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# Product collecting robot

Project Submitted

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April, 2017



East West University

# Product collecting robot

A Project submitted to the Electronics and Communications Engineering Department, Faculty of Sciences and Engineering, East West University in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electronics and Telecommunication Engineering**.

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**Spring 2017**



## DECLARATION

This is to certify that this project —”Product collecting robot” is our original work. No part of this work is submitted anywhere else partially or fully for the award of any degree or diploma. Any material reproduced in this project, has been properly acknowledged.

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## APPROVAL

The project titled —”**Product collecting robot**” prepared by the following students have submitted to the following respective members of the board of examiners of the Electronics and Communications Engineering Department of Sciences and Engineering Faculty, East West University in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electronics and Telecommunication Engineering**. The project has been accepted on April, 2017 as satisfactory.

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**Tanvir Rayhan Badhan**

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## **Abstract**

Product collecting robot is a machine that can detect an object and able to carry the object to destination by following a line. The path can be black line on white surface. This machine can detect any object with a range of distance and it has capability to grip that and also it is able to carry this object to destination. Generally, the path is predefined by a black line on a white surface with a high contrasted color. Therefore, this kind of Robot should sense the line with its

Infrared Ray (IR) transceiver sensors that installed under the robot. In this project we developed the robot to detect the object by using HC-SR04 ultrasonic ranging sensor. This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy. To grip the object we use we use SG91R micro servomotor, which is tinny. The program for the system has been developed using Arduino programming language. All the components are interfaced with the Atmega 2560 microcontroller, which is the heart of all control. And the whole system has mainly seven units. These are 11.2 V power supply, 5V power supply, At mega microcontroller, Motor driver, IR transceiver, DC Motor and Sonar with servo motor.

Keywords- Product collecting robot, IR transceiver, at mega 2560, ultrasonic ranging sensor.

# Chapter one

## Introduction

### 1.1 Over View of the Project

In this project, a product collecting robot has been design and developed. Product collecting robot is a machine that can detect an object and able to carry the object to destination by following a line. The path can be black line on white surface. This machine can detect any object with a range of distance and it has capability to grip that and also it is able to carry this object to destination. This product collecting robot can be used in factory or shopping mall to perform this type of job.

### 1.2 Literature review of this project

Although not same, a lot of works have already been done about the field of robots. Among them some of examples which are related to this project are described below.

Andrew James Thomson worked on this type of project and was a student of university of Auckland in the year of 2001<sup>[1]</sup>. His project name was” A PATH FOLLOWING SYSTEM FOR AUTONOMOUS ROBOTS WITH MINIMAL COMPUTING POWER”. He worked with Classical mobile robot control systems and developed its features.

Amithash e. Prasad <sup>[2]</sup> worked a project which is close to similar about our project and he was ex-student of Department of Electronics and Communication Engineering of Global Academy of Technology, Bangalore. He worked on line follower with Arduino and developed his project.

Robot Richard T. Vannoy Designing and Building a Line Following and developed this project. He design and developed an autonomous line tracking robot in the year of 2005<sup>[3]</sup>. He analysis of Line Sensor Configuration for the advanced Line Follower Robot.

Mayur Agarwal Prashant Agrawal Krishna Nand Gupta Hitesh Meghani were also woked on this in Robotics Workshop Currents 15th march 2008 EEE <sup>[4]</sup> Department NIT Trichy. They worked about the inelegancy of the robot.

M. S. Islam & M. A. Rahman worked on Design and Fabrication of Line Follower Robot and they were student of Department of Electrical and Electronic Engineering, Rajshahi University in 2013<sup>[5]</sup>

Jaseung Ku in the year of 17 Dec 2005<sup>[6]</sup> made a project named A Line-follower Robot.

M. Mehdi Sanaatiyan and Fac. of Compute, Mazandaran Inst. of Technol., Babol, Iran

Worked on this and there papers published on IEEE.org in the year of 2009<sup>[7]</sup> . ICCEE '09. Second International Conference on

Some papers are published on IEEE.org. The authors name and year are given at below.

Kazi Mahmud Hasan

Electronics and Communication Engineering Discipline, Khulna University. These papers are published about line follower.<sup>[8]</sup>

Abdullah-Al-Nahid

Electronics and Communication Engineering Discipline, Khulna University, 9208,<sup>[9]</sup> Bangladesh also worked on this and there publication submitted at Education and Research Conference (EDERC)

### **1.3 Objective of the Project**

The objectives of the product collecting Robot include:

- Move forward by searching for a black line on a white surface and looking for the object that is on the line.
- Detect the object within the range 5 cm on a black line on a white surface.
- Generate control commands to follow a detected black line.
- If black line track is not used, it has to be controlled by a remote controller.

# Chapter Two

## Theoretical Study

### 2.1 IR Transceiver

This IR reflective sensor utilizes a TCRT5000 to detect color and distance. It emits IR and then detects if it receives the echo. This sensor is often used in line following robots, auto data logging on utility meters, because this module can sense if a surface is white or black. The infrared diode will emitting the infra red light continually when the module connect to the power, when the emitted infra red light has not been reflected or the strength is not big enough, the diode will in the off state, at this time, D0 output logic LOW and the signal indicate LED off.

#### 2.1.1 Application Idea:

- Rainfall detecting.
- Liquid leakage.
- Tank overflow detector.

#### 2.1.2 Features:

- Supply Voltage: 3.3V~5V.
- Detect distance: 1mm-8mm.
- Digital Outputs HIGH when objects detected.
- On-board indicator LED to show the results.
- On-board potentiometer to adjust the sensitivity.
- On-board LM393 chip.



**Figure 2.1 IR Transceiver**

## **2.2 Digital IR Sensor Array8**

This sensor package is for line following Bot. Every now and then hobbyists who are willing to play with Line following Robot has tough time with the IR sensor arrangement. This is a neat solution for them.

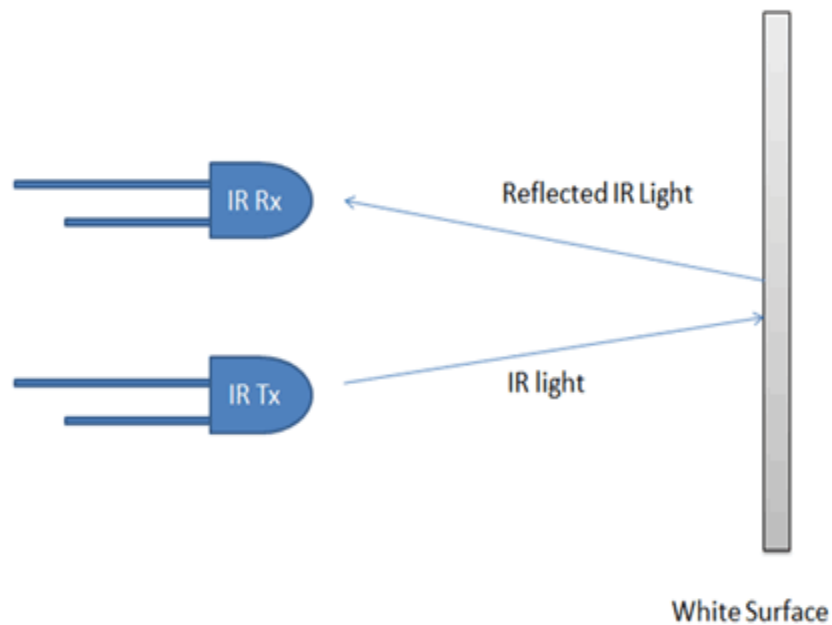
Eight TCRT5000 reflective optical sensors have been used here. The LM358 dual OPAMP works as a comparator with two reference voltages set by eight Pots. The sensors have 0.5 inches spacing.



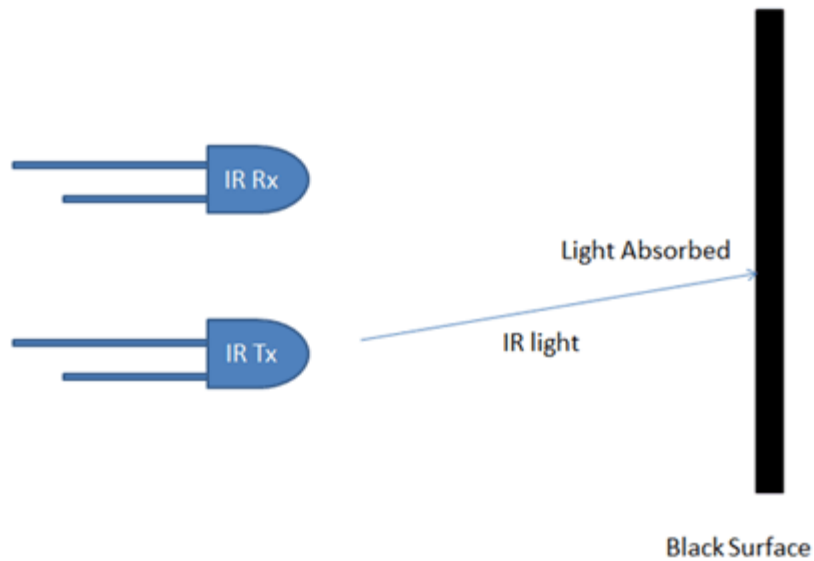
**Figure 2.2:TCRT5000 IR ARRAY 8**

### 2.2.1 Working principle:

Concept of working of line follower is related to light. We use here the behavior of light at black and white surface. When light fall on a white surface it is almost full reflected and in case of black surface light is completely absorbed. This behavior of light is used in building a line follower robot.



**Figure 2.2.2 Working principle of the Sensors**

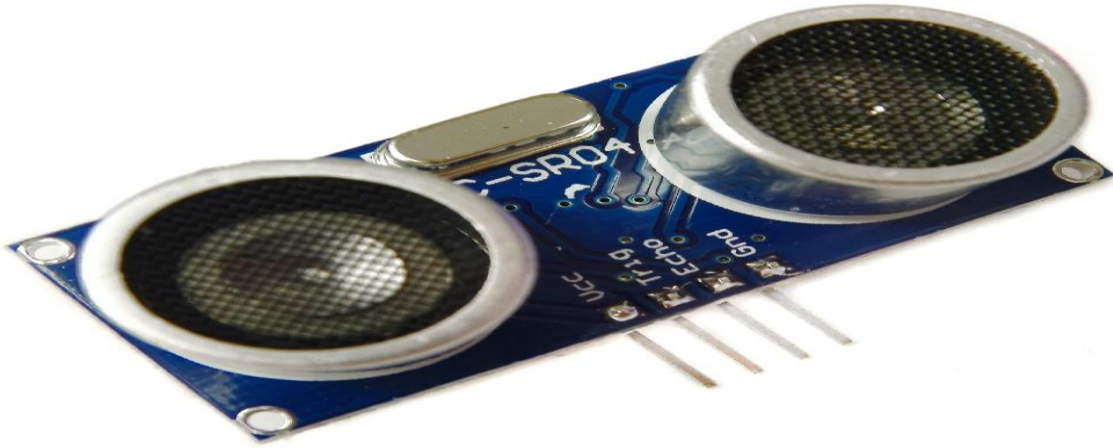


**Figure 2.2.3: Working principle of the Sensors**

### **2.3. Sonar**

This is the HC-SR04 ultrasonic ranging sensor. This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit. There are only four pins .VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground). The HC-SR04 Ultrasonic Module has 4 pins, Ground, VCC, Trig and Echo. The Ground and the VCC pins of the module needs to be connected to the Ground and the 5 volts pins on the Arduino Board respectively and the trig and echo pins to any Digital I/O pin on the Arduino Board.

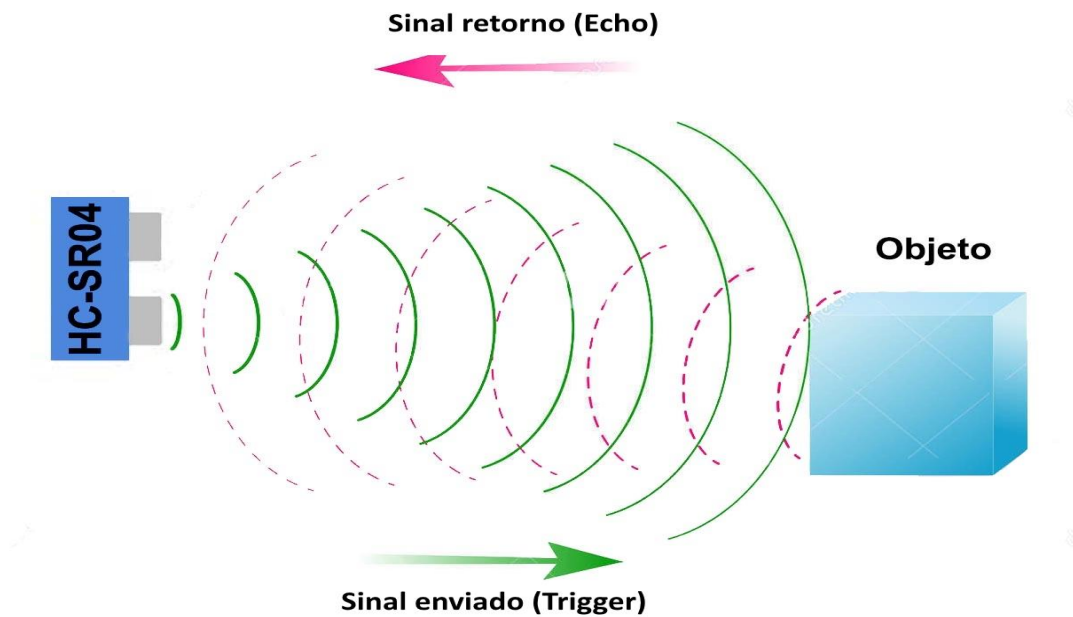




**Figure 2.3.1: Sonar sensor.**

### **2.3.1 The basic principle of sonar:**

- Using IO trigger for at least 10us high level signal.
- The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.
- If the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning. Test distance=(high level time velocity of sound (340M/S) /2.



**Figure 2.3.2: Working principal of hc-sr04 sonar sensor.**

### **2.3.2 Features:**

- Operating Voltage: 5V DC.
- Operating Current: 15mA.
- Measure Angle: 15°.
- Ranging Distance: 2cm - 4m.

### **2.4 Arduino:**

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments

Here we use arduino mega

### **2.4.1 Atmega2560:**

We used an Arduino Mega board which is based on At mega 2560. Arduino Mega has total 100 pin. Among these pins 16 is analog pin and 54 is digital pin. It has also 4MB EEPROM space and 256 Kbytes flash memory. It is operating at 16MHz frequency. At mega 2560 is 8-bit micro-controller. Default bit rate of data transmission is 9600. It is also enabled in Universal Synchronous/Asynchronous Receiver/Transmitter (USART), Serial Peripheral Interface (SPI) and Inter-integrated Circuit (I2C). EEPROM write/erase Cycles of At mega 2560 is 10,000 to 100,000[5].10-bit ADC.It has two 8-bit and four 16-bit Timer.8-bit Timer/Counters have Separate pre-scalar and compare mode.16-bit Timer/Counter has separate pre-scalar, Compare and capture mode. It has also four 8-bit PWM Channels.At mega 2560 is enable in external and internal interrupt.

# ARDUINO MEGA PINOUT DIAGRAM

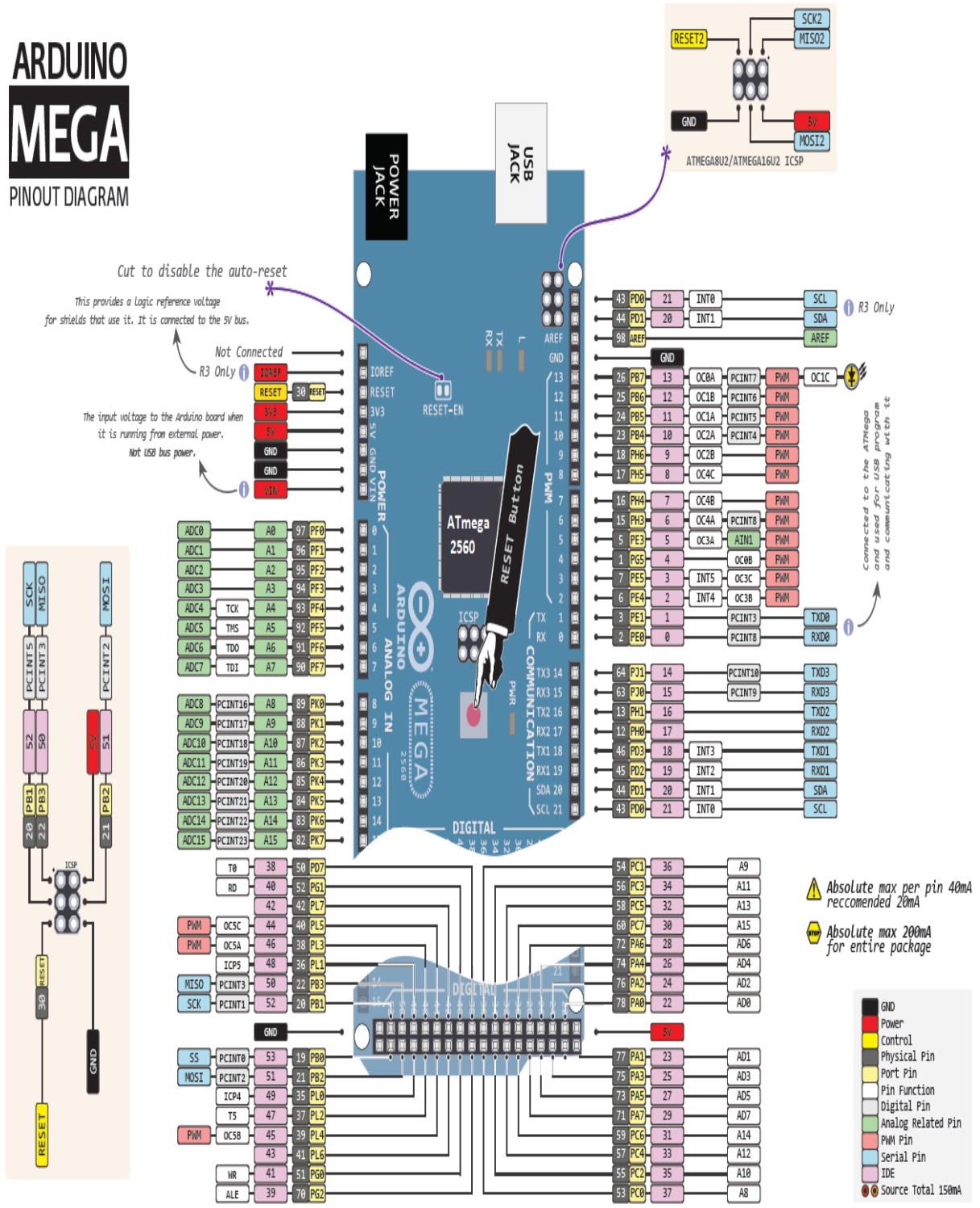


Figure 2.4.1: Arduino mega pin-point diagram.

Arduino mega has an on-board voltage regulator so it is capable to take an input voltage 6V to 20V .But it is recommended to give an input voltage from 7V to 12V and maximum input current 500V. Pin output voltage 5V and output current is 20mA. It has also built in power supply which can provide 3.3V and 5V. The 3.3V pin has 50mA current.

## 2.5 Gear Motor:

Gear motors are an all-in-one combination of an electric motor and gears or a gearbox. A gear motor simplifies combining a motor with a gear reducer system. Gears are used with motors to lower the motor's speed while increasing the output torque.



**Figure 2.5.1 Gear motor.**

### 2.5.1 Specification

- RPM: 600RPM / 300RPM;
- Length: 68mm;
- Diameter: 25mm;
- Shaft length: 9.5mm;
- Shaft diameter: 4mm;
- Torque: 0.8kg/cm.

## 2.6 Servo Motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback.

Here we use SG91R micro servo motor. It is tiny and lightweight with high output power. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos. Good for beginners who want to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. It comes with a 3 horns (arms) and hardware.



**Figure 2.6.1 SG91R micro servo motor.**

### 2.6.1 Specification:

- 1- Dimension 23x12.2x29mm.
- 2-Stall torque 1.8kg/cm (4.8V).
- 3-Operating speed 0.1sec/60degree (4.8v).
- 4-Operating voltage 4.8V.
- 5-Temperature range 0 -55C.
- 6-Dead band width 10us.

## 2.7 Bread board

A breadboard is a construction base for prototyping of electronics. Originally it was literally a bread board, a polished piece of wood used for slicing bread. In the 1970s the solder less breadboard (AKA plug board, a terminal array board) became available and nowadays the term "breadboard" is commonly used to refer to these. "Breadboard" is also a synonym for "prototype".

Because the solder less breadboard does not require soldering, it is reusable. This makes it easy to use for creating temporary prototypes and experimenting with circuit design. For this reason, solder less breadboards are also extremely popular with students and in technological education. Older breadboard types did not have this property. A strip board (Vero board) and similar prototyping printed circuit boards, which are used to build semi-permanent soldered prototypes or one-offs, cannot easily be reused. A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central processing units (CPUs). This project board for experimental, non-soldered setup of electronic circuits.



**Figure 2.7.1 Breadboard**

## 2.8 LEDs

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor.



**Figure 2.8.1 LED**

### 2.8.1 Features

- High luminous intensity output.
- Low power consumption.
- High efficiency.
- Versatile mounting on PCB or panel.
- I.C. Compatible/low current requirement.
- Reliable and rugged.



## 2.8.2 Applications

- Status indicator.
- Backlighting front panels.
- Light pipe sources.
- Lighted switches.

## 2.8.3 Specification

- Diameter:5mm
- Forward Voltage :2.0V
- Forward Current:20mA

## 2.9 Breadboard Jumper Wire Set:



**Figure 2.9.1 Jumper wires**

This set of jumper wires can help remove the clutter on breadboard. It comes in 14 different lengths and 8 colors to keep circuit on the surface. All of them are pre-formed and pre-sorted. We can easily find the color and length that need within a sec.

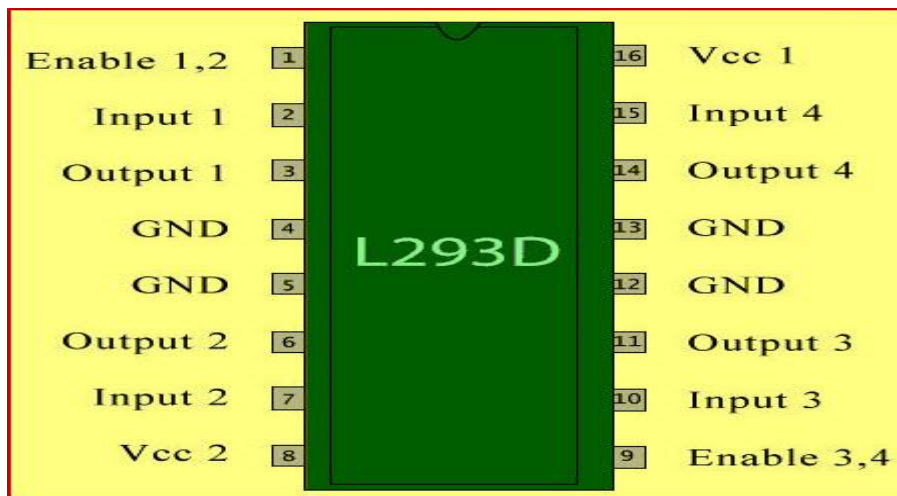
## 2.10 L293D Description

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge *Motor Driver integrated circuit (IC)*.

The l293d can drive small and quiet big motors as well, check the Voltage Specification at the end of this page for more info.

### 2.10.1 Working of L293D

There are 4 input pins for l293d, pin 2, 7 on the left and pin 15, 10 on the right as shown on the pin diagram. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1.



**Figure 2.10.1: L2938 IC**

A voltage regulator is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages.

Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

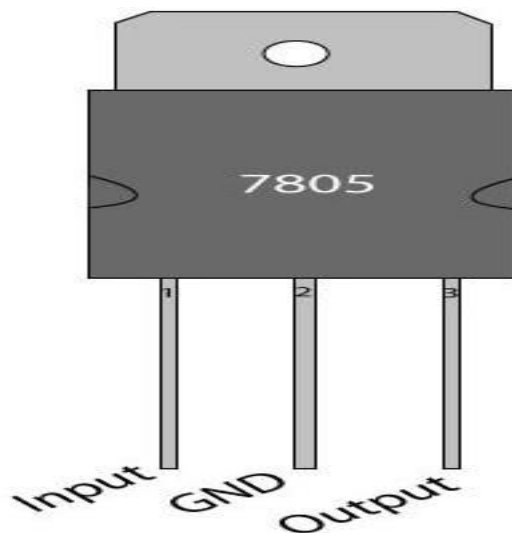
Here we use 2 regulators IC,

1-7805 regulators IC

2-7809 regulators IC

### 2.11 7805 regulator IC

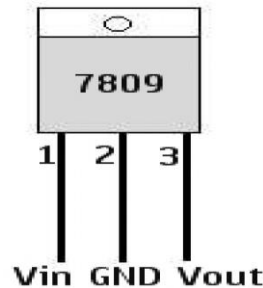
7805 is a voltage regulator integrated circuit. It is a member of 78xx series of fixed linear voltage regulator ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage output. The voltage regulator IC maintains the output voltage at a constant value. The xx in 78xx indicates the fixed output voltage it is designed to provide. 7805 provides +5V regulated power supply. Capacitors of suitable values can be connected at input and output pins depending upon the respective voltage levels.



**Figure 2.11.1: 7805 regulator IC.**

## 2.12 7809 regulator IC

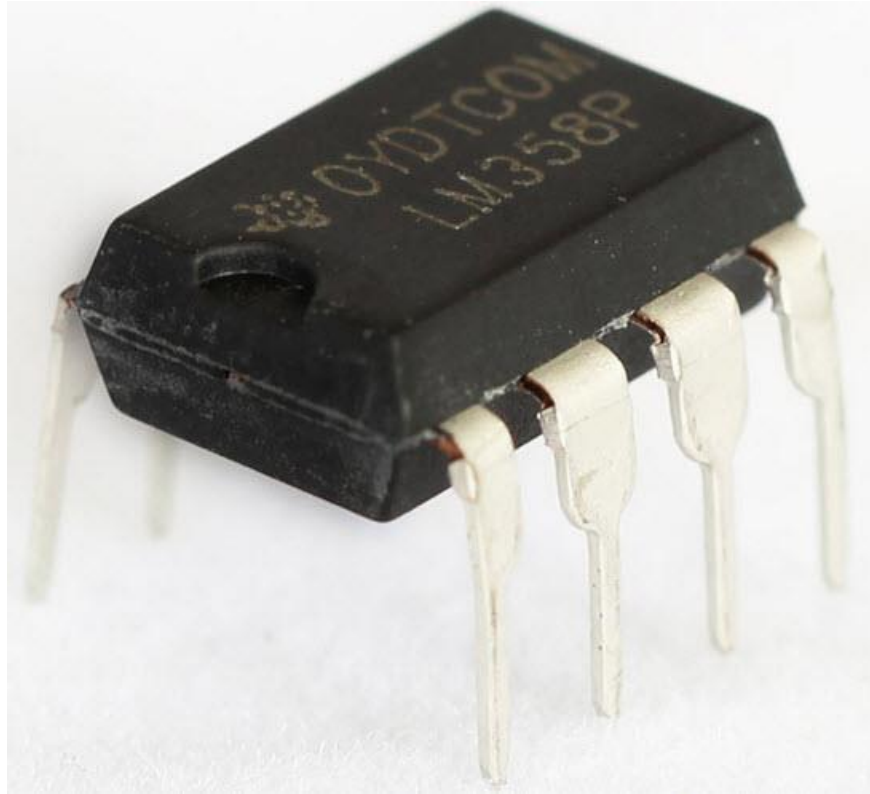
The 7809 is a 9 Volt voltage regulator IC with features such as internal current limit, safe area protection, thermal protection etc. A 16 V transformer brings down the 230V mains, 1A bridge rectifier rectifies it and capacitor C1 filters it and 7809 regulates it to produce a steady 9V DC output.



**Figure 2.12.1: 7809 regulator IC**

## 2.13: OTHER ICs

The LM358 IC is a great, low power and easy to use dual channel op-amp IC. It is designed and introduced by national semiconductor. It consists of two internally frequency compensated, high gain, and independent op-amps. This IC is designed for specially to operate from a single power supply over a wide range of voltages. The LM358 IC is available in a chip sized package and applications of this op amp include conventional op-amp circuits, DC gain blocks and transducer amplifiers. LM358 IC is a good, standard operational amplifier and it is suitable for your needs. It can handle 3-32V DC supply & source up to 20mA per channel. This op-amp is apt, if you want to operate two separate op-amps for a single power supply. It's available in an 8-pin DIP package

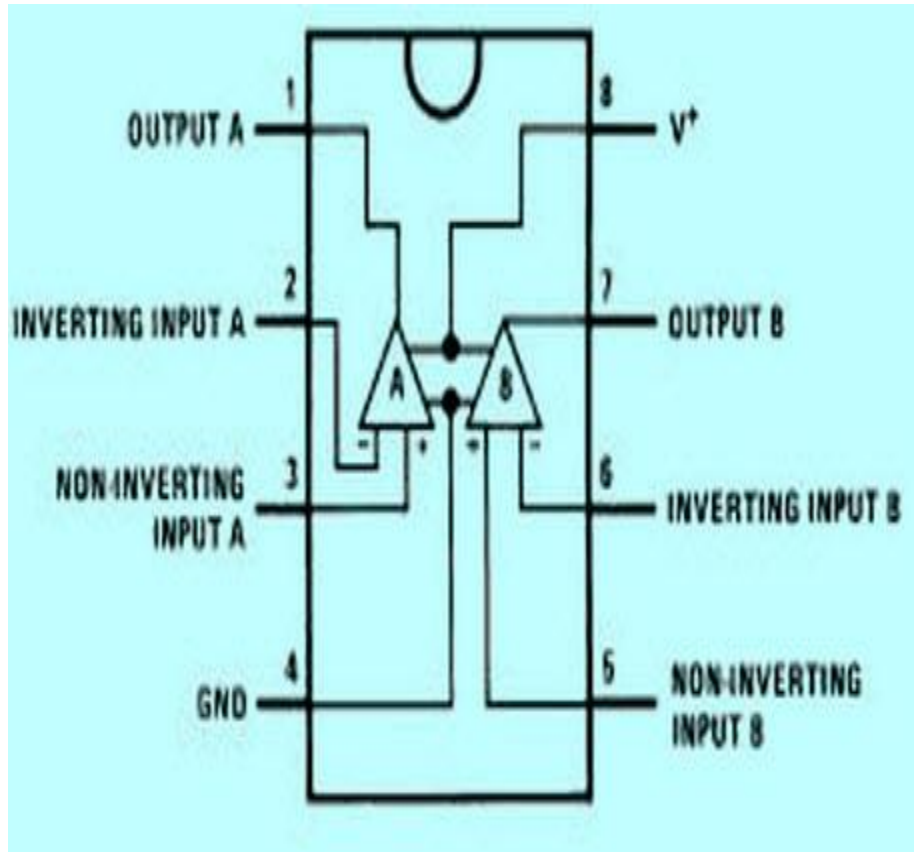


**Figure 2.13.1: LM358 IC Chip**

### **2.13.1 Pin Configuration of LM358 IC**

The pin diagram of LM358 IC comprises of 8 pins, where

- Pin-1 and pin-8 are o/p of the comparator
- Pin-2 and pin-6 are inverting i/ps
- Pin-3 and pin-5 are non inverting i/ps
- Pin-4 is GND terminal
- Pin-8 is VCC+



**Figure 2.13.2: LM358 IC Pin Configuration**

### 2.13.2 Features of LM358 IC

**The features of the LM358 IC are,**

- It consists of two op-amps internally and frequency compensated for unity gain.
- The large voltage gain is 100 dB.
- Wide bandwidth is 1MHz.
- Range of wide power supplies includes single and dual power supplies.
- Range of Single power supply is from 3V to 32V.
- Range of dual power supplies is from + or -1.5V to + or -16V.
- The supply current drain is very low, i.e., 500  $\mu$ A.
- 2mV low i/p offset voltage.

- Common mode i/p voltage range comprises ground.
- The power supply voltage and differential i/p voltages are similar.
- o/p voltage swing is large.

## 2.14 Variable resistance

A potentiometer, informally a pot, is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat.

The measuring instrument called a potentiometer is essentially a voltage divider used for measuring electric potential (voltage); the component is an implementation of the same principle, hence its name.

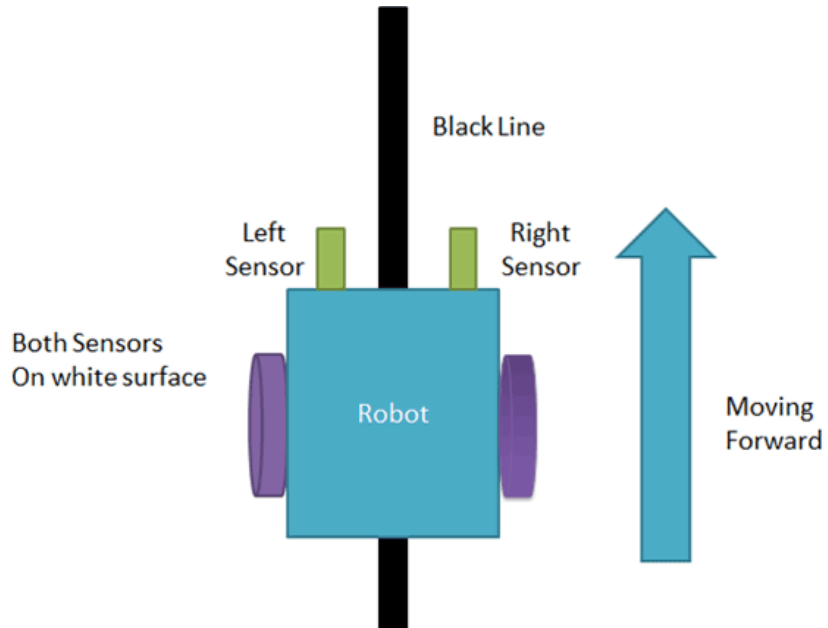
Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. Potentiometers operated by a mechanism can be used as position transducers, for example, in a joystick. Potentiometers are rarely used to directly control significant power (more than a watt), since the power dissipated in the potentiometer would be comparable to the power in the controlled load.



**Figure 2.14.1: Variable resistance 103.**

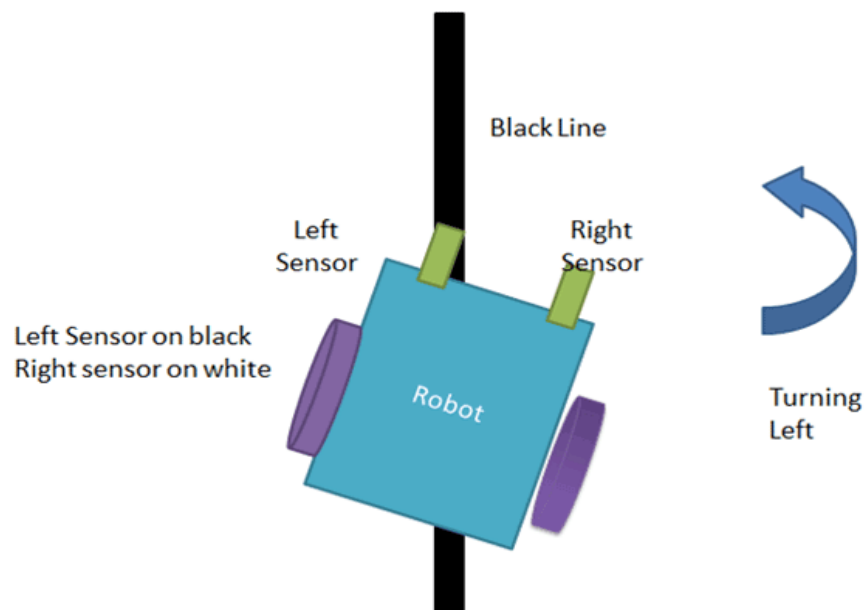
## 2.15 Following principle of the Robot

Here in this project we are using 8 IR sensor modules. When the 2 middle IRs sense black then it go forward.



**Figure 2.15.1** Line following principle of the robot

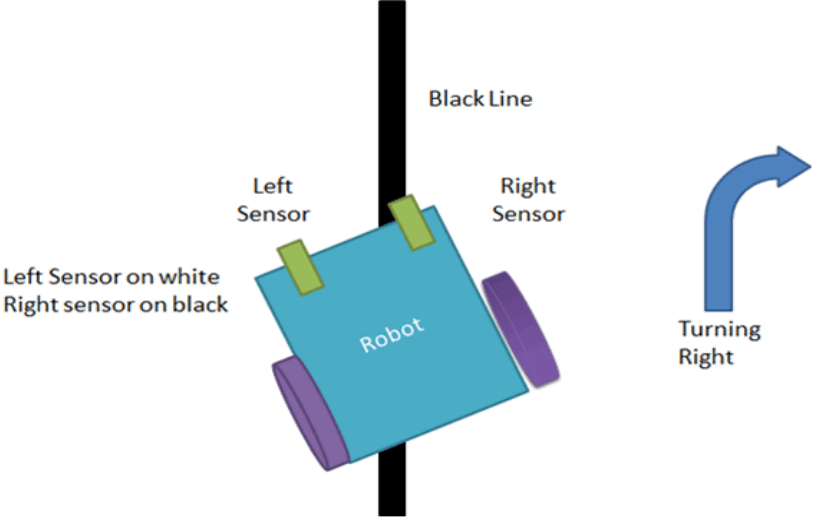
If left 3 sensors comes on black line then robot turn left side.



**Figure 2.15.2** Line following principle of the robot

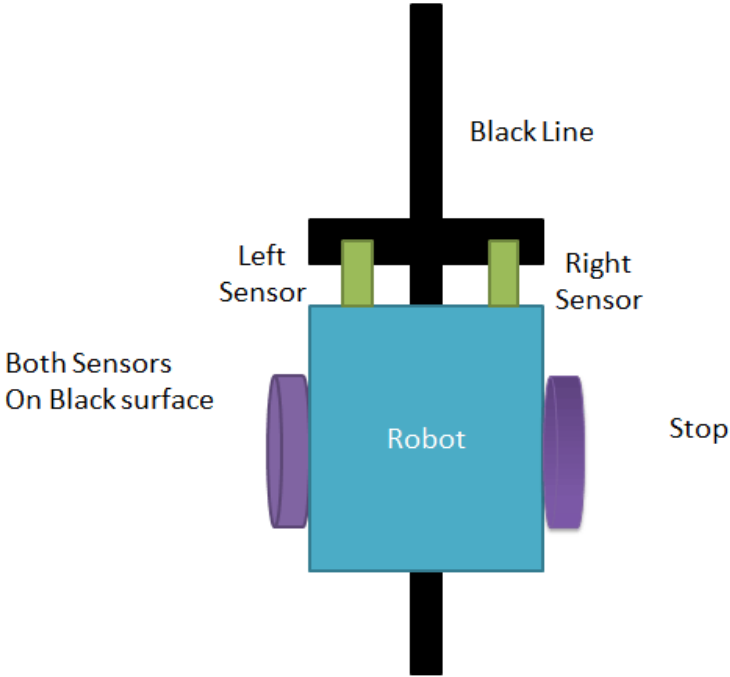


If right3 sensor sense black line then robot turn right side until both sensor comes at white surface. When white surface comes robot starts moving on forward again.



**Figure 2.15.3** Line following principle of the robot

If all sensors come on black line, robot stops.



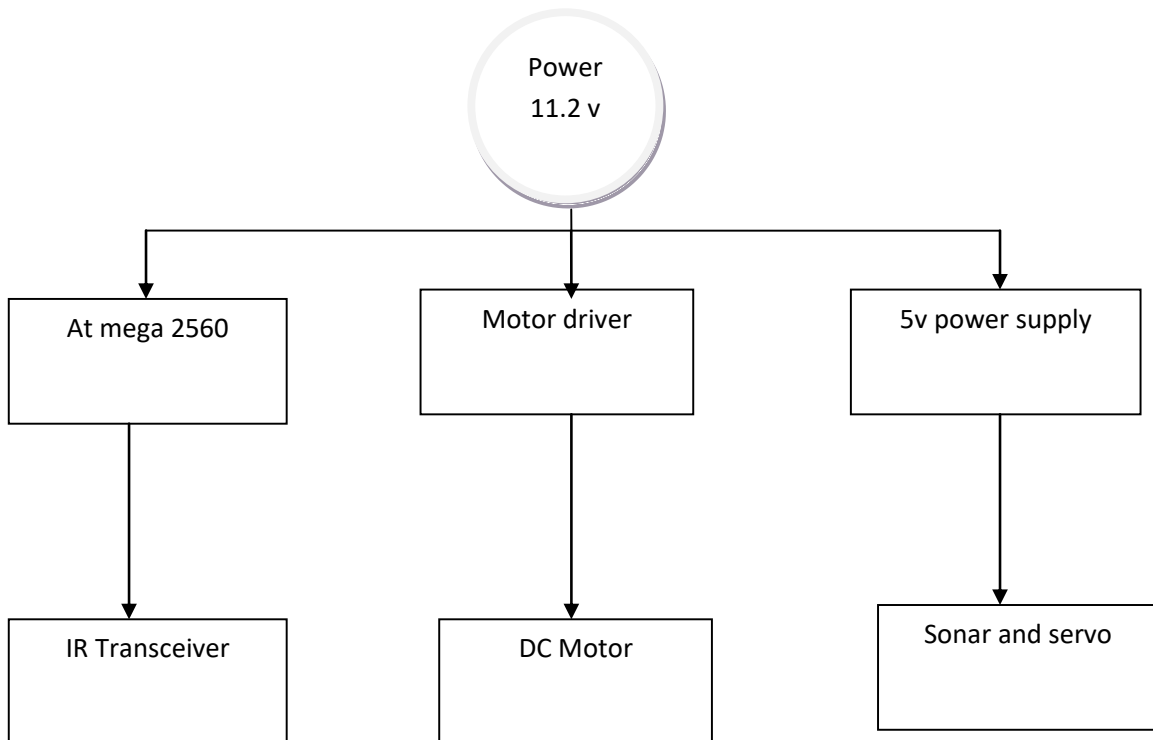
**Figure 2.15.4** Line following principle of the robot

## Chapter Three

### Design and Implementation of the Project

#### 3.1 System Block Diagram

The complete circuit of the product collector robot has many sub units. The block diagram of the complete system is given below.



**Figure 3.1.1: Block diagram.**

The whole system has mainly seven units. These are 11.2 V power supply, 5V power supply, At mega microcontroller, Motor driver, IR transceiver, DC Motor and Sonar with servo motor. The DC motor runs with 11.2 V supply with help of motor driver and all other units are run by 5 V. The DC is rotated clock-wise and anticlock-wise by the motor drive to move the robot forward and backward. The servo motor is used to pick up the object. The IR transceiver always detects the position of the black track. The At mega microcontroller is the heart of all control.

## **3.2 Interfacing IR With Arduino**

### **3.2.1 Description**

Eight TCRT5000 reflective optical sensors have been used here. There is total 8 IR which are connected with Arduino analog pin A0-A7. IR sends light and the receiver detects the reflected light. The reflected light is converted into analog voltage and read by the analog to digital inputs of the Arduino. Here in this figure IR transceivers have been interfaced with the Arduino pins A0-A8 as shown in the following schematic diagram.

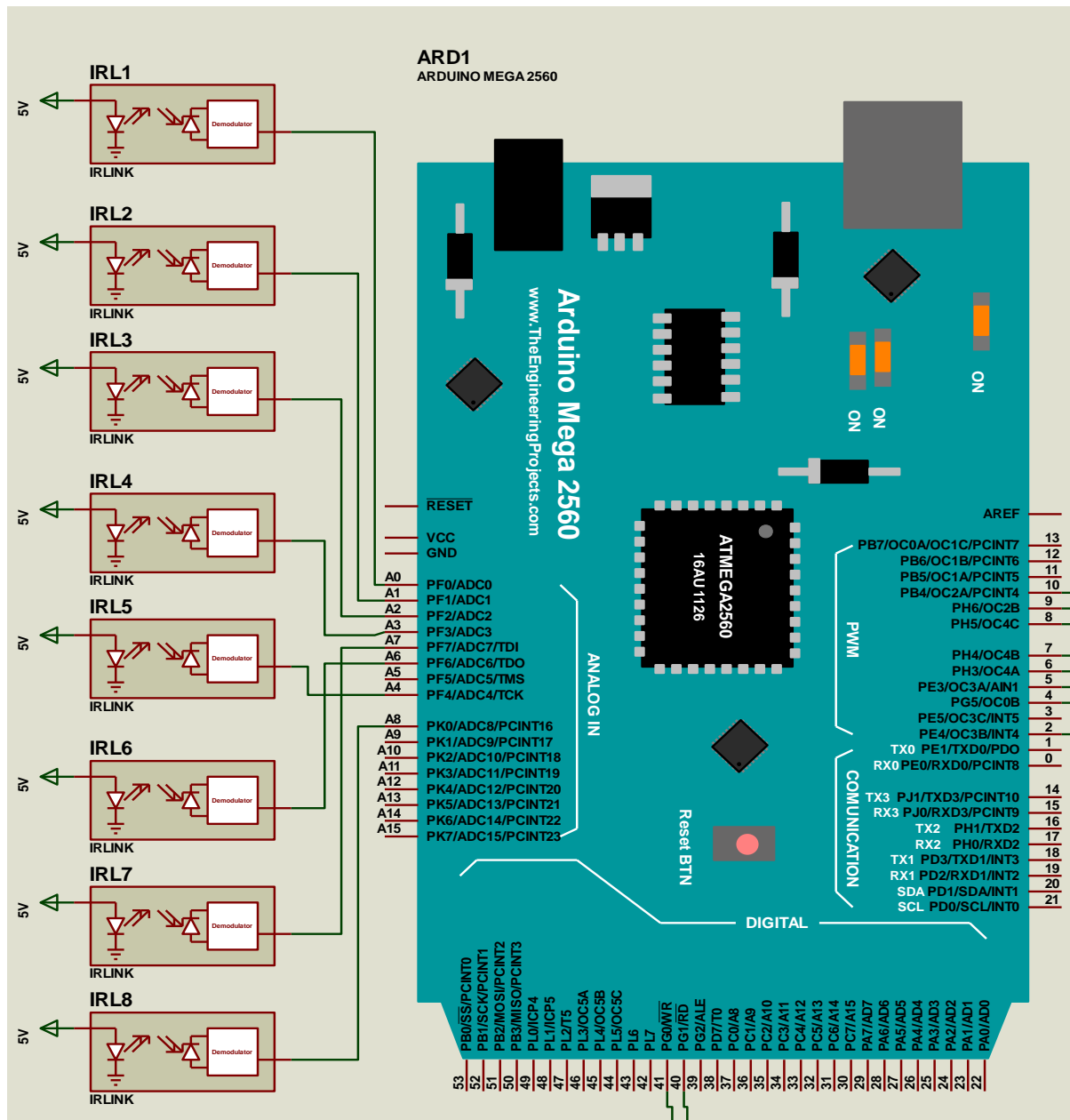


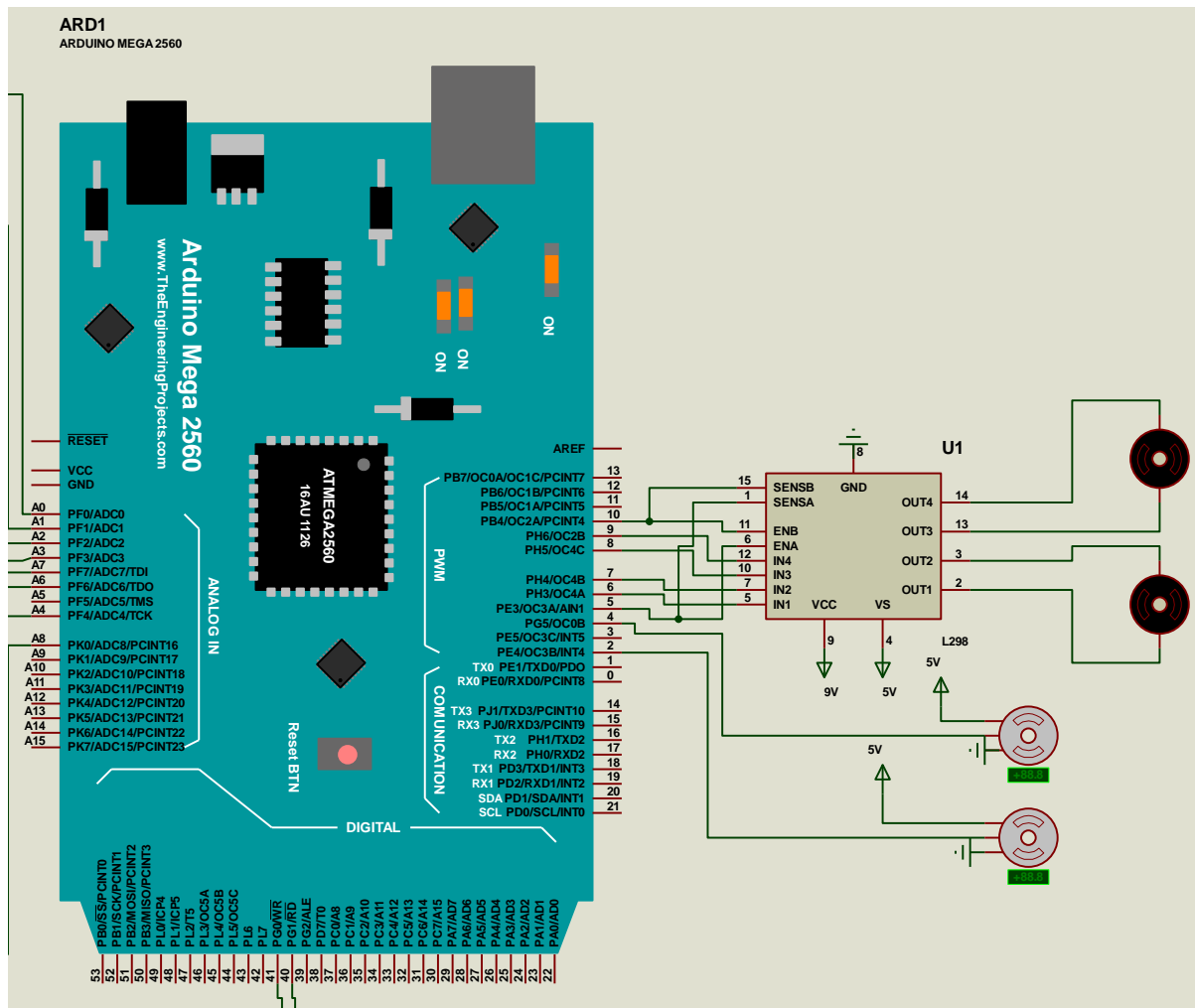
Figure 3.2.1: schematic diagram of IR with Arduino.

### 3.3 Interconnection of the DC Motor With the Arduino

#### 3.3.1 Description:

Here we use L298D motor to change the direction of rotation of the motor. The schematic diagram of the connection of the driver with Arduino is shown in the following schematic

diagram. Enable pins ENA and ENB are connected with Arduino pins 5 and 10 and two motors are connected with 2, 3 and 13, 14 pins of motor driver. Pin 8 is ground and 4, 9 no pins are connected to 9V and 5 V supply, respectively.



**Figure 3.3.1: Schematic diagram of motor driver with Arduino.**

Figure 3.3.1 also shows the connections of two servo motors. These motors are operated by 5V supply and controlled by the Pins 4 and 2 which have PWM facilities.

### 3.4 Interconnection of Sonar with Arduino

#### 3.4.1 Description:

Here we use the HC-SR04 ultrasonic ranging sensor. This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit.

The HC-SR04 Ultrasonic Module has 4 pins, Ground, VCC, Trig and Echo. The Ground and the VCC pins of the module needs to be connected to the Ground and the 5 volts pins on the Arduino Board respectively and the trig and echo pins to 40 and 41 no Digital I/O pin on the Arduino Board.

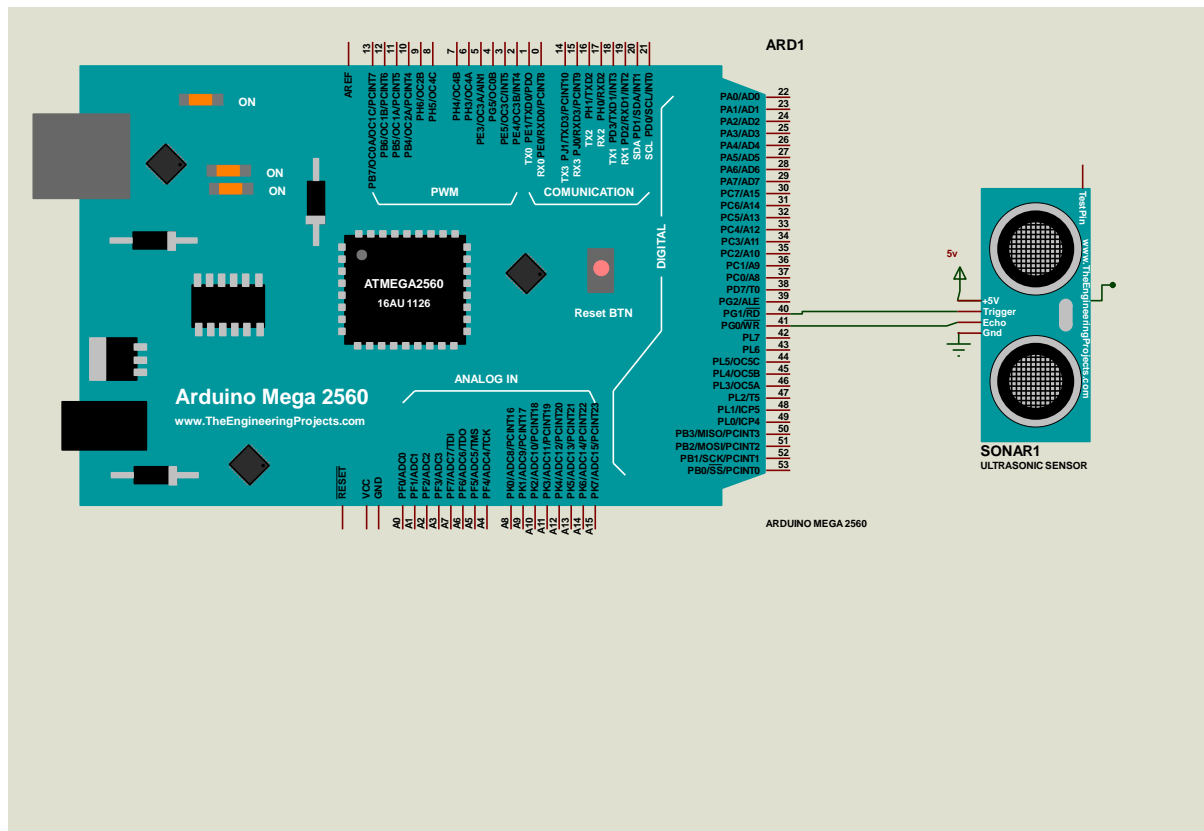


Figure3.4.1: schematic diagram of sonar with Arduino.

### 3.5 Flow chart

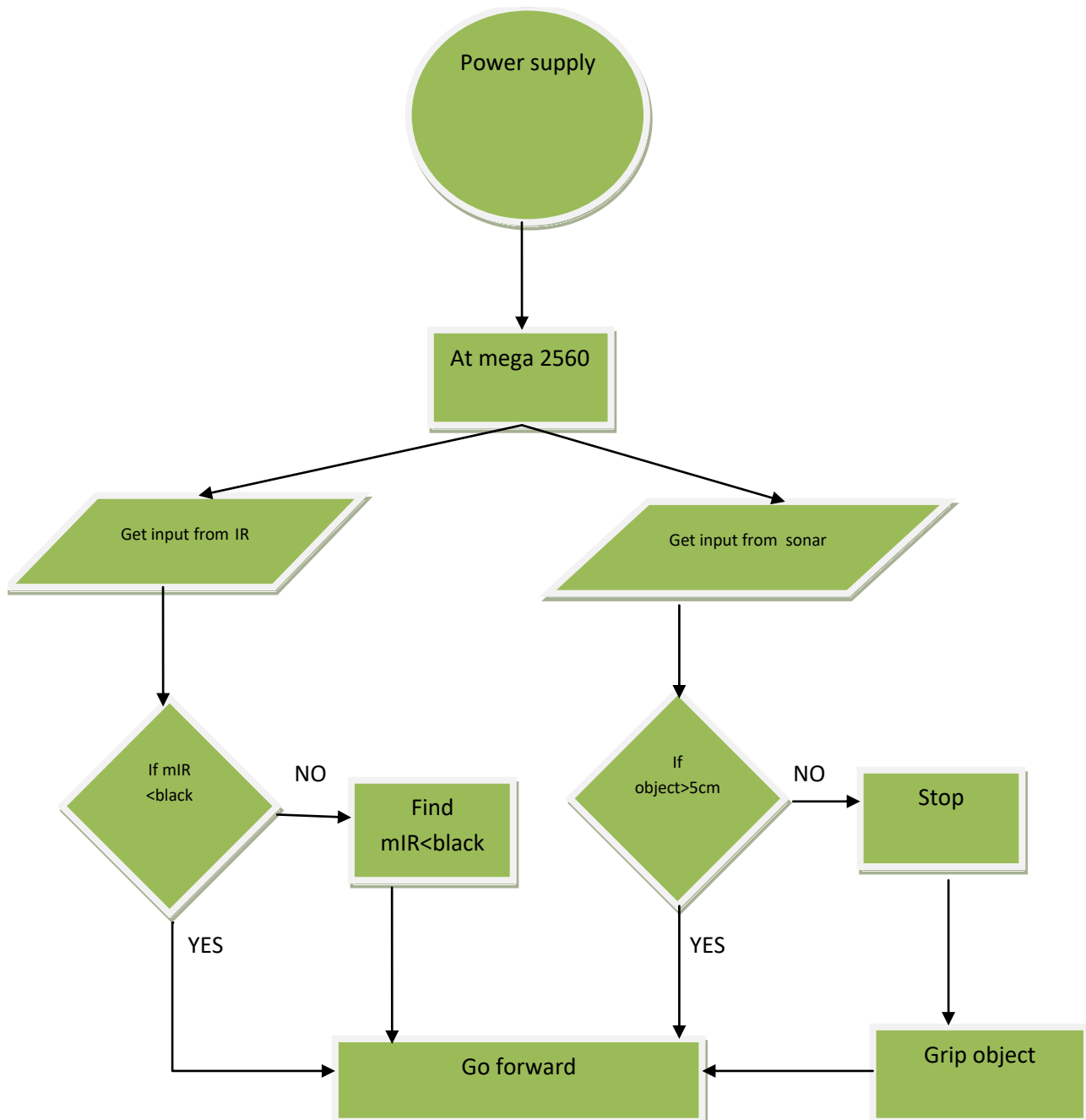


Figure 3.5.1: Flow chart

At first power from power supply goes to mega and mega takes data from ir,sonar and the ir provide analog value to mega by searching black path if it get on the track it go forward and if doesnot get it then find it. on the other hand sonar also takes power from mega and it also search object and if it detects it within 5 cm then stop and grip it and go forward .and does not find go continue its moving forward to find it.

### **3.6 Schematic Diagram of the Complete Product Collecting Robot**

#### **Description:**

Here we use one power supply which is 11.2 V and 800 mA. This power supply divided into three different voltages through regulator IC which divided 5 V and 9 V. Arduino directly powered by battery and motor driver takes 9V. Ultra sonic sensor, servo motor and IR take 5 V parallel.

When we switch on the system then IR takes the analog value to find its path by transmitting and receiving light. If IR doesn't find the path then it makes left or right dc motor active or inactive to find the path. When it is on the path Ultra sonic sensor transmit the ultra sonic waves and move forward. If it detects an object within the range 5 cm then it send a signal to dc motor and the motor will be stopped and servo motor will be active to grip the detected object. Then again the motor will move forward.



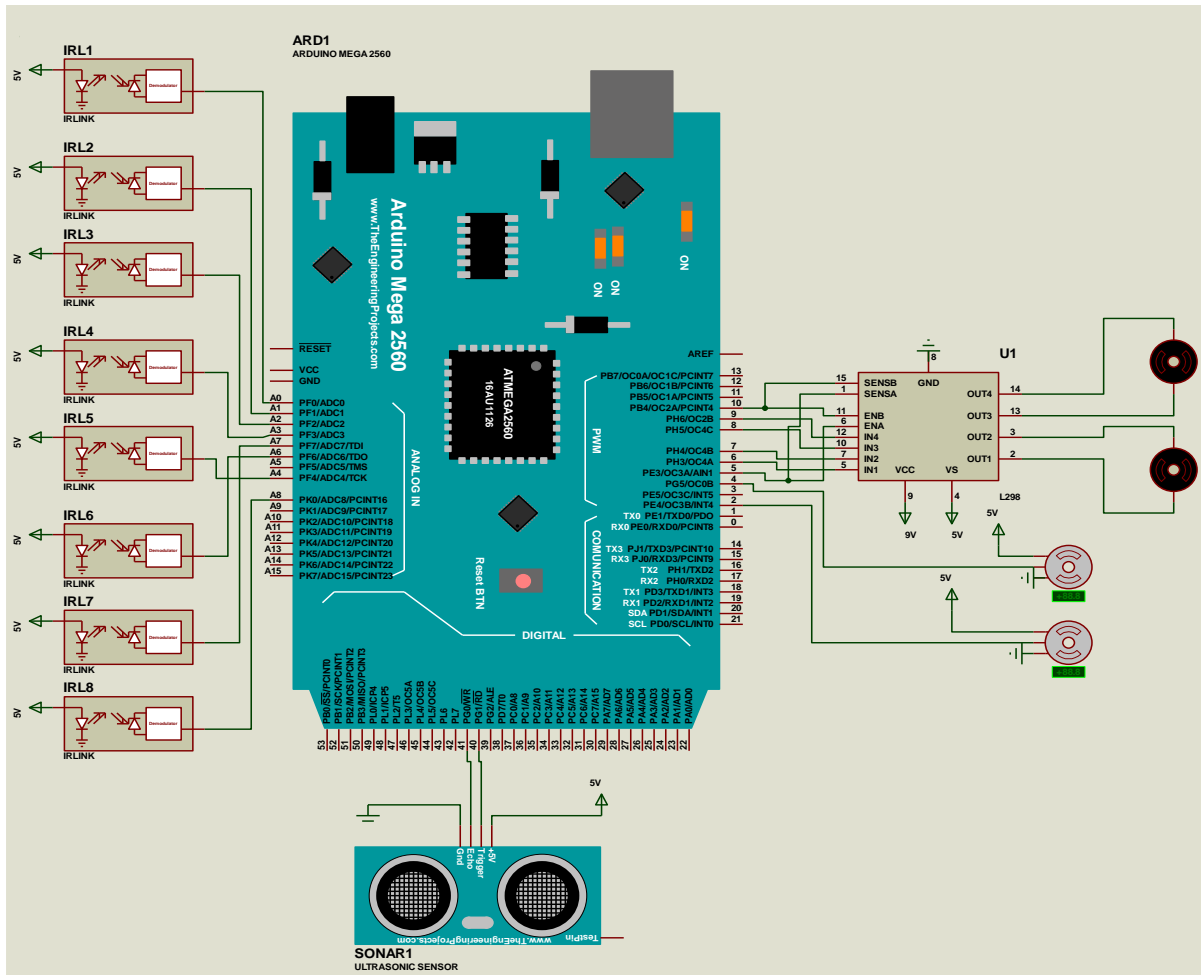


Figure 3.6.1: schematic diagram of the product collecting robot.

### 3.7 APPLICATIONS

- Product collecting Line followers can be used to deliver mail within an office building
- It can be used to deliver medications in hospital.
- The technology has been suggested forerunning buses and other mass transit systems, and may end up as part of autonomous cars navigating the freeway.
- The line follower can be used in guidance system for industrial robots moving on shop floor. An example might be in a warehouse where the robots follow 'tracks' to and from the shelves they stock and retrieve from.
- A line follower robot can be used in military as spy kids or in many other applications.

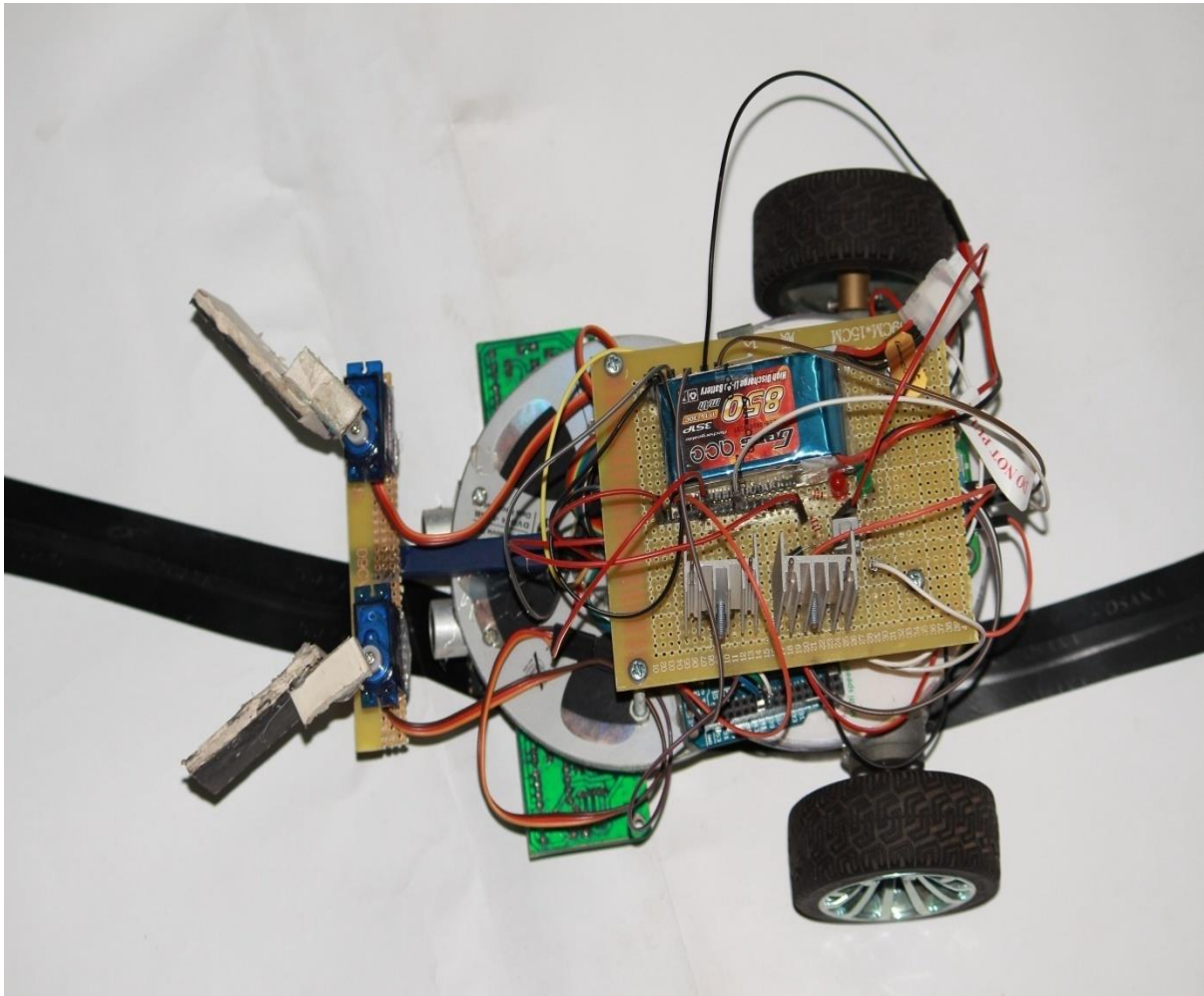
# Chapter Four

## Performance Study

### 4.1 Results

The robot has been constructed and its performance has been measured. The performance results are shown step by step in the following figures.

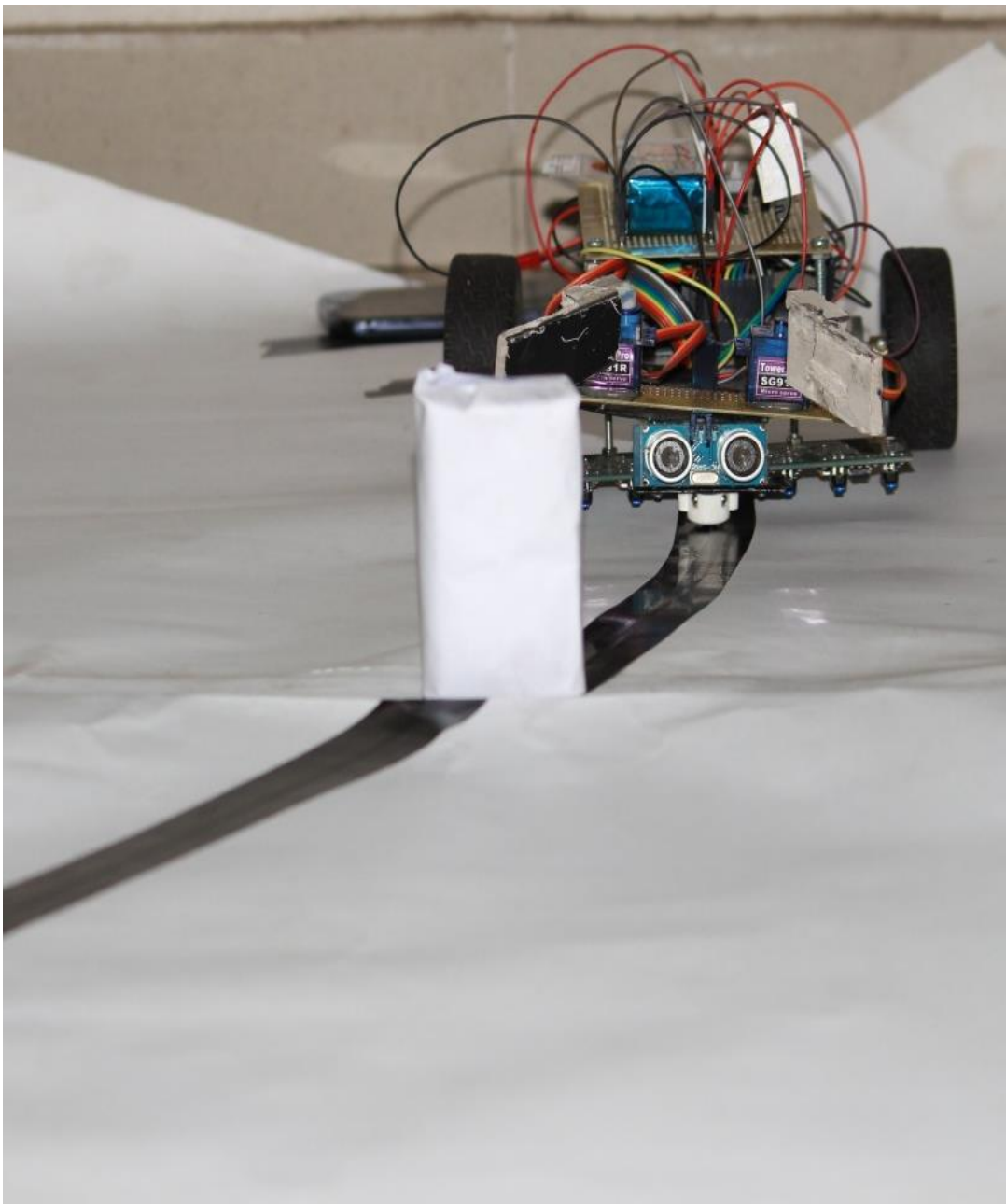
✚ **Project work performance:** Product collecting robot on the path:



**Figure 4.1.1: Product collecting robot on the line**

Here we see that the producting collecting robot is on the path and ready to move. It will follow the black path.

✚ **Project work performance:** Robot towards the object following the line:

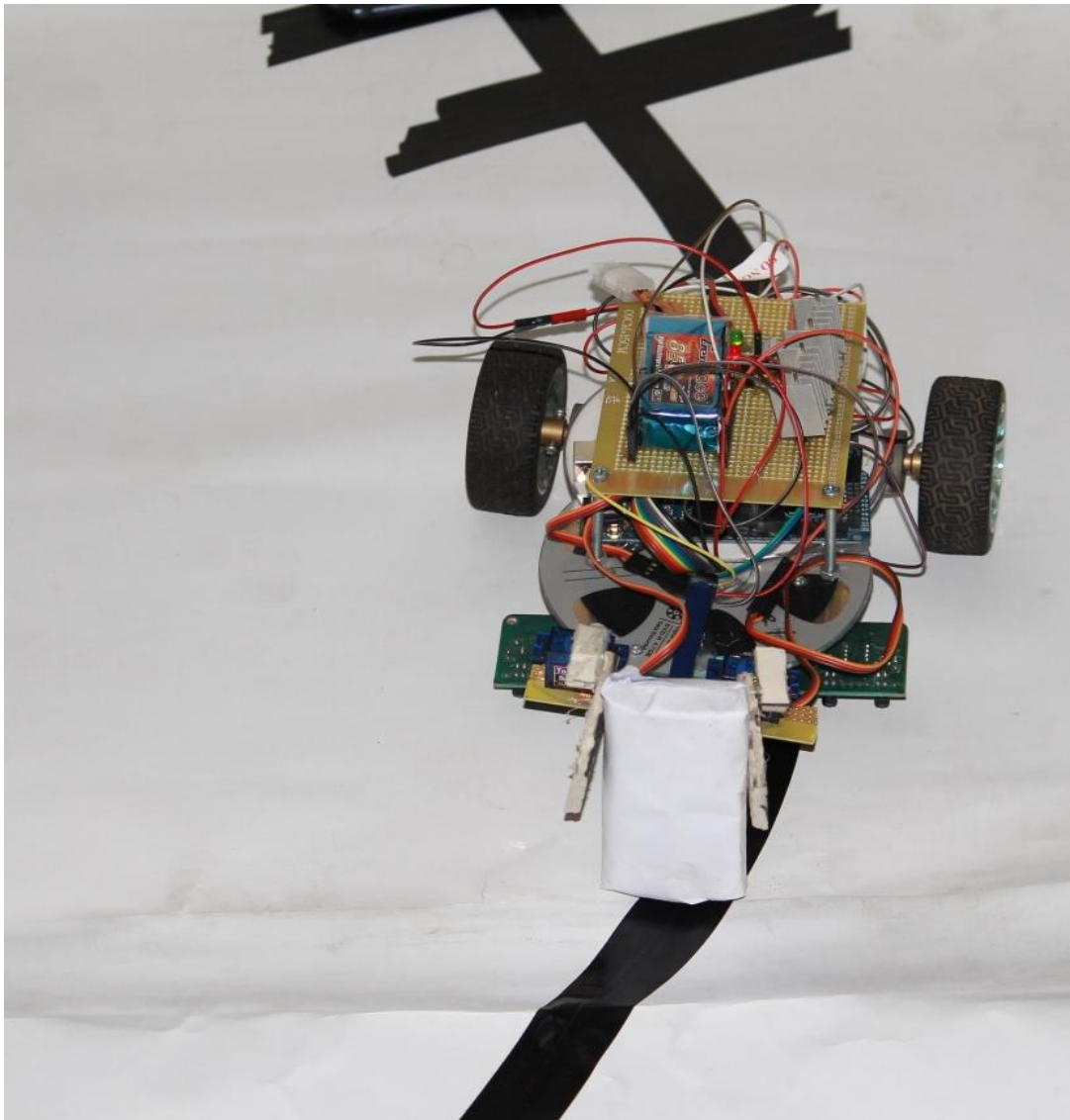


**Figure 4.1.2: Product collecting robot following the line**

Here, in Figure 4.1.2, we see that the product collecting robot is moving on the path and close to an object. Its hand is free now at this state.

Robot will hold the object on his path when it comes within the range of 5 centimeters.

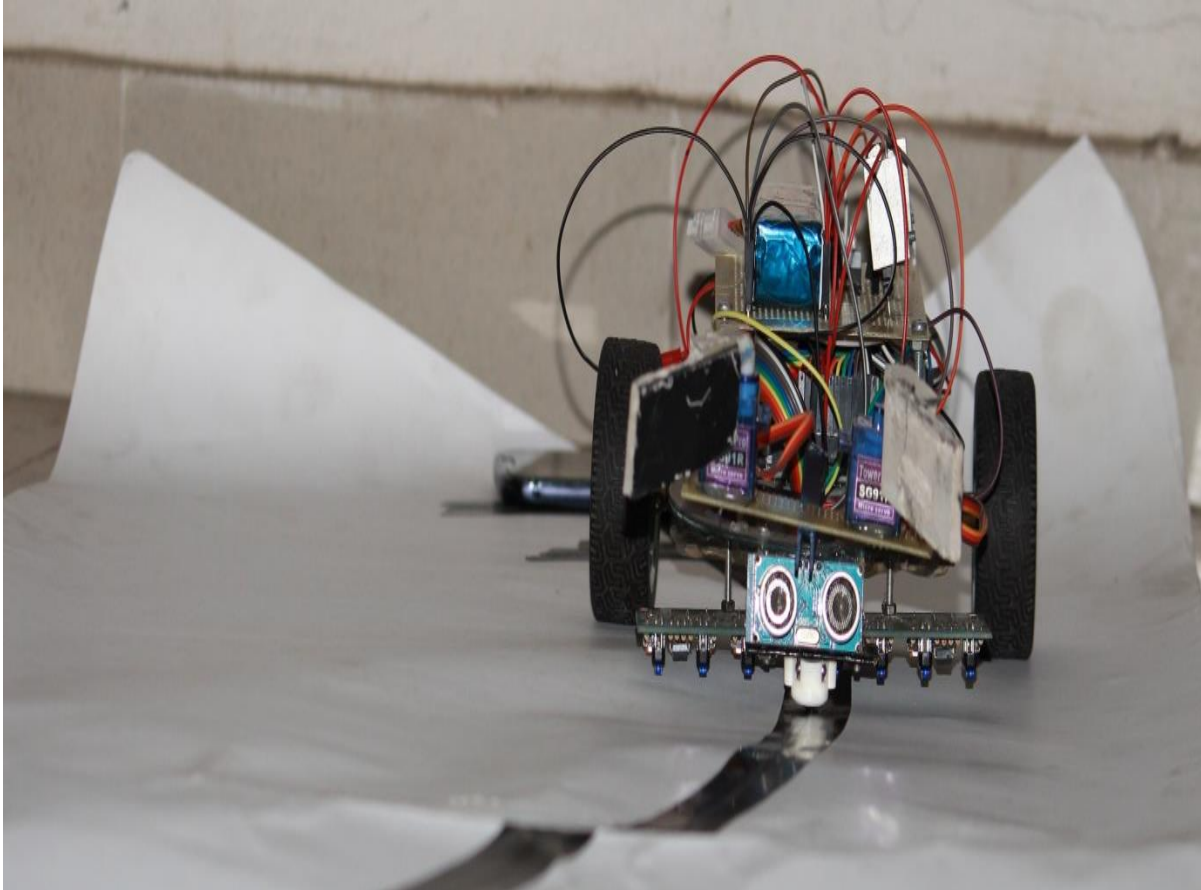
✚ **Project work performance:** Product collecting robot hold the objective:



**Figure 4.1.3: Product collecting robot hold the objective**

Here we see that the product collecting robot grip the object and ready to carry it to the destination.

✚ **Project work performance:** Product collecting robot relise the object:



**Figure 4.1.4: Product collecting robot relise the object**

Here we see that the producing collecting robot relised the object and its hand becomes again free.

Here we work about producing robot and makes a clear concept about some features and equipment like sonar, IR, At mega 2560, register, IC. In addition, we figure out some advantages and disadvantages.

Those are shown bellow

**Advantages:**

1. Robot movement is automatic
2. Used in home and industrial automation
3. Cost effective

**Disadvantages:**

1. This follows line only on a width of 1 or 2 inches on a white surface
2. It needs a smooth path otherwise IR values differ

# Chapter Five

## Discussion and Future Work

### 5.1 Discussion

By creating the product collecting line-following robot, we learned the basics of energy flow and exactly what building a circuit entails. We found out how voltage is potential energy, and how wires can run in series or in parallel depending on how many points the wires share. We understood the purpose of resistors, to transform excess energy into heat, and we discovered the function of transistors, the comparator, variable resistors, photo resistors, headlights, diodes, motors, and light emitting diodes (LEDs). We came to the conclusion that because we used less power than the robot built by David Cook, we could use less resistance. Building the robot consisted of a heavy revision and modification process. For example, knowing that the inside of the robot would be crowded with our circuit and power source, we realized that if the gears were also placed inside the robot, they would be incapable of moving without constant adjustment. Consequentially, we decided to locate the gears outside of the robot, allowing a free range of motion with less friction. Another modification we were forced to make involved the headlight circuit. Because the robot was already crowded, we decided to #electrically glue# the headlights to another breadboard using a soldering iron. However, in the end, we disconnected the headlights from the second breadboard and simply added them to the initial circuit. In the future, if we were to adjust and make further modifications, we would make the wheel size larger and experiment with different gear ratios. After getting a working circuit, we were able to test different configurations and the extent of the the robot's ability to follow a course.

In building a robot that follows lines, we explored circuits and robotics.



## 5.2 Future work

The product collecting robot is made by microcontroller, IR,sonar etc. where the motor is directly on or off using the signal of the comparator. Now the techniques can be replaced by PWM using more sensor, microcontroller and L298 motor controller IC. Also instead of LDR it can be used IR whose response is much better than LDR. There are 8 line sensors used here so the fluctuation of line is a fact. Using more than 8 sensor likely 2 sensor array may be used to detect the black line quickly. Also using microcontroller it can draw the reverse direction as well as obstacle avoiding turning the motor 180°. The block diagram may be represented as follows. Also using color sensors the robot can sense different colors. It can be used in the robotic game competition and other fields.

So the development features in brief:

- Applying PWM technique
- Use of Microcontroller
- Use of hand to grip

## 5.3: Conclusion

In this project, we have designed a product collecting robot. This robot does not need any remote controller or any controller like Bluetooth, WI-Fi, GSM, etc, it will run automatically with following a line. We have not used At mega 2560 microcontroller. This robot is very low cost but very effective for various purposes. Our project can be used in various sectors like in medicine delivering in hospitals, delivering products in any places, spying, and surveillance and so on. In future we can add several sensors, cameras etc to get more features.



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[http://ieeexplore.ieee.org/xpl/tocresult.jsp?isnumber=6317321&filter%3DAND\(p\\_IS\\_Number%3A6317321\)%26pageNumber%3D6&pageNumber=7](http://ieeexplore.ieee.org/xpl/tocresult.jsp?isnumber=6317321&filter%3DAND(p_IS_Number%3A6317321)%26pageNumber%3D6&pageNumber=7)

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## Appendix

### Codes

```
#include <Servo.h>
```

```
Servo servor;
```

```
Servo servol;
```

```
#define black 500
```

```
const int trigPin = 40;
```

```
const int echoPin = 41;
```

```
int enA = 10;
```

```
int enB = 5;
```

```
int led=39;
```

```
int rmotor2 = 8;
```

```
int lmotor3 = 7;
```

```
int lmotor4 = 6;
```

```
int rrir = analogRead(A0);
```

```
int rmir = analogRead(A1);
```

```
int rlir = analogRead(A2);
```

```
int mrrir = analogRead(A3);
```

```
int mlir = analogRead(A4);
```

```
int lrir = analogRead(A5);
```

```
int lmir = analogRead(A6);
```

```
int llir = analogRead(A7);
```

```
int abc=0;
```

```
long duration, inches, cm;
```

```
long microsecondsToInches(long microseconds){
```

```
    return microseconds / 74 / 2;
```

```
}
```

```
long microsecondsToCentimeters(long microseconds){
```

```
    return microseconds / 29 / 2;
```

```
}
```

```
void stopauto(){
```

```
    analogWrite(rmotor1, 0);
```

```
    analogWrite(rmotor2, 0);
```

```
    analogWrite(lmotor3, 0);
```

```
    analogWrite(lmotor4, 0);
```

```
}
```

```
void rightturn(){
```

```
    analogWrite(rmotor1, 0);
```

```
    analogWrite(rmotor2, 0);
```

```
    analogWrite(lmotor3, 200);
```

```
    analogWrite(lmotor4, 0);
```

```
    delay(300);
```

```
    if((rmir>black )||( rlir>black))
```

```
    {
```

```
        while(1){
```

```
            mrir = analogRead(A3);
```

```
            if(mrir>=black)
```

```
                break;
```

```
        }
```

```
    }
```

```
}
```

```

void sonar(){
  pinMode(trigPin, OUTPUT);
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(5);
  digitalWrite(trigPin, LOW);
  pinMode(echoPin, INPUT);
  duration = pulseIn(echoPin, HIGH);
  inches = microsecondsToInches(duration);
  cm = microsecondsToCentimeters(duration);
}

void setup()
{
  pinMode(enA, OUTPUT);
  pinMode(enB, OUTPUT);
  pinMode(rmotor1, OUTPUT);
  pinMode(rmotor2, OUTPUT);
  pinMode(lmotor3, OUTPUT);
  pinMode(lmotor4, OUTPUT);
  pinMode(led, OUTPUT);

  servor.attach(4);
  servol.attach(2);
  //Serial.setTimeout(900);
  Serial.begin(9600);

  servol.write(120);
  servor.write(50);
}

```

```

void loop(){
    sonar();
    int rrir = analogRead(A0);
    int rmir = analogRead(A1);
    int rlir = analogRead(A2);
    int mrir = analogRead(A3);
    int mlir = analogRead(A4);
    int lrir = analogRead(A5);
    int lmir = analogRead(A6);
    int llir = analogRead(A7);
    if(abc==0){

        if(cm<5){
            abc=1;
            Serial.println(cm);
            digitalWrite(led, HIGH);

            stopauto();
            delay(1000);
            servol.write(90);
            servor.write(90);
            delay(500);
        }
    }

    if ((mrir>black || mlir>black ) && llir<black && rlir<black && lrir<black){
        analogWrite(rmotor1, 100);
        analogWrite(rmotor2, 0);
        analogWrite(lmotor3, 100);
    }
}

```

```

    analogWrite(lmotor4, 0);
}
else if ((r1ir>black || rmir>black || rrir>black)&& mrir<black && mlir<black && lrir<black &&
lmir< black){
    analogWrite(rmotor1, 0);
    analogWrite(rmotor2, 0);
    analogWrite(lmotor3, 100);
    analogWrite(lmotor4, 0);
    if(rmir>black || rrir>black){
        while(1){
            mlir = analogRead(A4);
            if(mlir>=black)break;
            analogWrite(rmotor1, 0);
            analogWrite(rmotor2, 80);
            analogWrite(lmotor3, 80);
            analogWrite(lmotor4, 0);
        }
    }
}
else if ((lrir>black || lmir>black || llir>black)&& rlir<black && rmir<black && rrir<black &&
mrir<black && mlir<black) {
    analogWrite(rmotor1, 100);
    analogWrite(rmotor2, 0);
    analogWrite(lmotor3, 0);
    analogWrite(lmotor4, 0);
    if(lmir>black || llir>black){
        while(1){
            mlir = analogRead(A4);
            if(mlir>=black)break;
            analogWrite(rmotor1, 80);
            analogWrite(rmotor2, 0);

```

```

        analogWrite(lmotor3, 0);
        analogWrite(lmotor4, 80);
    }
}
}

else if (rmir>black && rlir>black && mlir>black && mrir>black && lmir>black &&
lrir>black){
    stopauto();
    delay(1000);
    servol.write(120);
    servor.write(50);
    delay (300);
    analogWrite(rmotor1, 0);
    analogWrite(rmotor2, 90);
    analogWrite(lmotor3, 0);
    analogWrite(lmotor4, 90);
    delay (100);
    abc=0;
}
/* else if (rmir<black && rlir<black && mlir<black && mrir<black && lmir<black &&
lrir<black){

}*/

}

```



