IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 9, Issue 5, May 2021

DOI 10.17148/IJIREEICE.2021.9542

# LINE FOLLOWING ROBOT

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**Abstract**: Line Following is one of the most important aspects of robotics. A Line Following Robot is an autonomous robot which is able to follow either a black line that is drawn on the surface consisting of a contrasting colour. It is designed to move automatically and follow the line. The robot uses arrays of optical sensors to identify the line, thus assisting the robot to stay on the track. The array of two sensor makes its movement precise and flexible. The robot is driven by DC gear motors to control the movement of the wheels. The dc gear motor is driven by the motor driven circuit . This project aims to implement the algorithm and control the movement of the robot by proper tuning of the control parameters and thus achieve better performance.. It can be used industrial automated equipment carriers, small household applications, tour guides in museums and other similar applications, etc.

Keywords**:** line following , microcontroller, DC gear ,sensors ,optical sensors.

## I. INTRODUCTION

Line follower is a machine that can follow a path. The path can be visible like a black line on a white surface. Sensing a line and manoeuvring the robot to stay on course, while constantly correcting wrong moves using feedback from the sensor forms a simple yet effective system. It can be used in automobile, industrial automations, guidance, etc. Line Follower is one of the most important aspects of robotics. A 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 color. It is designed to move automatically and follow the plotted line. It enhances interdisciplinary approach to mechanical,electronic, electrical and programming skills. The application of the project is range from the individual domestic appliance to automation and control aspect of large industry. Human are intelligent natural machine but it has serious limation of efficiency and realiblity. Robots are made to replace dependency of human force partially. The project is somehow designed to perform the similar task.

The objectives of the project are:

- It should be capable of taking various degrees of turns.
- The robot must be insensitive to environmental factors such as lighting and noise.
- It must allow calibration of the line's darkness threshold.

Scalability must be a primary concern in the design.
The robot must be capable of following the line.

## COMPONENTS DISCRIPTION

**Motor Driver :-** Motor driver is a current enhancing device; it can also be act as Switching Device. Thus, after inserting motor driver among the motor and microcontroller. Motor driver taking the input signals from microcontroller and generate corresponding output for motor.

**IC L293D** -- This is a motor driver IC that can drive two motor simultaneously. Supply voltage (Vss) is the voltage at which motor drive. Generally, 6V for dc motor and 6 to 12V for gear motor are used, depending upon the rating of the motor. Logical Supply Voltage deciding what value of input voltage should be considered as high or low .So if the logical supply voltage equals to +5V, then -0.3V to 1.5V will be considered as Input low voltage and 2.3V to 5V is taken into consider as Input High Voltage. The Enable 1 and Enable 2 are the input pin for the PWM led speed control for the motor L293D has 2 Channels .One channel is used for one motor.

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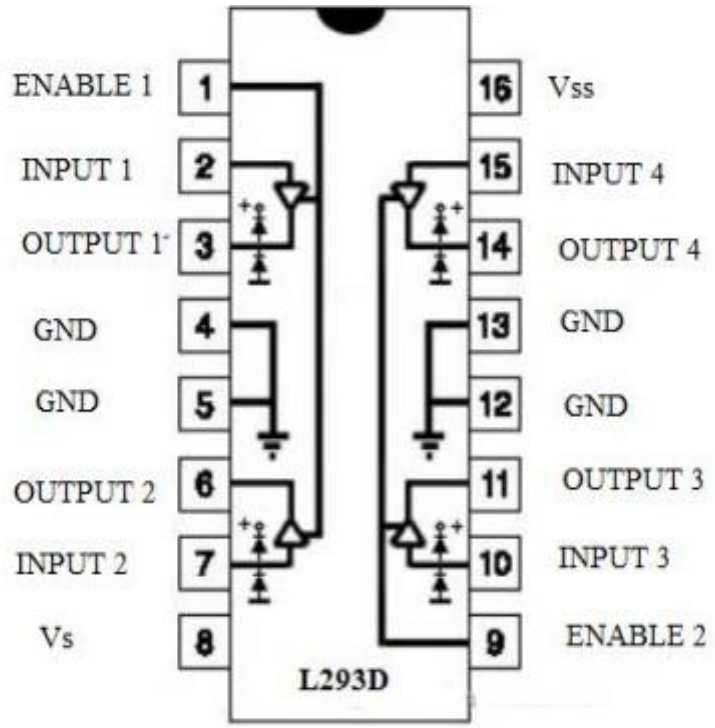
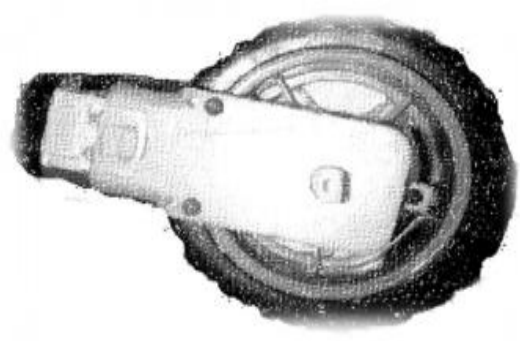



**Gear DC Motor:-** Motor is a device that converts any form of energy into mechanical energy or imparts motion. In constructing a robot, motor usually plays an important role by giving movement to the robot. In general, motor operating with the effect of conductor with current and the permanent magnetic field. The conductor with current usually producing magnetic field that will react with the magnetic field produces by the permanent magnet to make the motor rotate. There are generally three basic types of motor, DC motor, even servomotor and stepper motor, which are always being used in building a robot. DC motors are most easy for controlling. One DC motor has two signals for its operation. Reversing the polarity of the power supply across it can change the direction required. Speed can be varied by varying the voltage across motor.



**SPECIFICATION OF DC GEAR MOTOR –**

Voltage of the dc motor- 9/12 volts
Number of gear motors used – 2
NUMBER OF ROTATION – 300-500 RPM

**Infrared sensor :-** An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR

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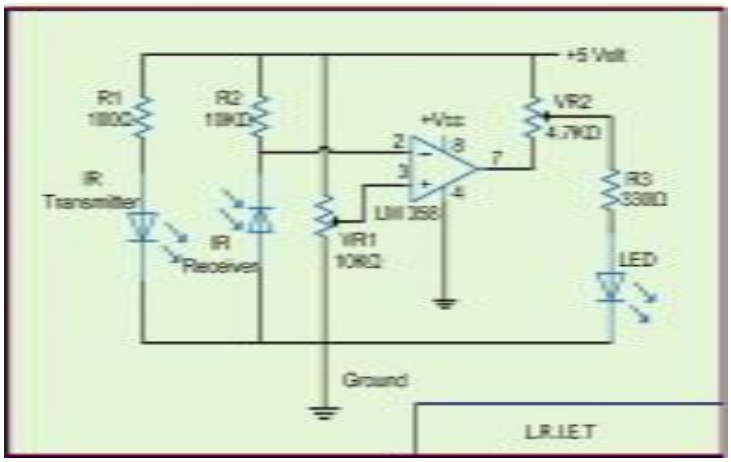
photodiode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

This circuit comprises of the following components

1. LM358 IC 2 IR transmitter and receiver pair
2. Resistors of the range of kilo-ohms.
3 . Variable resistors.
4. LED (Light Emitting Diode).




In this project, the transmitter section includes an IR sensor, which transmits continuous IR rays to be received by an IR receiver module. An IR output terminal of the receiver varies depending upon its receiving of IR rays. Since this variation cannot be analyzed as such, therefore this output can be fed to a comparator circuit. Here an operational amplifier (op-amp) of LM 339 is used as comparator circuit.

When the IR receiver does not receive a signal, the potential at the inverting input goes higher than that non-inverting input of the comparator IC (LM339). Thus the output of the comparator goes low, but the LED does not glow. When the IR receiver module receives signal to the potential at the inverting input goes low. Thus the output of the comparator (LM 339) goes high and the LED starts glowing. Resistor R1 (100 ), R2 (10k ) and R3 (330) are used to ensure that minimum 10 mA current passes through the IR LED Devices like Photodiode and normal LEDs respectively. Resistor VR2 (preset=5k ) is used to adjust the output terminals. Resistor VR1 (preset=10k ) is used to set the sensitivity of the circuit Diagram.


**Power supply :-** Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely toothers. Here in our application we need a 9v DC power supply for all electronics involved in the project. This requires step down transformer, rectifier, voltage regulator, and filter circuit for generation of 5v DC power. For our project we have used one 9V battery .

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**Battery Snap** :- Probably the easiest way to connect our DC LEDs to power is using a 9V battery, with these nice long battery snaps. As you can see from this photo, the battery snap is designed to snap onto the leads on the terminal end of any standard 9V battery.These battery straps have two leads, a red "positive" wire and a black "negative" wire. Each of our pre-wired LEDs also come with a red positive wire and a black negative wire.

Fig. 14 Battery Snap

**Robotic Chassis:** This robotic chassis kit contains of an acrylic base with two gear motors, two compatible wheels, a ball caster, and other accessories.

**Wheel specification—**
Width: 30mm
Diameter: 65mm

**Jump wire ;-** (also known as jumper wire, or jumper) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

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## WORKING OF PROJECT

In this line follower robot we have used IR Transmitters and IR receivers also called photo diodes. They are used for sending and receiving light. IR transmits infrared lights. When infrared rays falls on white surface, it's reflected back and catch by photodiodes which generates some voltage changes. When IR light falls on a black surface, light is absorb by the black surface and no rays are reflected back, thus photo diode does not receive any light or rays. Here in this line follower robot when sensor senses white surface then IC gets 1 as input and when senses black line IC gets 0 as input.

The whole line follower robot can be divided into 3 sections: sensor section, control section and driver section.

**Sensor section**: This section contains 2Array IR Sensors which includes IR diodes, potentiometer, Comparator (Op-Amp) and LED's. Potentiometer is used for setting reference voltage at comparator's one terminal and IR sensors are used to sense the line and provide a change in voltage at comparator's second terminal. Then comparator compares both voltages and generates a digital signal at output. Here in this line follower circuit we have used two comparator for two sensors. LM 358 is used as comparator. LM358 has inbuilt two low noise Op-amps.

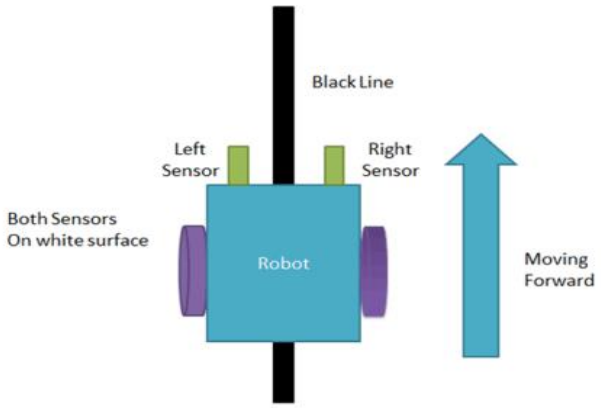
**Control Section**: **IC L293D** is used for controlling whole the process of line follower robot. This IC reads these signals and send commands to driver circuit to drive line follower.

**Driver section:** Driver section consists motor driver and two DC motors. Motor driver is used for driving motors. So we add a motor driver circuit to get enough voltage and current for motor. **IC L293D** sends commands to this motor driver and then it drive motors.

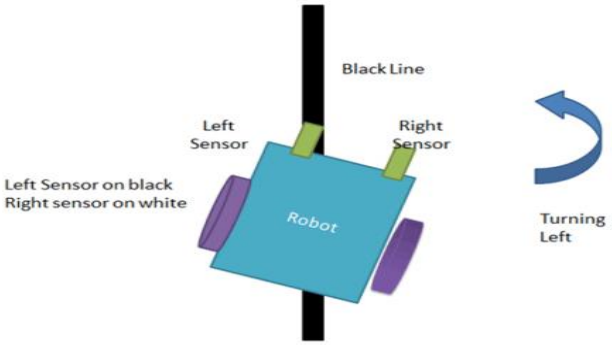
Here in this project we are using two IR sensor modules namely left sensor and right sensor.

When both left and right sensor senses white then robot move forward.

forward.




If left sensor comes on black line then robot turn left side.




If right 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.

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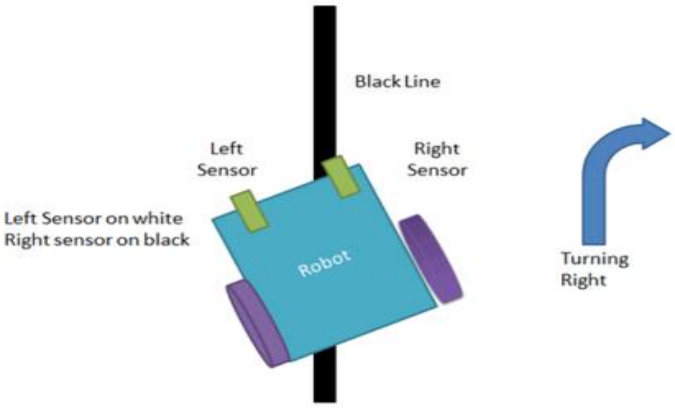
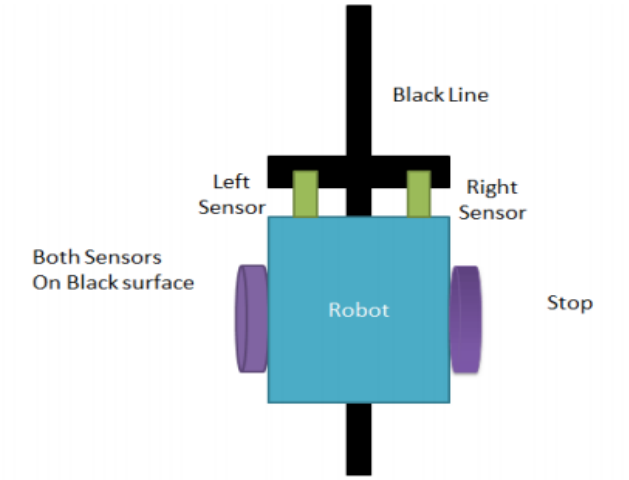



If both sensors comes on black line, robot stops




**Track For LINE FOLLOWING ROBOT:** We can use any track for the robot. The following we have used. We had to make sure that the black line should be opaque and the surface be transparent.

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## APPLICATIONS OF PROJECT

Line followers can be used to deliver mail within an office building It can be used to deliver medications in a hospital. The technology has been suggested for running buses and other mass transit systems ,and may endup 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.

## LIMITATIONS OF PROJECT

The system has restricted to the following limitation.
The ir sensor cannot be work in the day light it works only in the dim light or room light .
Few curves are not made efficiently, and must be avoided
The turning radius should be of minimum 50m to take smooth U-turning of robot
The width of the path must be of 35mm so that it can cover minimum 2 sensors.
The path should be plane and obstacle free.
The steering mechanism is not easily implemented in huge vehicles and• impossible for non-electric vehicles.

## CONCLUSION

In this project, we have designed a line following robot. This robot does not need any remote controller or any controller like Bluetooth, Wi-Fi, GSM, driver etc, it will run automatically with following a line. We have not used any 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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