NEW HORIZON
COLLEGE OF ENGINEERING

Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC Accredited by NAAC with 'A' Grade, Accredited by NBA

# LINE FOLLOWING ROBOT

**A MINI PROJECT REPORT**


*Submitted by:*

**Ponnappa M M – 1NH18EE040**

**Sagar Kulkarni – 1NH18EE049**

**Shiva R V – 1NH18EE055**


***In partial fulfilment for the award of the degree of***

**Bachelors of Engineering (BE)**

**In**

Electrical & Electronics

NEW HORIZON
COLLEGE OF ENGINEERING
Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade, Accredited by NBA

## DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

### CERTIFICATE

Certified that the Mini Project work entitled **"LINE FOLLOWING ROBOT"** carried out by **Ponnappa M M(1NH18EE040), Sagar Kulkarni(1NH18EE049), Shiva R V(1NH18EE055)** are bonafide students of New Horizon College of Engineering submitted the report in completion of project at Department of Electrical and Electronics Engineering, New Horizon College of Engineering during the Academic Year 2019-20.

It is certified that all the corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for said Degree.

**Project Guide** **HoD-EEE**

**Mr. Muni Prakash T** **Dr. RamKumar S**

# ACKNOWLEDGMENT

We would like to thank everyone who supported us during this entire period of making of this project. It would not have been possible without the kind support and help of many individuals and professors. We would like to extend our sincere gratitude to every one of them. In performing this mini project, we had to take the help and guideline of some respected persons, who deserve our greatest gratitude. The completion of this project gives us much pleasure and satisfaction. We would like to show our gratitude to **Mr. Muni Prakash T, Professor Dept. of Electrical Engineering** for giving us a good guideline and helping for project throughout numerous consultations. We would also like to thank **Dr. Ramkumar S, Head of the Dept. of Electrical Engineering** for helping us**.**

I am thankful to other professors also for the valuable information provided by them in their respective fields. I am grateful for their cooperation during the period of our mini project. We would also like to expand our deepest gratitude to all those who have directly and indirectly guided us in preparing this report for this mini project.

Many people, especially our own classmates and team members itself, have made valuable comment suggestions on this proposal which gave us an inspiration and hope to improve and complete the mini project. We were very excited in doing this. We thank all the people for their help directly and indirectly to complete our project successfully.

# CONTENTS:

# 1) AIM AND OBJECTIVE OF THE PROJECT:

To create a robot that is capable of following a line. It must be capable of taking of various degrees of turns. The robot must be reliable. It must be capable of following a line even if it has breaks and high curvature and angle deviation up to 90 degrees. The colour of the line must not be a factor as long as it is darker than the surroundings. Even the robot must be intensive to environmental factors such as lighting and noise. It must allow calibration of line's darkness threshold. Scalability must be a primary concern in the design.

# 2. ABSTRACT:

The overall goal of this project is to construct a line following robot which follows a dark line over a lighter base no matter the curvature of the line. The line following robot is a self-operating robot that detects and follows the line that is drawn on the floor. It is a common basic industry demanded automated instrument which makes work easy. From the transportation of manufacturing parts inside a factory till the new food supplying robots in restaurants, line follower has its use.

This kind of robot should sense the line with infrared ray sensor that is installed under the robot. After that, the data is transmitted to the processor by specific transition buses. Hence the processor is going to decide the proper commends and then it sends them to the driver and thus the path will be followed by the line follower robot. Now, let us learn about the construction, working and its basic applications where it is in demand.

# 3. INTRODUCTION:

Since the inception of computers, automation and robotic technologies have been utilised to create consumer products that increase life quality. An example of this is the automated robot vacuum cleaner, which has become increasingly common across the world. Although vacuum cleaning may seem like an extremely minor problem to be solved, one such brand of these products, the Roomba, has sold over 10 million units worldwide, which clearly shows that there is extremely high demand for such products.

The Line Following Robot Carrier aims to utilise such technology to solve another common issue, carrying heavy items. There are many issues that are associated with carrying heavy items, ranging from health concerns to simply being inconvenient. The Line Following Robot Carrier therefore aims to eliminate such problems, by being a helpful robot that can carry almost any kind of item whilst following the user in an accurate and demure manner. Although this robot would be useful for people of all ages, this project's main demographic is the elderly (60+) and those with physical disabilities.

Since mid-1974's, the population of those aged 60 or over has increased by 47% and now make up nearly 18% of the population, while the number of those aged 75 or over has increased by 89% and makes up 8% of the population. Approximately one-third of independent adults aged 60 or over experience a fall, many of which occur because of instability caused by groceries. Citizens with physical disabilities make up roughly 9% of the population of England. The Line Following Robot Carrier would greatly increase the level of safety for those who want more independence from human care.

There is currently no aide on the market that helps to carry objects for those who need it. The closest competitor would be the Starship25 robot, which is designed to make package deliveries. ALT is a rapidly expanding part of the worldwide market for robot systems in 2014 was estimated to be around $32 billion, with government subsidies being planned for such products, thus the Following Robot Carrier could make a name for itself as a staple piece of technology for this large proportion of the population.

However, this product must be designed with extra criteria in mind, as although there is a trend of the elderly becoming more technology savvy, the large majority are still finding it difficult to understand technology. To cater towards this, the robot must be made to be very simple to operate. Furthermore, the robot should be easy to set up for use to make it accessible, for those with physical impairments. For the prototyping of the robot, features such as obstacle avoidance will be excluded, and the main focus will be on optimising the way in which the robot follows the user.

# 4. COMPONENTS USED:

## 1) IR proximity sensor

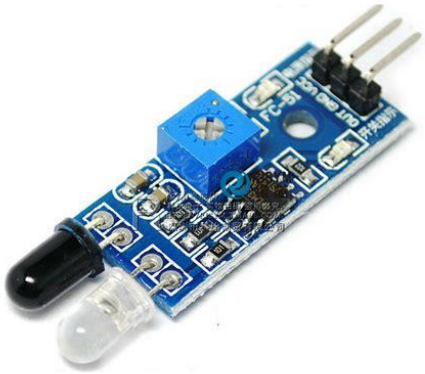


Fig 1. (Range = 5V. LM368, Potentiometer included in the sensor)

**IR Proximity Sensor** is a multipurpose **infrared sensor** which can be used for obstacle **sensing**, colour detection, fire detection, line **sensing**, etc and also as an encoder **sensor**

## 2) L293D IC


Fig 2. (Range =5V.)

**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

**3) Switch (3 pin)**

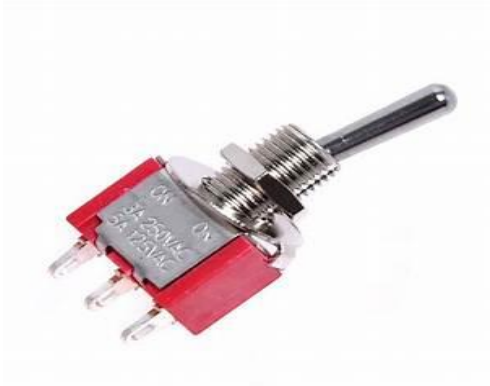


Fig 3.

**4) BO motor**

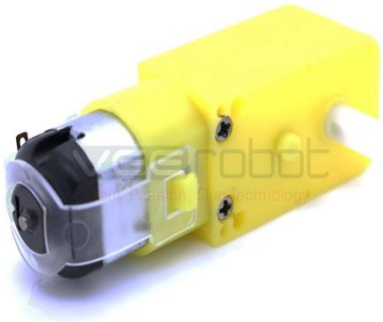


Fig 4. (I Shape motor. Range = 5V)

**BO** (Battery Operated) light weight DC geared **motor** which gives good torque and rpm at lower voltages. This **motor** can run at approximately 200 rpm when driven by a single Li-Ion cell.

**6) Pin head wires**

Fig 5.

**7) Wires**

(Single strand)

**5) IC7805**


Fig 6.

(Max voltage applied = 18V. Regulated to voltage =5V) IC **7805** is a 5V Voltage Regulator that restricts the output voltage to 5V output for various ranges of input voltage

**8) Battery 9V(x2)**


Fig 7.

**9) Wooden frame/Chassis**

Fig 8.

**10) Wheels (x2)**

# 5. CIRCUIT DESCRIPTION:

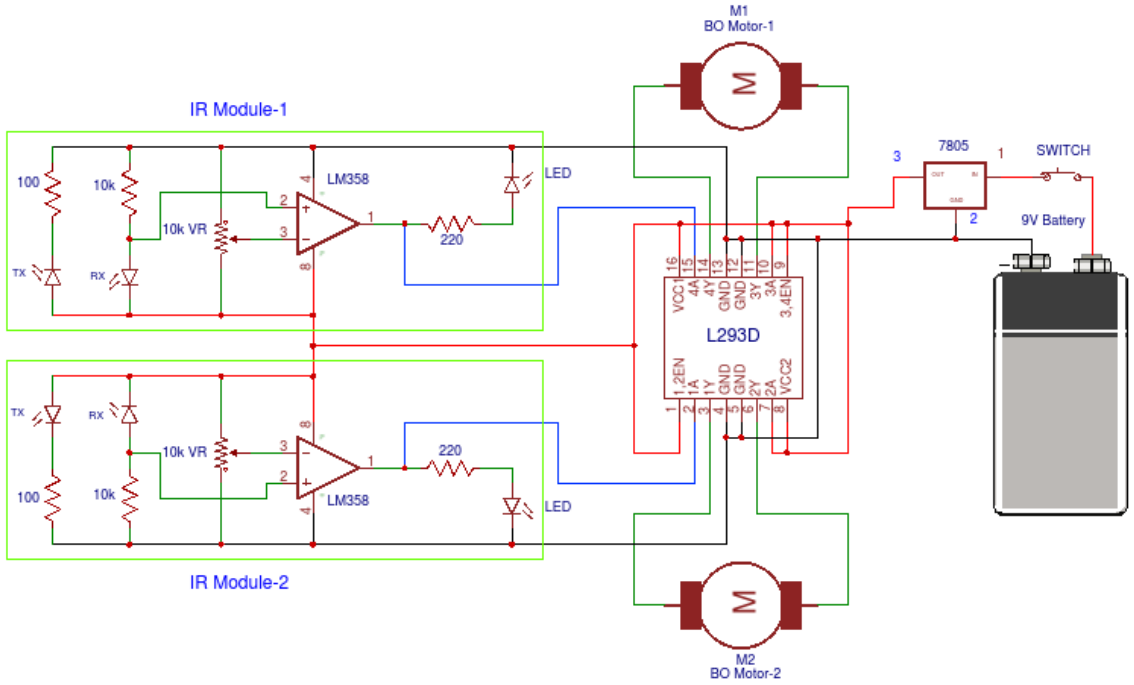



Fig.8.Circuit diagram of line follower robot

When an object comes in the sensing area, the emitted IR light reflects off the object back to the photo-transistor. The amount of light energy reaching the detector increases. This change in light energy or photo-current is used as the input signal to activate the motors, of the line following robot.

The collector current of the photo-transistor is also dependent on the distance of the object's reflector surface from the sensor. The intensity of the reflected signal returning to the detector depends on the surface over which the robot moves. White surface reflects maximum infrared signal, while black surface absorbs maximum infrared signal.

Motor driver L293D, is interfaced with sensors and controls the 9V geared DC motors M1 and M2. The L293D is a quadruple high-current, half-H driver. It is designed to provide bidirectional drive current of up to 600 mA, at 4.5V to 36V. The device is designed to drive inductive loads such as motors

as well as other high-current or high-voltage loads in positive-supply applications.

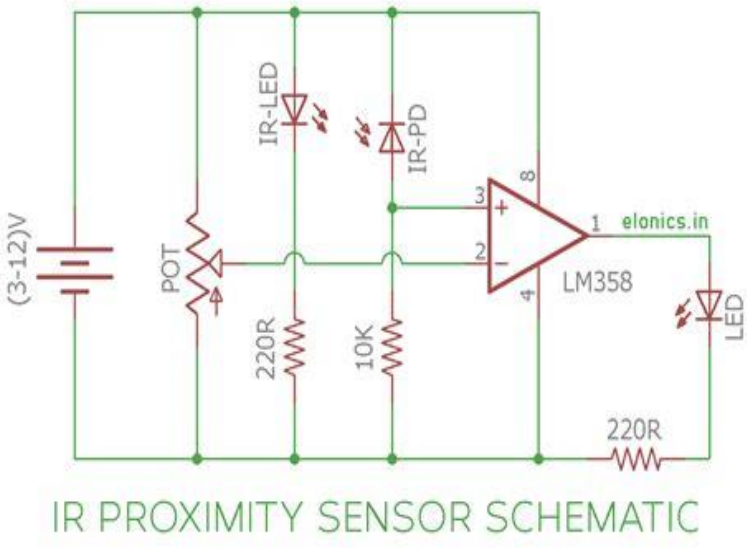



Fig.10.Circuit diagram IR proximity sensor

The motor drivers are enabled in pairs. When enable input pins 1 and 9 of IC4 are high, the associated drivers for M1 and M2 are enabled and their outputs pin 3 and 6, pins 11 and 14, respectively and are active and in phase with the inputs.

With the proper data inputs, each pair of drivers forms an H-bridge reversible drive suitable for motor applications. Motors M1 and M2 rotate in forward direction (say clockwise) when both the sensor outputs are low.

# 6. CONSTRUCTION:

A 9V battery is connected to the breadboard via battery holder. The positive power supply is passed to the input of IC7805 (1) and sent out through the OUT (3). The negative power supply is sent to the GND (2) connection of IC 7805. In between, two capacitors (C1 and C2) are connected to the IN and OUT of IC 7805 respectively. As a result of this process, 5V of current is acquired. Subsequently, an IC L293D is placed on the breadboard.

The first 12V DC motor is connected to the 3rd and 6th pin of IC L293D, while the second is attached to 11th and 14th pin. The two plastic wheels are connected together with the motors. Additionally, a castor wheel is included at the front of the robot for balancing and as well as for making quick movements. The 1st, 8th, 9th, and 16th pins are given the power supply of 5V. The 2nd and 15th pin are integrated with the two IR sensor circuits. Now, connect the battery to the circuit, and place the robot on the black lines of the white surface.

The IR sensor will start sensing the black lines, and travel on it as it is drawn on the surface. A most advantage factor in this project is that it can be developed within 400 Rupees. These robots can also be developed with the help of a micro-controller. However, the connections made will be very complex to understand even for the professionals.

As a result, this simple line following robot will certainly make you easy to gather the components by just observing its particular circuit diagram.

# 7. WORKING:

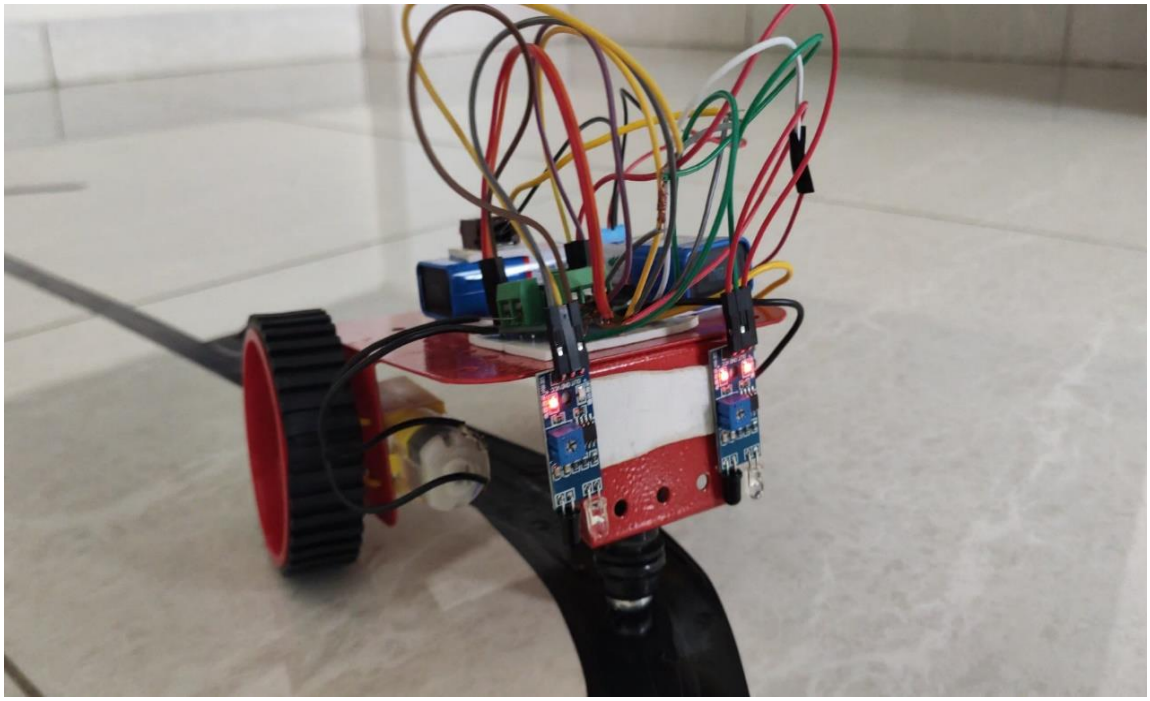
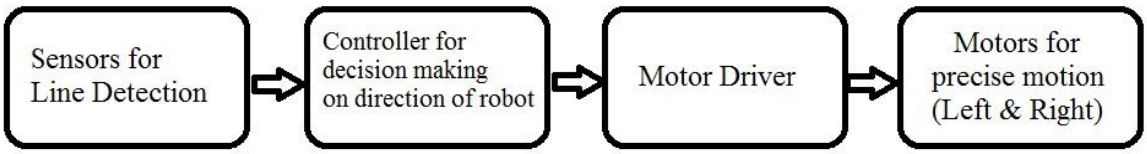


fig 11. Line following robot (working hardware model. Front view)

The line follower robot built in this project is divided in to 4 blocks. The following image shows the block diagram for line follower robot.




Block Diagram for Line Follower Robot

The regulator 7805 which is inserted between input of battery and input voltage ports of the IC and IR sensor regulates the voltage to 5V. IR rays will be reflected by white surface while black surface will absorb IR rays. Normally white surfaces don't absorb the light and they end up reflecting most of the incident light. Whereas black surfaces absorb most of the light incident and barely reflect the light from the diode.

In the line follower as we have placed both the IR sensors on the left and right side of the robot's front face, both the IR sensors will be on the white

surface. The IR sensors are not placed initially on the black line and thus when it is switched ON, the robot tends to move automatically.

Now, when the switch is in ON condition, IR rays will be emitted from the IR transmitter and reflected back by the white surface and the reflected rays will be absorbed and be detected by the Photo diode, in this state the IR sensor will sends output voltage to the comparator LM358.

The comparator LM358 will relatively compare the input voltage (5V) with the output voltage received from the output of the IR sensor. The HIGH digital signal ("1") is generated when output voltage is higher than the input voltage and LOW digital signal (“0”) is generated when input voltage is higher than the output voltage.

The output voltage is higher when the IR sensor is present on the white surface and lower on the dark surface. Therefore, on the white surface, the output voltage is higher and the comparator gives a HIGH digital signal ("1").

Similarly when the sensor is on a black surface IR rays will be emitted and will not be reflected back which will be absorbed by the black surface, in this state the IR sensor will send voltage to the comparator and as the input voltage is higher than the output voltage, LOW digital signal ("0"), thus with these digital values 1 and 0 we can easily identify the state of the sensors.

Now the output is sent to the main IC L293D. This IC works on H bridge principle which is basically used in functioning 2 DC motors simultaneously.

We will be using two 500rpm DC motors here, you can use motors with different rpm as per your requirement. These motors will work when they are connected to any DC power source, the direction of rotation of the motor can be changed by changing the polarity of the source.

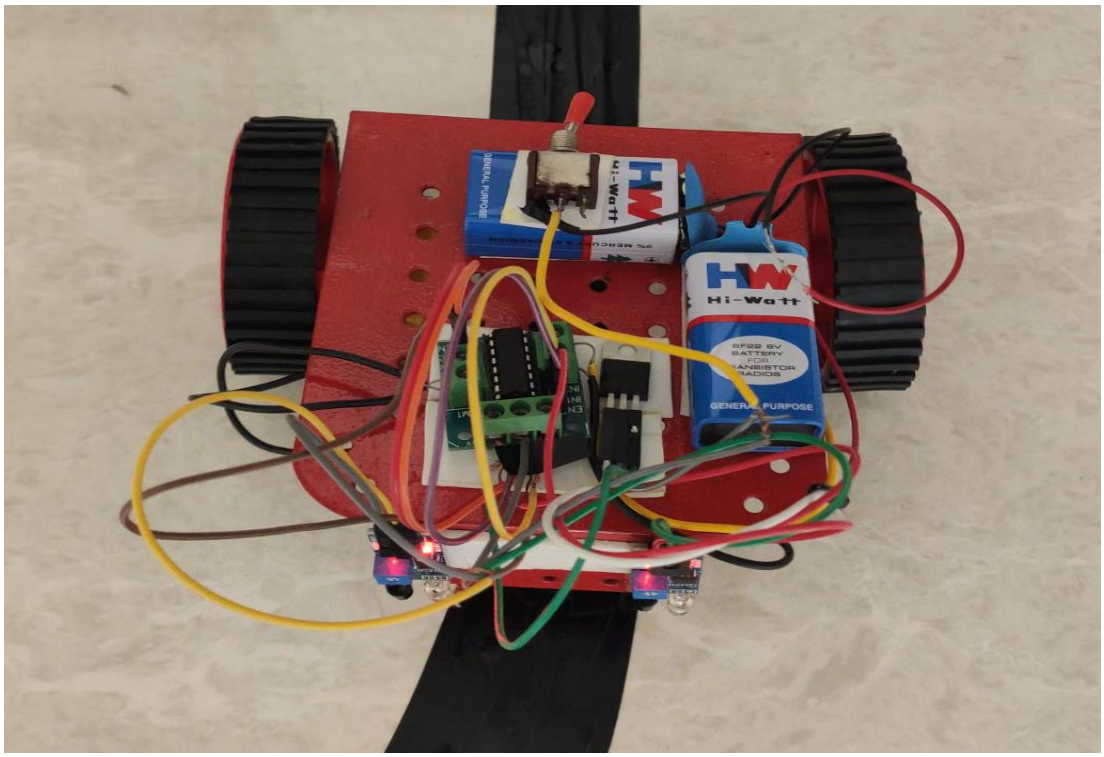



Fig 12. Line following robot (working hardware model. Top view)

IC L293D will be used to control the motors which will work with digital I/O. Assume that the input given to the motor through L293D is HIGH("1") and LOW("0 similarly "). When the left IR sensor sends a signal “1”, to the pin 2 of L293D, the left motor which is connected to pin 3 and 6 of the IC will receive the output voltage 5V and the motor starts to rotate. On the black surface, the output voltage from the IC will be 0V and the motor doesn’t work

Similarly, when the left IR sensor sends a signal “1”, to the pin 15 of L293D, the right motor which is connected to pin 11 and 14 of the IC will receive the output voltage 5V and the motor starts to rotate. On the black surface, the output voltage from the IC will be 0V and the motor doesn’t work.

When the right IR sensor detects the white surface and the left IR sensor detects dark surface, the right motor only turns and left motor stops which makes the robot take a left turn and similarly vice versa.

# 8) MERITS, DEMERITS AND APPLICATIONS:

## Merits:

1) The system used in the robot is one time install and forget.
2) It is relatively cheap.
3) This type of robot is simple to build.
4) They can also be used for long distance.

## Demerits:

1) LFR can move on a fixed track or path.
2) It requires power supply.
3) Lack of speed control makes the robot unstable at times.
4) Choice of line is made in the hardware abstraction and cannot be changed by any software.

## Applications:

1) Used in Industrial automated equipment carriers.
2) Automated cars applications.
3) Used in tour guides in museums and other similar applications.
4) Deliver medications in a hospital.
5) It can also be used for floor and room cleaning.

# 9) SUMMARY:

Line follower is one of the important concepts of robotics. Line following robot is an autonomous robot which is able to follow either a black or white line, that is drawn on the surface consisting of a contrasting colour. It is designed to move automatically and follow the plotted line.

It enhances inter disciplinary approach to mechanical, electrical, electronic and programming skills. The application of the project is range from the individual domestic appliance to automation and control aspect of large-scale industry. Humans are intelligent natural machine but it has serious limitation of efficiency and reliability. Robots are made to replace dependency of human force partially. The project is a sample of similar tasks.

# 10) CONCLUSION:

In the modern age, implementation of something new which is more reliable and minimum in cost is needed. This type of robot can be used for defence purpose also for carrying injured soldiers and heavy armoury and machinery. Using the idea of this project, robot which is used in various fields for various purposes can be implemented.

It has been implemented recently in hotels for automatic food serving and carrying goods which are heavy from one place to another. The value of this product has been increasing to reduce labour pressure. Amazon, flipkart, myntra, snapdeal, walmart have been using line following robots to carry massive goods and supply them.

Therefore, we can conclude by saying that this line following robot is a basic sample model which is completely runs on analog circuit without using a microcontroller. This project can further be upgraded and modified to set different speeds and accuracy, precision by inserting number of Infrared Radiation proximity sensors and Microcontrollers with required Arduinos with precise programming and implementation.

# 11) REFERENCES:

**Books:**


- Programming and Customizing the AVR Microcontroller – Dhananjay V. Gadre
- Parallel Port Complete – Jan Axelson
- Modern Digital Electronics – R.P Jain
- IEEE Spectrum magazine / http://spectrum.ieee.org/magazine/
- IEEMA Journal


**Links:**


- Atmel Corp. Makers of the AVR microcontroller http://www.atmel.com
- AVRbeginners.net http://www.avrbeginners.com
- Wikipedia www.wikipedia.org
- Electronics tutorials www.electronics-tutorials.ws
- WWW.ELECTRAMA.COM