Sensor Based Black Line Follower Robot

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Abstract:- **Robot is an invention of modern times. A robot is a machine design to execute one or more tasks repeatedly with speed and precision. It is a system that contains power supplies, sensors, manipulators, control systems, and software, all working together to perform a task.**

Line follower is a machine that can follow a path. The path can be a black line on white surface or vice-versa or it can be invisible like a magnetic field. Line follower robots were one amongst the earliest automatic target-hunting robots.

Key words: Line Follower, Sensor, Manipulator, Magnetic field, Comparator.

I. INTRODUCTION

Now a day's industries are highly automated for various applications. Line follower robots are used in semi as well as fully autonomous plants. The line follower is a self-operating robot that detects and follows a line that is drawn. The path consists of a black line on a white surface.

The sensors that can be used are typically LED/LDR, LED/Photodiode or LED/Phototransistor pairs. The line follower mechanism conferred here is meant to follow a black line on a white background. It is a combine of sensors (LED / LDR). It is not required to use microcontroller for this type of mechanism. A group of comparators and a motor driver circuit can do the duty. This kind of robot can be used for transportation systems, blind assistive applications, military purposes, delivery services. There are many annual line follower robots competitions organized by universities or industries around the world. They usually ask robotic teams to build a small robot with specific dimensions and weight. Fig.1 shows the side view of the robot.

Organization: The paper is organized in the following sections. Section 2 describes about the sensors, section 3 describes about the comparator, section 4 describes about the motor driver, section 5 describes about the Dc motor and wheels, section 6 describes about the chassis and body structure.

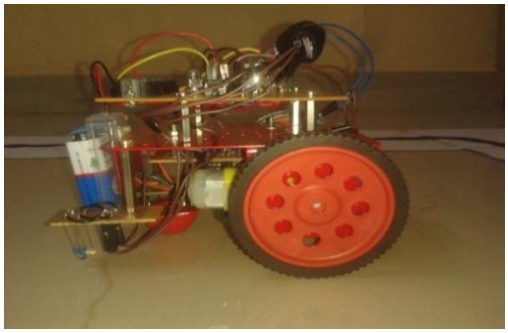

Fig.1 Line Follower Robot- Side View

The line following robot can be divided into several blocks, as shown in Fig.2:

- Sensor
- Comparator
- Motor driver
- Dc motors and wheels(actuators)
- Chassis and body structure

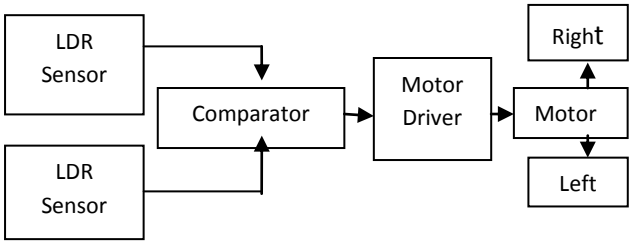

Fig.2 Block Diagram for Line Follower Robot

II. SENSORS

The sensor part consists of a set of LED / LDR pairs for the left side and right sides. These LED / LDR pairs detect the black line on the white surface on which the robot is supposed to move. The LDR has an inverse relationship between its resistance and the light falling on it.

When a particular LED / LDR pair is above the white surface the reflected light falls on the LDR and its resistance drops, conversely when the LED / LDR pair is above the black line, its resistance rises. This variation in resistance of the LDRs is used to assess the orientation of the line follower robot in the X-Y plane.

III. COMPARATOR

In electronics, a comparator is a device that compares two voltages or currents and outputs a digital signal indicating which is larger than the other. It has two analog input terminals V_+ and V_- and one binary digital output V_o

The job of the comparator circuit is to convert analog voltage output of the sensor into a digital format. The comparator circuit is built around opamp IC LM324 (IC1). LM324 is a general purpose quad opamp which can be operated from a single power supply. Only two comparators are used here, out of the four comparators inside LM324. One for the left side and the other for the right side.

Table 1.1 Comparator output

Orientation of Sensor	Input to Comparator		Output from Comparator	
	Right	Left	Right	Left
Both sensors on white	1.4V	1.4V	5V	5V
Right sensor on black and Left sensor on white	0.5V	1.4V	0V	5V
Right sensor on white and Left sensor on black	1.4V	0.5V	5V	0V

Two LM324 can support eight sensors. The resistance of the receiver sensor is decreased when infrared is radiated on it. A good sensor will have near zero resistance in the presence of the ray and have a very large resistance in the absence of the ray. We can use the property to form a potential divider. The comparator output is given in Table1.1.

IV. MOTOR DRIVER

Robot needs a driver IC for controlling and giving power to the motors. If the signal received by the driver is high, it will make the motors to rotate. The L293 and L293D are quadruple high-current half-H drivers. The IC L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5V to 36V.

The IC L293D is designed to provide bidirectional drive currents of up to600-mA at voltages from 4.5V to 36V. Both the ICs are designed to drive inductive loads such as solenoids, relays, bipolar stepping motors and dc motors, as well as other high-current/high-voltage loads in positive-supply applications. All the inputs are TTL compatible.

V.DC MOTORS AND WHEELS (ACTUATORS)

The movement system is an important part of a robot and its objective is how to move robot from one point to another. This system has some details which show us how to use wheels and motors. There are many kinds of wheels and motors. Our choice is dependent on the robot function, power, speed, and precision.

Two motors have been used to rotate the two wheels clockwise or anticlockwise. This provides motion to the robot. Motors are arranged in a fashion called H-Bridge. It is an electronic circuit which enables a voltage to be applied across a load in either direction. Using Gear box the speed is reduced to 30rpm at 6V.

The motors are run at 12V, so that an effective speed of 150rpm is achieved, with increase in torque. Depending upon the load, the speed of motor reduces. It is better to use gearbox motors instead of common DC motors because it has gears and an axle and its speed does not change. Pay attention that the more speed is, the less precision will be; thus it is better to choose a motor that has authentic RPM.

Wheels are mainly of two types, one is the attached to the motors at the back which is used for steering and another wheel in front known as castor wheel, which allows 360 degrees free rotation and avoids friction on the ground, as shown in Fig.3 and Fig.4.

Table 1.2 Movement of Robot

Left Motor Movement	Right Motor Movement	Robot Movement
Straight	Straight	Straight
Stop	Straight	Left
Reverse	Straight	Sharp Left
Straight	Stop	Right
Straight	Reverse	Sharp Right
Reverse	Reverse	Reverse

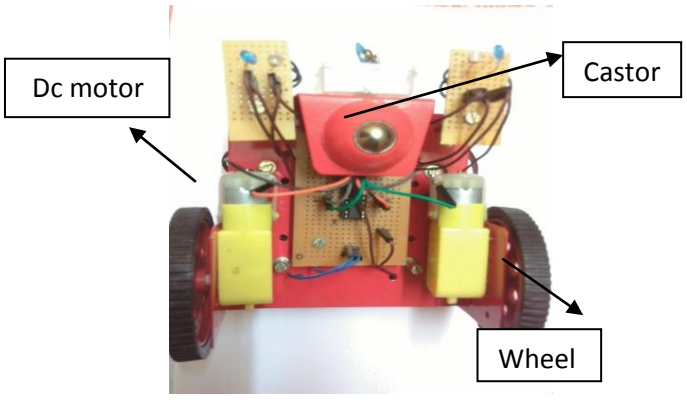

Fig.3 Robot with DC motor and Wheel

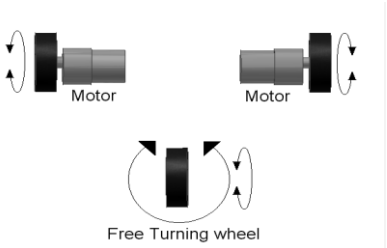

Fig.4 Wheel Arrangement

VI. CHASSIS AND BODY STRUCTURE

There are some good materials for designing robots such as wood, plastic, aluminum and brass alloys. We must pay attention to the resistance, weight and mechanical ability for choosing one of them. It is noted that the performance is much more important than other things. It is better not to use any types of glue for installing components. Therefore, the components can be installed just by screws.

Result:

The robot here follows a black line marked on white background, as shown in fig 4. The result is briefed in the table 1.2.

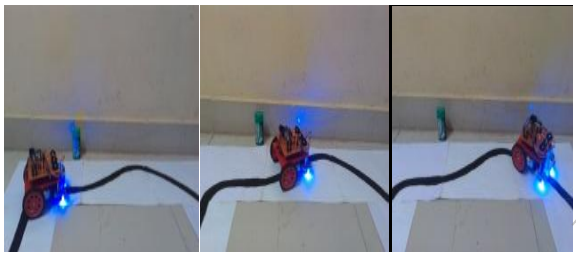

Fig 4.Movement of line follower robot

CONCLUSION:

In its current form robot is enough capable. Calibration is difficult, and it is not easy to set a perfect value. Use of IR even though solves a lot of problems pertaining to interference. The robot must also be capable of following a line even if it has breaks and must be insensitive to environmental factors such as lighting and noise. The color of the line must not be a factor as long as it is darker than the surroundings. The line follower robot finds applications in various fields such as industrial automated equipment carriers; tour guides in museums, automated cars deliver the mail within the office building, deliver medications in a hospital etc.

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