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A NOVEL DESIGN OF SENSOR BASED LINE FOLLOWER ROBOT WITH OBSTACLE APPREHENSION

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Abstract - Arduino microcontroller using line follower robot is an auto driven vehicles. Line follower robots are one type of mobile robot having ability to follow a line very accurately which have an onboard hardwired control circuit [1] and [2].It is just follow the line under the robot vehicle. It reduces the accident which is made by the drivers at factories (or) Industries. As a consequence, a line follower robot is designed using artificial intelligence for autonomous driving and to stay on the line [3]. Several components are put together to ensure the proper working of this design. It contains an Arduino board, motor shield, infrared IR sensor, DC motors, battery & some connecting wires etc. Used for designing this line follower robot vehicle. The Arduino board is responsible for the motion of robot vehicle. The DC motors are controlled by the motor shield and the reflectance sensor is used to identify the line. Nowadays it is useful & safety product for labour. Because, in factories the large raw material packages are transported by vehicles are known as mini excavator trucks.These trucks are not easy to drive. In that case we use these types of line follower robot vehicle it is very useful. Like previous method this design procedure is capable of tracking destination and avoids collision among each other through sensors. A mobile robot controlling algorithm is developed having the ability of avoiding barriers [4].Not only in industries but also in a work place to transport heavy files and documents and in hospitals for serving medicines for patients and more.

Keywords: ***Arduino, Infrared sensor, DC motor, photodiode.***

Motor Shiel

1.INTRODUCTION:

A Robot is any machine which is completely automatic, i.e. it starts on its own, decides itsown way of work and stops on its own. It is actually a replica of human being, which has been designed to ease human burden. It can be controlled pneumatically or using hydraulic ways or using the simple electronic control ways [Fig 1].

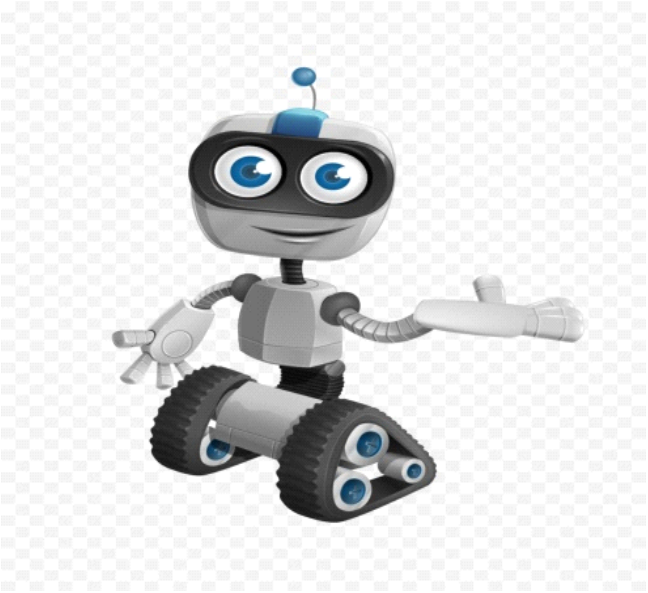


Fig 1: The Robot

- A robot should not harm the human being directly or indirectly.
- A robot should obey human orders and follow the instructions.
- A robot should protect its own existence providing service to humans.

1.1. Robot classification

Fig 2: Fixed Robot

Robots can be fixed robots[Fig 2] or mobile robots[Fig 3]. Mobile Robots are robots with a mobile base which makes the robot move freely within the environment. One of the advanced mobile robots is that the Line Follower Robot.

It is basically a robot which follows a specific path or trajectory and decides its own course of action which interacts with obstacle. The path is often a black line on the white floor (visible) or a magnetic flux (invisible).

Its applications start from basic domestic uses to industrial uses, etc. The present condition in industry is that they are carrying the parcels or materials one place to a different place using grus system. Sometimes lifting of massive weights at that point may cause the breakage of lifting materials and can be cause damage to the parcels also.

The line following robots is usually used for carry children through shopping malls, homes, entertainment places, industries. The use of line following robotic vehicle is transport the materials from one place to a different place within the industries. This robot movement completely depends on the track.

The robot can do anything you set them to try to do. Like in factories all they need to try to do with making their products is make the robot.

Fig 3: Mobile Robot

1.2 Line Follower Robot

A line follower robot is a robot which follows a certain path controlled by a feedback mechanism [Fig 4].

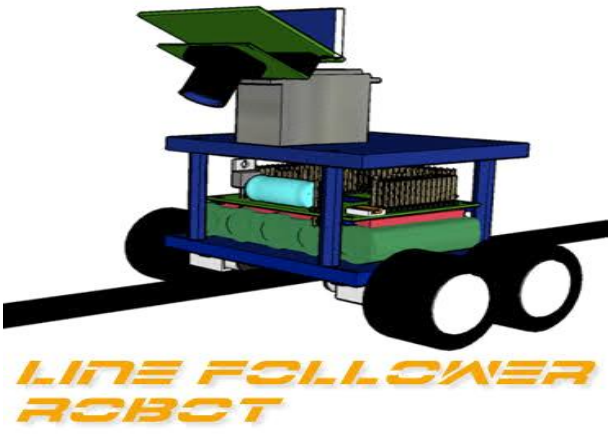


Fig 4: Line Follower Robot

2. Building a basic line follower robot:

Building a basic Line Follower Robot involves the following step.

- Designing the mechanical part or the body of the robot.
- Defining the kinematics of the robots.
- Designing the control of the robot.

The mechanical part or body of the robot is often designed using AutoCAD or Workspace. A basic Line follower robot can contain a base at the 2 ends of which the wheels are mounted. A rectangular sheet of hard plastic is often used because the base. Further a rigid body sort of a cylinder is often added alongside other shaped bodies inter connected with one another by joints, and every with its defined motion especially direction. The Line follower robot are often a wheeled mobile robot with a hard and fast base, a legged mobile robot with multiple rigid bodies interconnected by joints. The next step involves defining the Kinematics of the robot. Kinematic analysis of the robot involves the outline of its motion with reference to a hard and fast frame of reference. It is concerned mainly with the movement of the robot and with motion of everybody just in case of a legged robot. It generally involves the dynamics of the robot motion. The whole trajectory of the robot is about using the Kinematic analysis. This can be done using Workspace software. The control of the robot is that the most vital aspect of its working. Here the term control refers to the robot motion control, i.e. controlling the movement of the wheels. A basic line follower robot follows certain path and therefore the motion of the robot along this path is controlled by controlling the rotation of wheels, which are placed on the shafts of the two motors. So, the essential control is achieved by controlling the motors. The control circuitry involves the utilization of sensors to sense the trail and therefore the microcontroller or the other device to regulate the motor operation through the motor drivers, based on the sensor output.

2.1.Ways of controlling a Line Follower Robot:

1. **Without using Microcontrollers**

It consists of an IR-LED and Photodiode arrangement for every motor which is controlled by the switching on and off of the transistor. The IR LED on getting proper biasing emits infrared light rays. This IR light is reflected just in case of a white surface and therefore the reflected IR light is incident on the photodiode. The resistance of the photodiode decreases, which results in a rise in current through it and thus voltage drop across it. The photodiode is connected to the bottom of the transistor and as a result of increased voltage across the photodiode, the transistor starts conducting and thus the motor connected to the collector of the transistor gets enough supply to start out rotating. In case of a black color on the trail encountered by one among the sensor arrangement, the IR light isn't reflected and therefore the photodiode offers more resistance, causing the transistor to prevent conduction and eventually the motor stops rotating [Fig 5].

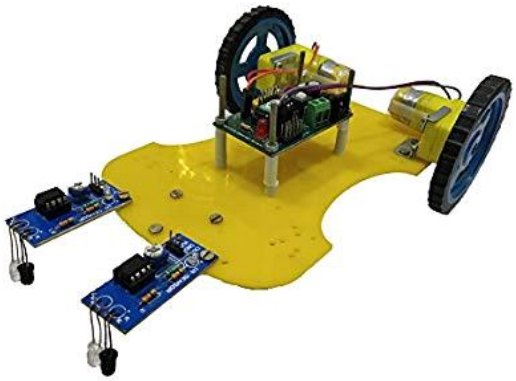


Fig5:Line Follower Robot without microcontroller

Thus the whole system can be controlled using a simple LED-Photodiode-Transistor arrangement.

2. **With using Microcontrollers:**

The line following robot is one among the self-operating robots. That detects and follows a line drawn on the surface. The line is indicated by reference white line on a black surface or black line on a white surface. This system must be sense by the line. This application is depending upon the sensors.

Here we are using two sensors for path detection purpose and obstacle detection. That is Ultrasonic sensor and IR sensor. The IR sensor used for path detection and Ultrasonic sensor used for obstacle detection. These sensors mounted at front of the robot. The microcontroller is an intelligent device the entire circuit is controlled by the microcontroller[Fig6].

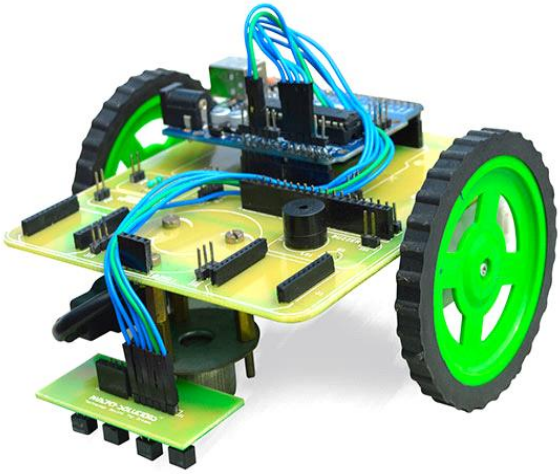


Fig 6: Line Follower Robot using Microcontroller

2.2. Different types of line controlled robotic vehicles:

There are two types of line controlled robotic vehicles:

- Mobile based line controlled robotic vehicle
- RF based line controlled robotic vehicle

3. Existing System:

In many places we are familiar with the vehicles called excavator trucks used to carry the goods and to serve for many works. But these trucks are working based on the principle of very old techniques. These trucks are working by fuel or by electricity. But these vehicles need a driver to handle it. For example: In an industry the raw material and goods are transported using the excavator trucks shown in below [Fig 7].

Fig 7: Goods carrier in Industry

These trucks need a drive and they face many problems while driving these vehicles.

Advantages:

- Used to carry goods in Industries and factories.
- Driven manually.

Disadvantages:

- These are not automatic.
- Needs well experienced drivers to handle.
- In the case of heavy goods or luggage, there might be a chance to meet with accidents easily.
- Complex to build these vehicles.
- Not preferable in all places like for domestic uses and many places.
- Also in the case of heavy goods it is not easy to stop these trucks by applying breaks.
- These does not follow the Fit and Forget System.
- It does not detect the obstacles on the way.
- Any time someone has to instruct the way for these vehicles.

4.Proposed System:

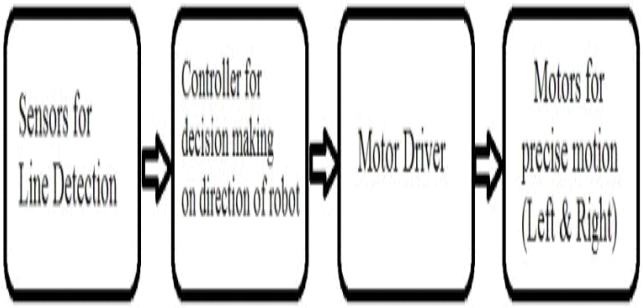
To achieve the drawbacks or the disadvantages in the existing system, proposed this Line Follower Robot. This Line Follower Robot use special sensors to detect the obstacles and to find the line on the surface.

Advantages:

- These trucks are automatic.
- These trucks do not need a driver.
- These are also used for domestic purpose and in hospitals etc.
- No need to instruct the way all the time.
- Once the instructions are programmed, then it will follow the same instructions all the time.
- It will detect the obstacles accurately.
- We can implement the alert on heavy load.
- These trucks follow the Fit and Forget System.
- Fit and Forget System: Once the instructions are given to that, we need not to take care of it again because it will follow the rules that are given to it accurately.
- In the case of heavy goods, it will give us alert, even after we applied heavy load if it caught with the accidents no one will be effected because it does not have any driver.

5. Working Principle:

Line Follower Robot has two sensors Infrared sensor and Ultra sonic sensor. Infrared sensor is the main sensor that is used to detect the line or path on the surface.IR sensor consist of two LED's, first one is IR LED that emits the light and that light is reflected after finding the line on the surface. The intensity of the reflected light is depending on the thickness of the color the line on the surface. If the line is thick then the intensity of the reflected light is high and vice-verse. Another LED, Photodiode which is responsible for receiving the light emitted by the IR LED and then finds the line or 0path on the surface. Another sensor, Ultrasonic Sensor which is used to detect the obstacles on the surface that is it finds the distance to an object using sound waves. The transducer of the ultrasonic sensor acts as a microphone which is used to receive and send the sound waves. According to the time that is taken to travel the sound wave between the transducer and the object, the distance is detected. Arduino board will control all the actions performed by these sensors and makes mobility according to its actions. A motor driver will control the running of the robot which is connected to DC motors. Motor driver perform actions according to the instructions given by the arduino board.



Block Diagram for Line Follower Robot

6. Technology:

6.1. IR Sensor: It is used to detect the line or path on the surface. By using the components like IR LED, Photodiode and comparator, LED etc. [Fig 8].

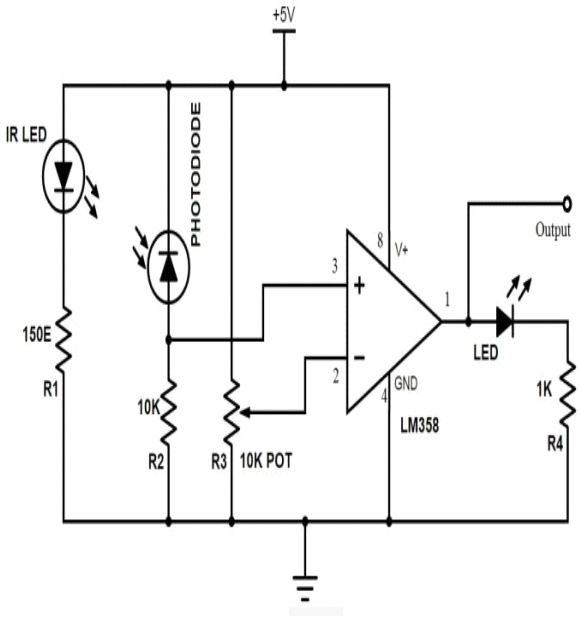


Fig 8: Working of IR sensor

6.2. Ultrasonic Sensor: It is used to detect the distance between an object using sound waves. It sends sound waves from transducer and receives it. It works like the microphone to receive and transmit the sound waves [Fig 9].

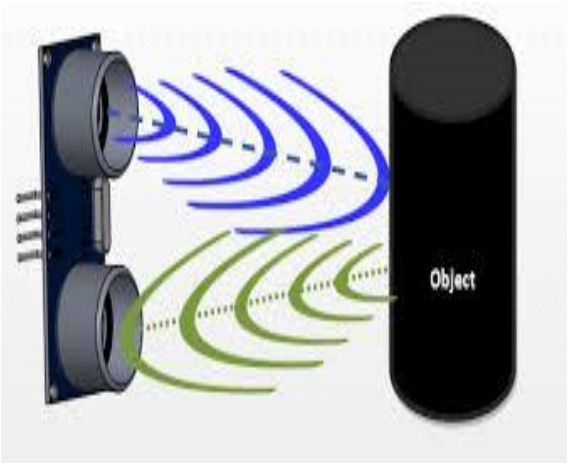


Fig 9: Working of Ultrasonic Sensor

6.3. Motor Driver: It is combination of discrete components integrated with IC's. Generally, the supply current signal is very low such as below +6Volts.Motor driver is used to convert the low current signal to high current signal. This high current signal is then supplied to the motors[Fig10].

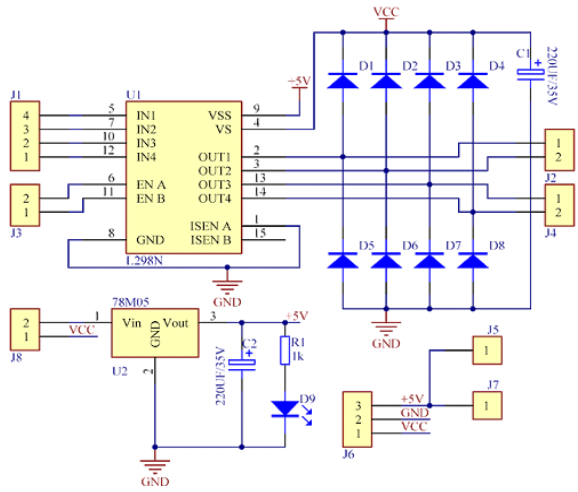


Fig 10: Working of Motor Driver

6.4. Arduino Board: It is a compatible, flexible Microcontroller board which is breadboard friendly. It is developed by Arduino.cc in Italy. Based on the reference of ATmega329p/ATmega168.It can perform maximum all the operations that are performed by the Arduino UNO but Arduino NANO is the compressed model of Arduino UNO having Mini-USB port[Fig11].

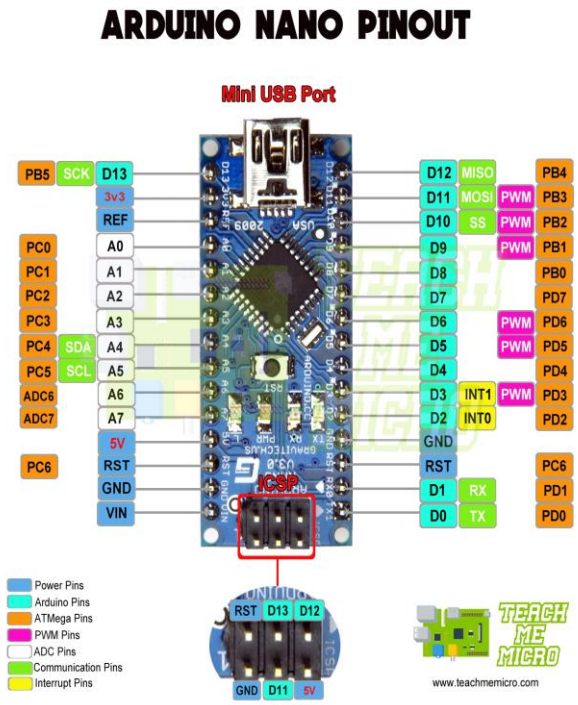


Fig 11: Pins of Arduino NANO

6.5. DC Motor: The working of DC motor is"When a current carrying conductor is placed in between the magnetic field then it will experience the mechanical force" then it will experience mobility accordingly which is connected to a rigid support [Fig 12].

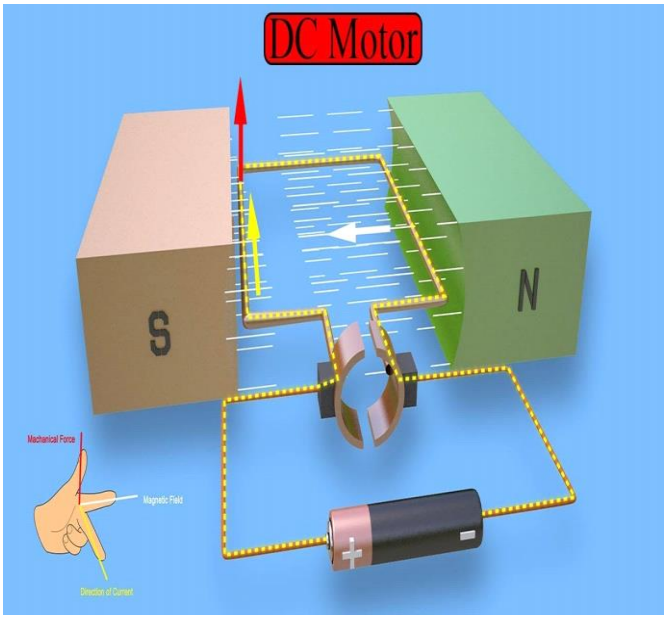


Fig 12: Working of DC motor

7. Circuit Diagram:

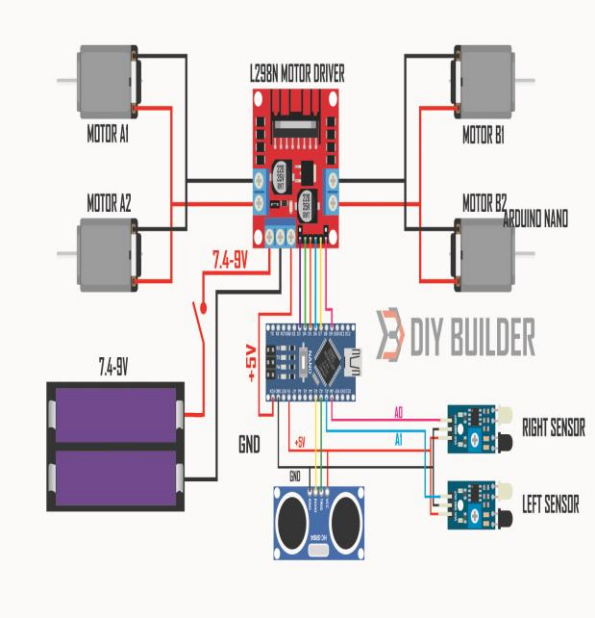


Fig 13: Circuit Diagram of Line Follower Robot

8. **Future Scope:**

These Line Follower Robots is unable to follow the line other than black or white colors on the surface. So, implementing this with RGB color combinations will be helpful and detecting an invisible magnetic field on the surface as a path. Gives alert message when a physical object is on the way. Implement using Bluetooth and Wi-Fi modules also this line follower robot can be controlled. By implementing the voice command controlling we can change the path of Line follower robot at junctions.

9. Applications of line follower robot:

These line follower robots are used in many streams:

1. Industrial applications: Line follower robots are used in industries and factories to carry goods and raw materials.

2. Automobile applications: Line follower robots are used in the invention of driver less cars.

3. Domestic applications: Line follower robots are used in homes for cleaning purpose etc.

4. Guidance applications: Line follower robots are used in public places like shopping malls and museums to provide guidance.

10. Conclusion:

The line following robot is automobile system that has ability to recognize its path, move and change the robot's position toward the line in the best way to remain in track. This project report presents a photodiode sensor based line follower robot which always directs along the black line on white surface. The electromechanical robot with max rpm 180 at no load and frictionless condition. The robot is in a position to detect its path just in case it's out of path. The line following robot project challenged the group to cooperate, communicate, and expand understanding of electronics, mechanical systems, and their integration with programming. The successful completion of each task demonstrated the potential of mechatronic systems and a positive group dynamic.

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