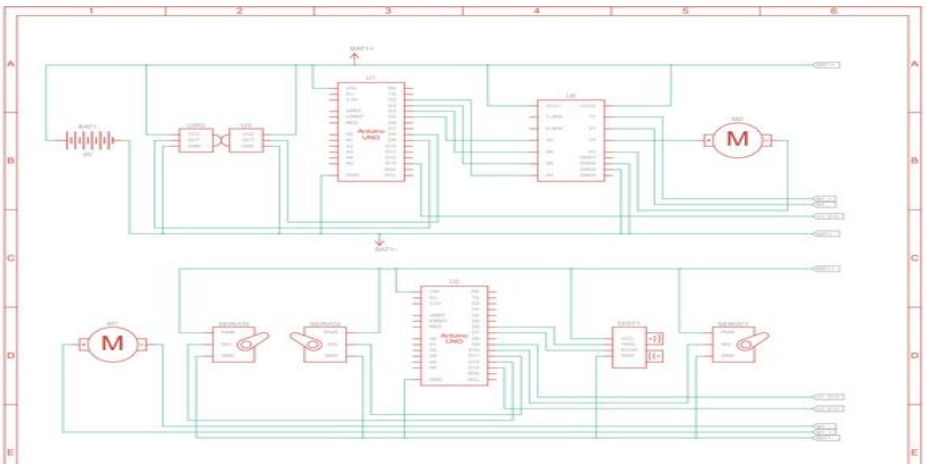
For successful placement of trash, it will rotate from 130 degree to 80 degree so that it can open the grip again.

Sequence of Trash Picking and Placement:

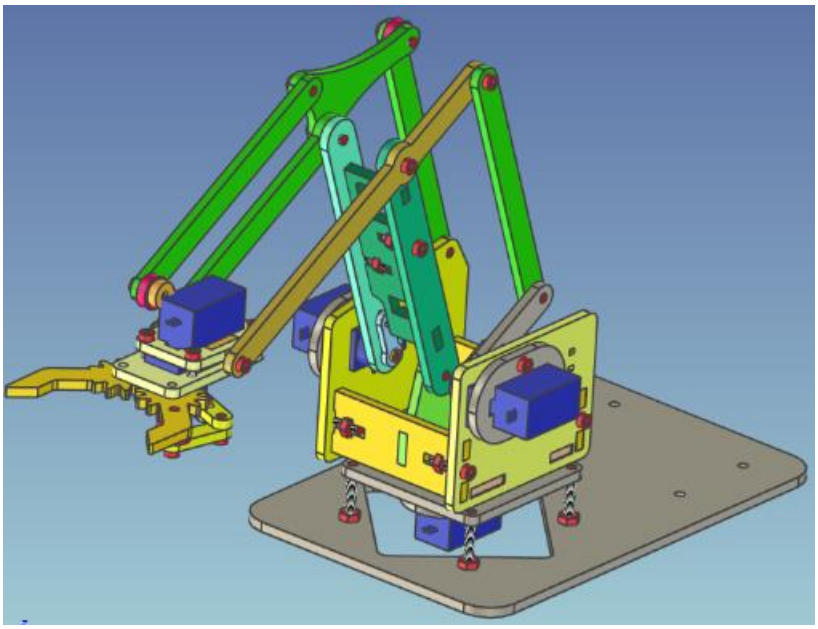
1.Servo motor1 rotates from 90 to 0 degree.
2.Servo motor2 rotates from 70 to 130 degree to downlift the arm closer to trash.
3.Servo motor3 rotates from 100 to 170 degree to uplift the arm closer to trash.
4.Servo motor4 rotates from 80 to 130 degree to close the grip and collect the trash.
5. Servo motor2 rotates from 130 to 70 degree to uplift the arm to set it ready for placement.
6. Servo motor1 rotates from 0 to 180 degree to go closer to the trash can.
7. Servo motor4 rotates from 130 to 80 degree to open the grip and place the trash.
8. Servo motor1 again rotates from 180 to 90 degree to again go back to the initial position.
9. Servo motor3 rotates from 170 to 100 degree to downlift the arm to the initial state

3.3 Circuit Diagram

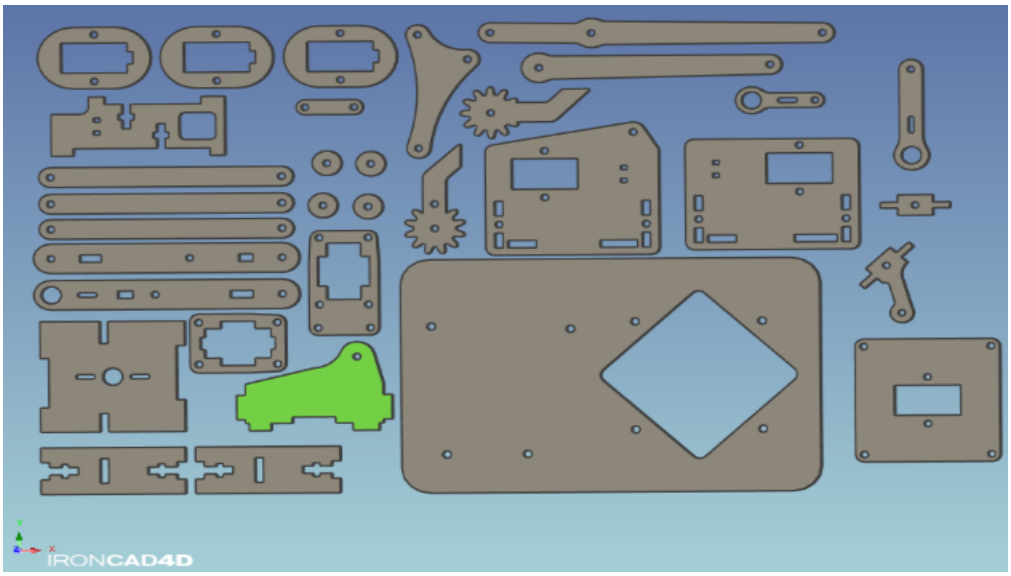




3.4 Simulation Model



3.5 CAD/Hardware Design



3.6 Full Source Code of Firmware

```
//Codes of IR sensor and line follower
#define IR_SENSOR_RIGHT 8
#define IR_SENSOR_LEFT 9
#define MOTOR_SPEED 100
#define sigR 13

int rightMotorPin1=4;
int rightMotorPin2=5;
int leftMotorPin1=2;
int leftMotorPin2=3;

long duration;
int distance;

void setup() {

   Serial.begin(9600);  //  Starts  the  serial
//communication

    pinMode(sigR,INPUT );
    pinMode(rightMotorPin1, OUTPUT);
    pinMode(rightMotorPin2, OUTPUT);

    //pinMode(enableLeftMotor, OUTPUT);
    pinMode(leftMotorPin1, OUTPUT);
    pinMode(leftMotorPin2, OUTPUT);

    pinMode(IR_SENSOR_RIGHT, INPUT);
    pinMode(IR_SENSOR_LEFT, INPUT);

}

void loop() {
  // Clears the trigPin
         int         rightIRSensorValue         =
digitalRead(IR_SENSOR_RIGHT);
          int         leftIRSensorValue         =
digitalRead(IR_SENSOR_LEFT);
  int sigRV=digitalRead(sigR);

  if (sigRV==HIGH){
      // Stop both motors
    digitalWrite(rightMotorPin1, LOW);
    digitalWrite(rightMotorPin2, LOW);
    digitalWrite(leftMotorPin1, LOW);
    digitalWrite(leftMotorPin2, LOW);
    }
   else{
            if  (rightIRSensorValue  ==  LOW  &&
leftIRSensorValue == LOW){
    // Set motor speeds to go straight
    digitalWrite(rightMotorPin1, HIGH);
    digitalWrite(rightMotorPin2, LOW);
    digitalWrite(leftMotorPin1, HIGH);
    digitalWrite(leftMotorPin2, LOW);
  }
  // If right sensor detects a black line, then
//turn right
   else  if  (rightIRSensorValue  ==  HIGH  &&
leftIRSensorValue == LOW){
```

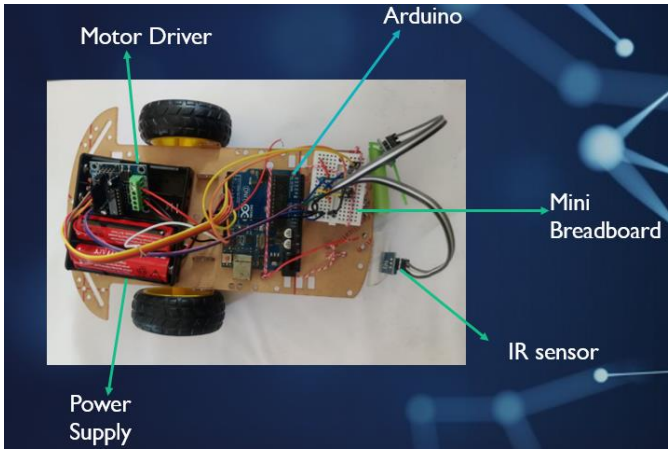
```
//Codes of ultrasonic and arm
#include <Servo.h>
Servo servoMotor1;  // Create a servo object
Servo servoMotor2;
Servo servoMotor3;
Servo servoMotor4;
#define sigT 9

int servoPin1 = 10;  // Pin to which the servo
signal wire is connected
int pos1 = 90;         // Variable to store the
servo position
int servoPin2 = 11;  // Pin to which the servo
signal wire is connected
int pos2 = 70;
int servoPin3 = 12;  // Pin to which the servo
signal wire is connected
int pos3 = 100;
int servoPin4 = 13;  // Pin to which the servo
signal wire is connected
int pos4 = 80;

// defines pins numbers
const int trigPin = 6;
const int echoPin = 7;

// defines variables
long duration;
int distance;

void setup() {

  pinMode(trigPin, OUTPUT); // Sets the trigPin
as an Output
  pinMode(echoPin, INPUT); // Sets the echoPin as
an Input
  pinMode(sigT,OUTPUT );
  Serial.begin(9600);  //  Starts  the  serial
communication

  servoMotor1.attach(servoPin1);  // Attach the
servo to the specified pin
  servoMotor2.attach(servoPin2);
  servoMotor3.attach(servoPin3);
  servoMotor4.attach(servoPin4);
    //rotateMotor(0,0);  //user defined function
to control the speed of the motor
}

void loop() {
  // Clears the trigPin
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);

  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  // Reads the echoPin, returns the sound wave
travel time in microseconds
  duration = pulseIn(echoPin, HIGH);
```

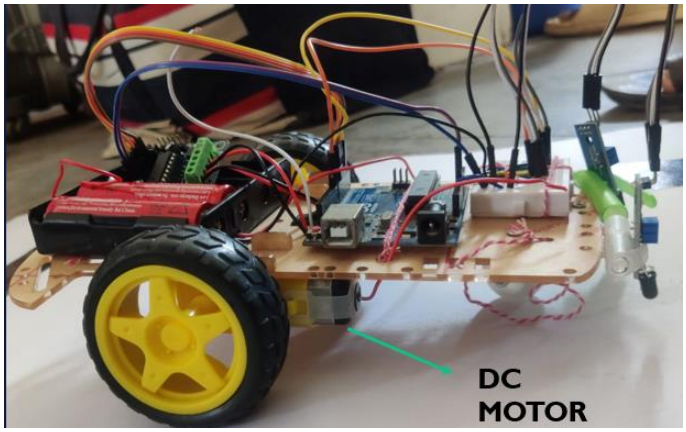
```
    // Set motor speeds to turn right
    digitalWrite(rightMotorPin1, LOW);
    digitalWrite(rightMotorPin2, HIGH);
    digitalWrite(leftMotorPin1, HIGH);
    digitalWrite(leftMotorPin2, LOW);
  }
  // If left sensor detects a black line, then
//turn left
    else if (rightIRSensorValue == LOW &&
leftIRSensorValue == HIGH ) {
    // Set motor speeds to turn left
    digitalWrite(rightMotorPin1, HIGH);
    digitalWrite(rightMotorPin2, LOW);
    digitalWrite(leftMotorPin1, LOW);
    digitalWrite(leftMotorPin2, HIGH);
  }
  // If both sensors detect a black line, then
//stop
  else {
    // Stop both motors
    digitalWrite(rightMotorPin1, LOW);
    digitalWrite(rightMotorPin2, LOW);
    digitalWrite(leftMotorPin1, LOW);
    digitalWrite(leftMotorPin2, LOW);
  }

  }


}
```

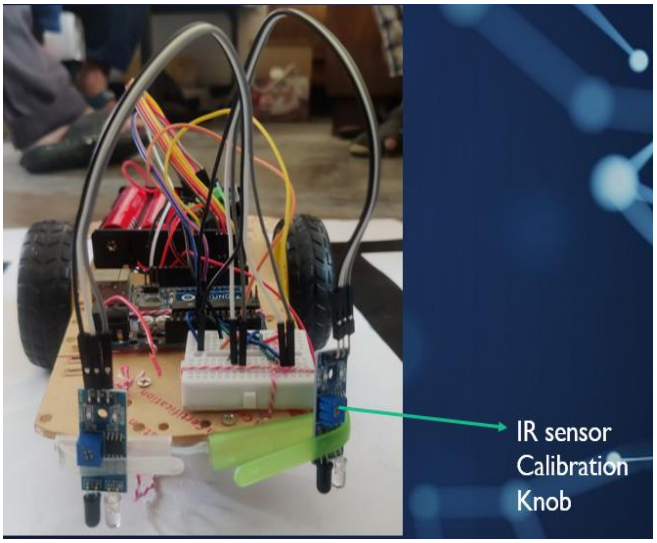
```
  // Calculating the distance
  distance = duration * 0.034 / 2; // distance in
cm
  // Prints the distance on the Serial Monitor
  Serial.print("Distance: ");
  Serial.println(distance);
  delay(500); ///kete dite hbe
  digitalWrite(sigT,LOW);
  if(distance>4 && distance <10)
  {
    digitalWrite(sigT,HIGH);
  for (pos1 = 90; pos1 >= 0; pos1 -= 1) {
    servoMotor1.write(pos1);          // Set the
servo position
    delay(100);
  }

for (pos2 = 70; pos2 <= 130; pos2 += 1) {
    servoMotor2.write(pos2);          // Set the
servo position
    delay(100);
  }

    for (pos3 = 100; pos3 <= 150; pos3 += 1) {
    servoMotor3.write(pos3);          // Set the
servo position
    delay(100);
  }

//GRAB
    for (pos4 = 80; pos4 <= 130; pos4 += 1) {
    servoMotor4.write(pos4);          // Set the
servo position
    delay(100);
  }

    for (pos2 = 130; pos2 >= 70; pos2 -= 1) {
    servoMotor2.write(pos2);          // Set the
servo position
    delay(100);
  }

  for (pos1 = 0; pos1 <= 180; pos1 += 1) {
    servoMotor1.write(pos1);          // Set the
servo position
    delay(100);

  }

// throw
  for (pos4 = 130; pos4 >= 80; pos4 -= 1) {
    servoMotor4.write(pos4);          // Set the
servo position
    delay(100);
  }

   for (pos1 = 180; pos1 >= 90; pos1 -= 1) {
    servoMotor1.write(pos1);          // Set the
servo position
    delay(100);

   }

  for (pos3 =150; pos3 >= 100; pos3 -= 1) {
    servoMotor3.write(pos3);          // Set the
servo position
    delay(100);
  }
  }
}
```

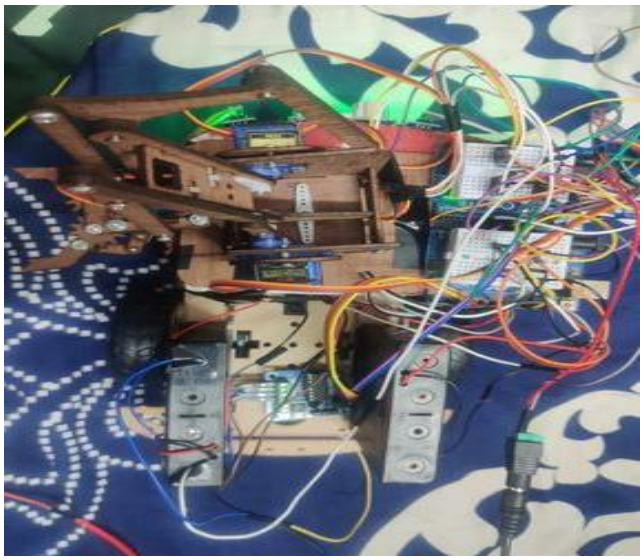
4 Implementation

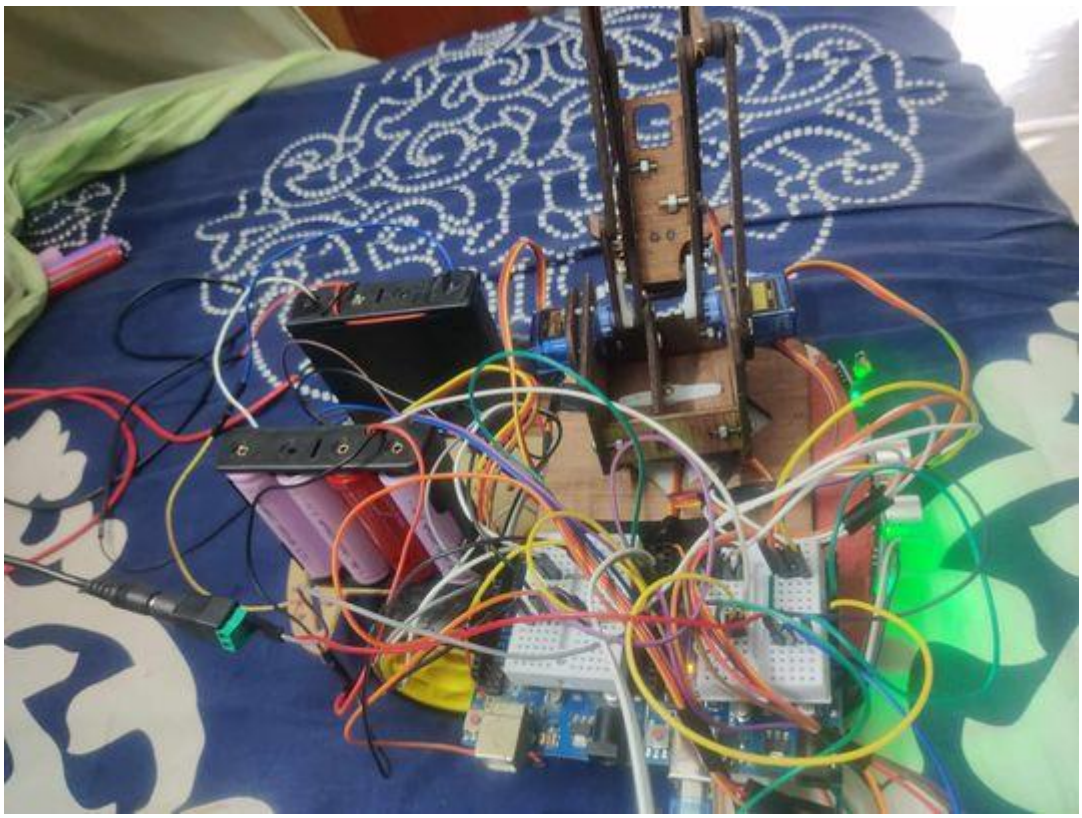
4.1 Description











4.2 Experiment and Data Collection

Our project does not have any requirement of data collection and analysis so much. We have only one arena ultrasonic sensor to show the received the data of distance and matching. One portion of ultrasonic sensed dataset are:

4.3 Data Analysis

1.IR sensors need to be calibrated frequently as they malfunction sometimes.
2.Ultrasonic sensors also fluctuate sometimes and show garbage results sometimes.
3.Use of two batteries as power supply could not drive all the servo motors connected to the arms. So, constant dc source with high current is been better.
4.The reference position, default position and variable position of arm control trash collection is done by calibrating the angles frequently and have been set to an optimum value.
5. There is a voltage limit from Arduino of 5 to 12V. And current limit upto 1A.

4.4 Results

1.Our first trial of LFR was successful. IR sensor, motor driver, dc motor and the power supply were working good.
2.Though IR sensor needs to recalibrated sometimes.
3. Ultrasonic sensors also fluctuate sometimes and show garbage results sometimes.
4. First trial of ultrasonic sensors was not successful due to miscalculation of codes.
5. The reference position, default position and variable position of arm control trash collection is done by calibrating the angles frequently and have been set to an optimum value.
6. The first trial of arm was not successful because of miscalculation. Then after successive calibration, it became successful.
7. Assembling the LFR with arm could not work due to excessive power requirement.
8. After setting the required power supply, the whole assemble worked properly.

5 Design Analysis and Evaluation

5.1 Novelty

1.Automation of garbage collection:

Automation and robotization of trash collection and waste management effectively and efficiently was the main goal of our project. Though this idea is not so unique but the way of design and implementation

2.Environment friendly:

Waste management is highly echo-friendly when it is operated and controlled by automized

Programmed robots which will eventually reduce pollution, noise, disease.

3.Scalabiity and adaptability:

Large scale implementation of our project is not easy but can be implemented by massive investment, huge design planning and industrialization.

4.Assistance in revolutionary experiments:

Combining this small piece of project with VR, AI and other self-programmed revolutionary experiments can be achieved in near future.

5.2 Design Considerations

5.2.1 Considerations to public health and safety

Maintenance of trash and filth is a key concern to public health and society. Our project possesses the most probabilistic scope for implementation in the arena of public health and society. Human mind is subconscious and easily allured to mistakes. That’s why we sometimes unintentionally spread filth and trash and wait for cleaning workers to maintain hygiene.
But automation of trash collection and management could be one of the most handy projects

under the circumstances. By introducing the line follower-based garbage collector robot may help to minimize labor, diminish health risk, incline the odor pollution and save time to accelerate the whole wastage management process.

5 Potential Places for implementation to public health and safety:

- Hospital
- Academic Institutes
- Apartment
- Train
- Park
- Eco parks

.... etc

5.2.2 Considerations to environment

Social Impact:

- Clean Society
- Saves time for more important tasks
- Continues to work with no loss of efficiency
- Reduces human exposure to hazardous objects

Environmental impact:

- Lessens plastic pollution
- Preservation of eco-parks & natural tourist spots

5.2.3 Considerations to cultural and societal needs

Maintenance of health and hygiene by the implementation of programmed robotic machineries will not only create social and health impacts but also it will accomplish the cultural enrichment of our country. The cultural impacts are:

- Cleanliness and Hygiene refreshes human mind to create literature.
- Automation of waste management creates a nourishing environment.
- It also creates a cheerful mind to motivate and inspire people.
- Clean and healthy environment helps people to think freely and enable themselves to express the true potential of themselves.
- It also creates a melody of peace to spread love and forget hatred.
- It also creates a peaceful situation among nations for negotiation and peace.
- Automation of waste management will create demonstration effect throughout whole world and increase trade, business and other commercial activities.
- All these things will create mutual correspondence of culture among societies and nations.

5.3 Investigations

5.3.1 Literature Review

Literature review means identifying the main points/objectives of any project and provide own thinking/idea/innovation/opinion adjacent to it.

Main objectives:

1.To automize waste and trash management using a LFR.

2.To design and develop an idea for large scale implementation.

Basics Plannings of these objectives:

1.To design a line follower robot at first with IR sensor, motor driver, motor and actuator, chasis and body.

2. To design the arm with accurate degrees of freedom, motor, screw, code and instructions.

3. Assemble the arm setup with the LFR setting and check the performance and make necessary adjustments.

Our own thoughts/opinions:

1.Designing the arm of the LFR from scratch and rebuilding can provide better actuation, control and movement.

2.Designning a PID controller for the LFR will decrease vibration, smooth the motion and increase sustainability.

3.Addition of image processing for garbage detection could be the best way for automatic trash collection.

4. More complex and sophisticated design with image processing-based garbage collection mechanism would not require any line for following to collect trash.

5.3.2 Experiment Design

Experimental design and description is given above. Now, here we will enlist the changes and adjustments that have helped us to implement our project.

1.Proper power supply setup.
2.Proper calibration.
3.Proper Code adjustment and debugging.
4.Necessary screw and joint setup.

5.3.3 Data Analysis and Interpretation

1.LFR was not supposed to vibrate. But it does for lack of PID controller.
2.IR and ultrasonic fluctuations.
3.Power supply fluctuations.
4.Loading effect adjustment.
5.Arm angles adjustments.

5.4 Limitations of Tools

1.IR sensors need to be calibrated frequently as they malfunction sometimes.

2.Ultrasonic sensors also fluctuate sometimes and show garbage results sometimes.

3.Use of two batteries as power supply could not drive all the servo motors connected to the arms. So, constant dc source with high current is been better.

4.The reference position, default position and variable position of arm control trash collection is done by calibrating the angles frequently and have been set to an optimum

value.
5. There is a voltage limit from Arduino of 5 to 12V. And current limit upto 1A.

5.5 Impact Assessment

5.5.1 Assessment of Societal and Cultural Issues

The social and cultural impacts are already discussed in the previous section. But their assessment cannot be possible by a small prototype project like ours. To evaluate the assessment of these impacts we need a large-scale implementation of our project throughout the whole world among all nations. But we have limitations of large-scale implementation. That's why assessment is still needed to be explored.

5.5.2 Assessment of Health and Safety Issues

The health and society are already discussed in the previous section. But their assessment cannot be possible by a small prototype project like ours. To evaluate the assessment of these impacts we need a large-scale implementation of our project throughout the whole world among all nations. But we have limitations of large-scale implementation. That's why assessment is still needed to be explored.

5.5.3 Assessment of Legal Issues

Legal issues can be thought of two different ways. Firstly, we haven't copied any project/code fully 100%. We took help of journals, websites to have inspiration for implementation and successfully completed our project without any illegal allegations.
Large scale automation of robotics for waste management may cause damage in the future. Automation, self-evaluation, self-thinking, self-programming, artificialization of the robotics machineries can lead to human devolution, human laziness, human ignorance and human vs machine phenomena in the next few decades. The existence of human race will be questionable. That's why large-scale automation now at this moment cannot be 100% legal. Laws and order need to implemented before this

5.6 Sustainability and Environmental Impact Evaluation

The sustainability and environmental impacts are already discussed in the previous section. But their assessment cannot be possible by a small prototype project like ours. To evaluate the assessment of these impacts we need a large-scale implementation of our project throughout the whole world among all nations. But we have limitations of large-scale implementation. That's why assessment is still needed to be explored.

5.7 Ethical Issues

Automation and artificialization of robotics machineries in the field of waste management can eventually cause human devolution, excessive human comfort, human vs machine wars, terminator or matrix like movie phenomena and an apocalypse. So, implementation of LFR based garbage collection or any other robotics in a very large scale cannot be ethically 100% right. But in our small-scale prototype like project we didn't face any ethical challenges. Ethics and morality will be questioned only when we intend to implement this in a large-scale applications.

6 Reflection on Individual and Team work

6.1 Individual Contribution of Each Member

1906080-Desgin, assemble and market study and purchase.
1906076-Idea innovation, problem analysis and deep searching.
1906070-Partial Arduino coding, cost analysis, resource collection, image and video editing.
1906074-Hardware implementation and result, data analysis.
1906077-Adjustment, correction, redesign and rest of the coding.

6.2 Mode of TeamWork

1.Hardware implementation
2.Assembling
3.Debugging
4.Setup building
5.Report and Presentation

6.3 Log Book of Project Implementation

Date	Milestone achieved	Team Role	Comments
19.06.23	Project Proposal Discussion & Assignment	Whole team discussion in lab	Proposed a line follower robot
03.07.23	Project Proposal Presentation	Presented a brief idea and working procedure of the project	Additional features- automated garbage collector with line follower robot
10.07.23	Online meeting & budgeting	Whole team attend a zoom to decide the next working procedure	A tentative cost sheet prepared
17.07.23	Buy and set up Process	Two members of the team bought the components and others started to set up the components.	Primary set up completed
24.07.23	First Progress Presentation	Team presented the first presentation	Line follower worked properly
31.07.23	Started Arm Design	Team members discussed	A Arm managed
07.08.23	Working with Arm	Some set the arm and others worked with code	Arm set up failed
14.08.23	Working with Arm	same	Arm set up succeed
21.08.23	Cascading Arm with main body	same	Cascading failed
04.09.23	Debugging the problem of cascading the Arm	All team members worked together	Debugging succeed
11.09.23	Final Presentation		

7 Communication

7.1 Executive Summary

Our project provides services for
1.A robot which will follow a specific line.
2.And a the robot will collect garbage when sensed.
The complex mechanism inside this LFR based trash collection system is not needed to be known by the mass users. They will be provided with a switch for power supply with self-programmed device that can be turned on/off very easily. So, though our project is complex and sophisticated, it is so much user friendly.

7.2 User Manual

Though our project is complex and sophisticated, it is so much user friendly. And user manual is very simple.

1.By turning the switch will provide power supply to the LFR.
2.Then it will start moving on a specific line.
3.IR and ultrasonic sensors will be activated.
4.When a trash object will be inside the threshold distance, the LFR will stop and collect the trash.
5.If not, then it will go back to it's destination following that line.
6.Agin, this will be ready for re-use.

8 Project Management and Cost Analysis

8.1 Bill of Materials

Cost Analysis				
Sl	Component	Quantity	Unit Price	Total
1	Soner	3	70	210
2	Wheel Set	1	380	380
3	IR	4	45	180
4	293D	2	180	360
5	9V cell	3	50	150
6	9V holder	2	10	20
7	7800 mA battery	3	120	360
8	Battery Casing	1	120	120
9	Screw Driver	1	180	180
10	Screw	3	60	180
11	Tape	2	160	320
12	Mini breadboard	4	35	140
13	Fare	-	300	300
14	Car Chassis	1	450	450
15	Arm	1	1000	1000
16	Arduino	1	800	800
17	Servo Motor	3	110	330
18	Miscellaneous		500	500
Total Cost=				5980

9 Future Work

Future Vision:

- Using Solar tech to make it more eco-friendly.
- Replacing wheels with a robust system to ensure freer & dynamic movement in uneven terrain
- Adding sophisticated trash sorting system to differentiate among organic, metal, plastic, fire hazardous, bio-hazardous and other trashes

10 References

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