IOT BASED LINE CONTROLLED ROBOT

Abstract

This document will provide an idea on Line Following robot using a microcontroller and motor driver to control the motion of robot in specified marking. The line following robot is type of Automated Guide Vehicle (AGV) made using Arduino which follows a particular path (generally a black/white strip) and makes its way to the destination. In modern days the usage of intelligent electronic devices has drastically incremented in this context for the ease of applications based on path dependent criteria line follower robot will come into picture mostly. This path following mechanism is carried out by Infrared sensors. Line follower robot has a lot of daily-life applications such as home cleaning, entertainment areas etc..

Keywords : IR Sensor , Arduino Uno,LM239D Driver IC , Dc motor;

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I. INTRODUCTION

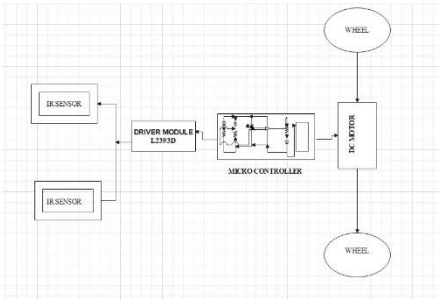
The line following robots are the one which controls itself according to required operation [1], [2]. Which follows the line drawn on the surface area using ir sensors, The line is of colour black on white surface or which on black surface for the ease of identification [3]. For the detection of line, Sensors need to be used, In this two sensors were used they are proximity and IR Sensor [4]. Proximity sensor is used for path detection and IR sensor used for obstacle detection [5], [6]. These sensors are attached to front area of the robot. The microcontroller is an electronic device which controls the whole circuit [7]. Novelty of this paper is to give an idea on microcontroller coding assembly and working criteria of the robot. Majorly there are three important factors which need to be concentrated for the smooth operation of robot they are 1. Capturing the path i.e.., Line which is Specified. 2.steering mechanism to drive the robot in direction of line defined. 3.Controlling of Speed according to the requirement [8]-[10]. As existing models suggests the following the AGV is designed using microprocessor to control their systems. To travel in the desired path, it uses a position feedback. To communicate with the system controller and vehicle, electric signals and RF communication are needed. Such functions are not required in this line following robot [11], [12]. Usually, carriers are used to carry the products from one plant to another plant in the industry. They are in different blocks and buildings. It consumes a lot of time and it will be difficult if all the work have to be done by mankind. The working will be most easy if the manpower is reduced by electronic gadgets. Thus for time consumption and better facility the electronic applications are required nowadays in this busy world. he L239D motor driver accepts input from four different directions, and it also has two enable inputs for turning the motors on and off. These kind of robots are mostly used in military purposes, Delivery services, Transportation purposes.

II. ASSEMBLING AND INITIALISING MICROCONTROLLER

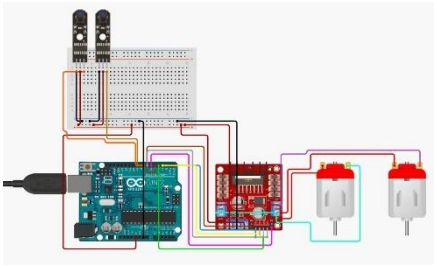
Initially all the sensors are to be assembled by using circuit diagram referred in fig 1.1, And Micro controller (Arduino Uno) is connected to the pc to code according to requirement of sensors usage.[13], [14]. Firstly the software Arduino.cc need to be installed and create a new project file and copy the code mentioned in figure 1.2, compile and upload the code to Arduino uno board and now assemble Arduino uno to the setup made earlier. The working and sensor control will be explained further in the paper.

CIRCUIT DIAGRAM	CODE

	int IR1=8;
	int IR2=9;
	int A = 5;
	int MotorAip1=2;
	int MotorAip2=3;
	int B = 6;
	int MotorBip1=4;
	int MotorBip2=7;
	void setup()
	{
	// put your setup code here, to run once:
	pinMode(A, OUTPUT);
	pinMode(B, OUTPUT);



Model Block Diagram



Assembling Diagram

Figure 1

```
  pinMode(IR1,INPUT);
  pinMode(IR2,INPUT);
  pinMode(MotorAip1,OUTPUT);
  pinMode(MotorAip2,OUTPUT);
  pinMode(MotorBip1,OUTPUT);
  pinMode(MotorBip2,OUTPUT);
}
void loop()
{
   if(digitalRead(IR1)==HIGH &&
digitalRead(IR2)==HIGH) //IR will not glow on
black line
  {
    //Stop both Motors
    digitalWrite(MotorAip1,LOW);
    digitalWrite(MotorAip2,LOW);
    digitalWrite(MotorBip1,LOW);
    digitalWrite(MotorBip2,LOW);
   analogWrite (enA, 0);
   analogWrite (enB, 0);
  }
  else if(digitalRead(IR1)==LOW &&
digitalRead(IR2)==LOW)  //IR not on black line
  {
    //Move both the Motors
    digitalWrite(MotorAip1,HIGH);
    digitalWrite(MotorAip2,LOW);
    digitalWrite(MotorBip1,HIGH);
    digitalWrite(MotorBip2,LOW);
    analogWrite (enA, 200);
    analogWrite (enB, 200);
  }
  else if(digitalRead(IR1)==LOW &&
digitalRead(IR2)==HIGH)
  {
    //Tilt robot towards left by stopping the left
wheel and moving the right one
    digitalWrite(MotorAip1,HIGH);
digitalWrite(MotorAip2,LOW);
    digitalWrite(MotorBip1,LOW);
    digitalWrite(MotorBip2,HIGH);
    analogWrite (enA, 200);
    analogWrite (enB, 150);
   delay(100);
  }
  else if(digitalRead(IR1)==HIGH &&
digitalRead(IR2)==LOW)
  {
    //Tilt robot towards right by stopping the right
wheel and moving the left one
     digitalWrite(MotorAip1,LOW);     // If I want
to turn right then the speed of the right wheel
should be less than that of the left wheel, here, let
```

```
a be the right wheel
    digitalWrite(MotorAip2,HIGH);
    digitalWrite(MotorBip1,HIGH);
    digitalWrite(MotorBip2,LOW);
    analogWrite (enA, 150);
   analogWrite (enB, 200);
   delay(100);
  }
  else
  {
    //Stop both the motors
    digitalWrite(MotorAip1,LOW);
    digitalWrite(MotorAip2,LOW);
    digitalWrite(MotorBip1,LOW);
    digitalWrite(MotorBip2,LOW);
    analogWrite (enA, 0);
   analogWrite (enB, 0);
  }
}
```

Figure 1.2

III. WORKING

In order to know the complete working of line following robot, the working of sensors and their controlling need to be known [13]. Firstly the flowgraph mentioned in Fig 1.3 will enhance the idea regarding power flow/ Signal flow in the system. Signal transmission from sensor to motor is, Initially Sensor sends Analog signal to microcontroller and microcontroller will send digital Signals to Motor Driver for it operation [14]. IR Sensor (Infrared Sensor) will detect the obstacles which are there in front of robot and it will send the data to the microcontroller and that will initialize the suitable commands to avoid obstacles which works according to the code written in the board. And L239D motor driver will get the signals from microcontroller and that will control the dc motor in order to move the robot in desired pattern [15]. Now to analyse the IR sensor functioning table 1.4 will helps how motor is controlled using sensor values. As per the IR sensor transmitted values the digital pins associated with motor inputs via driver will get initialised. Direction of Motor will be accessed by the sensor values. Pins 1, 2, and 3 and 4 are used to change the rotational direction and speed of a paired DC motor. This regulates the H bridge switches. The input pins 1 and 2 must be set to high for forward motion and low for reverse. Again, low input at pins 1 and 2 and high input at pin 3 correspond to a motion in the opposite direction. When there is a match between the two inputs, the motor will turn off [16]. When operating two motors, an L239D driver is used. The L239D motor driver accepts input from four different directions, and it also has two enable inputs for turning the motors on and off. L239D is commonly used in circuits for motor control, and it is selected since its current capability is 2A per channel at 45V, as opposed to 0.6A at 36V [16]. (In Table 1.4 Int refers to initialised pin number in code referring to motor.)Fig 1.5 will provides the complete overview of the robot after its assembly. Detailing about the components will be explained below. Operation of is as follows 1) when motor to run in forward motion and to move in left direction left motor will be stopped and right motor will move. 2) when motor to run in forward motion and to move in right direction right motor will be stopped and left motor will move.

1. **Sensors:** IR Sensor (Infrared Sensor) is used in this paper for the path detection purpose. Ther are two diodes in IR sensor in which one will send rays and another will receive rays. By the receiver rays the robot will analyse whether it is on line or not, When robot receives same reflected ray it means robot is in white surface else on black surface. infrared transmitter and infrared receiver pair will be contain in IR reflectance sensor.IR will measure the amount of light reflected by reflector. For the transmission the reflected light will helps the robot to follow line accordingly. For limiting current resistors R1 & R2 resistors are used.resistors (R3, R5, R6, R8) are works as voltage dividers which used to limit voltage which is in connection with LDR's .on white surface LED/LDR will run properly when sensor classifies accordingly. In this condition, resistance will be low because sufficient amount light will be reflected to LDR's. Voltage across the LDR is low because of this. When the robot is drifted towards one side, the sensor in the opposite side falls over the black line and the intensity of light reflected back to the corresponding LDR will be low. Due to this, LDR voltage will rises up and voltage drop will also increases.reciever will works well when it is subjected to ambient light which helps receiver to receive signals from sensors and also distance between the sensor and surface is low. For detection of white and black surfaces IR sensors are used, due to high reflection property for white as compared to black surfaces. According to the reflection they will transmit the data to microcontroller as specified in Fig 1.4. Fig 1.6 & 1.7 will provide an overview on IR sensor looking and it's phenomenon.

2. **Microcontroller:** Arduino Uno is the micro controller used for this application, which renders output values from sensors and provide input to the drivers as per the code specified. It can read both Analog and digital values from sensors, But Writes only Digital values as output. ADC (Analog to Digital converter) is inbuilt for the reading and writing operation of the values to sensors. Fig 1.8 will give glance on Arduino Uno hardware assembly. In other words, DC or Barrel Jack The Arduino board can be supplied with electricity via the corresponding power jack. A wall adapter is often plugged into the barrel jack. For reliable operation, keep the board's voltage between 7 and 12 V; typically, this range is 5 to 20 V. The regulators could overheat at 12 volts, and 7 volts could be insufficient. The VIN PIN allows the Arduino Uno board to accept power from an external supply. In order to keep equipment safe, the voltage should stay inside the aforementioned parameters. When connected to a computer, a USB cable supplies 5 volts at 500 milliamperes. The VIN pin receives roughly 1 Amp from the positive end of the barrel jack via a protection diode. The circuit's power supply is conditional on the ability to supply electricity. On average, a USB port will supply 500mA at 5v, or around 2.5W. In addition, there are 5 ground pins (GND) for use in closing the circuit. allows the circuit to share a single logic reference voltage. All GND pins must be connected to a shared ground. There is a RESET PIN on the Arduino that can be used to reset the device. There are six analogue inputs on the Arduino board that can also be used as digital inputs or digital outputs thanks to the board's on-board analog-to-digital converters (ADCs). seeing is believing, as Fig 1.8 represents the same.

3. **Motor Driver:** Here in the paper, L239D motor driver IC for the operation of motor is being used. There are 2 motors for the operation to control this L239D motor driver is used. L293D IC is basically a dual h-bridge driver IC combination.for bidirectional operation one h-bridge IC is suffice. The power might insufficient for driving the motors, in order to enhance the current L239D driver IC is used. L293D includes two enable pins

that will stay high to activate both H-bridges, and has 16 total pins. The microcontroller supplies a small current, and the motor driver amplifies this signal so that it may control and operate the motor. 16-pin DIP package, L293D. (dual-in line package). With only 4 pins, this motor driver IC can guide two motors in either direction. The appearance of IC is depicted in Fig. 1.9. The motor may be enabled and its speed adjusted using the Enable A and Enable B pins. The engine will be activated and run at full tilt. When a jumper is installed here, PWM can be connected in place of the jumper to regulate motor speed.. If this pin to a Ground is connected, the motor will be disabled. Next, controlling the rotation direction of the motor A the Input 1 and Input 2 pins are used, and inputs 3 and 4 for the motor B. Using these pins. the switches of the H-Bridge inside the L239D IC would be controlled. If input 1 is HIGH and input 2 is LOW the motor will move backward, and vice versa. If both inputs are either LOW or HIGH in same state the motor will stop. The same applies for the motor B with inputs 3 and 4.

4. **DC motors:** The movement system of a robot is very important to its operation. It is responsible for moving the machine from one point to another. In addition to this, it is also used to convert the electrical energy into the mechanical energy. There are various types of motors that are commonly used in the production of robots. For the ease of operation and cost-effectiveness, the DC motors for robot applications is being used. This type of motor can be used to increase the speed of the machine. In addition to this, it can also be used to improve the power and accuracy of the robot. One of the most important factors that needs to be considered when it comes to choosing a good motor is the function and power.

5. **Programming:** Microcontroller has special function to control the user interface system our main moto is to control the motors in different directions so the program with the language C or python can be written. After creating a code first the code needs to be compiled, then next step the compiled program is sent to the Arduino . A microcontroller is a device that can be connected with a computer and it is required to be connected with via usb cable then user computer send data to microcontroller then the programmer sends the program into the microcontroller's memory. There are a lot of libraries which user must use select the appropriate library then the board Tx and RX pins of microcontroller is observed. For this application a open source software named Arduino. cc for the programming purpose is being used. And Arduino is the micro controller used for the application. The code has been in Fig1.2 for the reference purpose

6. **Batteries:** Line follower robot runs according to design .as per our project required four batteries. As per our power rating, the robot is selected to operate in fast movement mode. The use of secondary batteries for better reusability and controllability of the robot and battery life will be increased if low power batteries is selected else battery needs replacement various no. of times. In this methodology battery selection parameters are most important policy Even though many parameters are there to choose the battery characteristics. here gone with with li-on battery for good power density light weight and cost-effectiveness, including the efficiency and state of charge.

7. **Code explanation:** As per Arduino instruction the Pin Numbers have initialized as per output and input specified first. Then the Arduino is required to be reset to delete the previous code then there is connection with Arduino. IR sensor transmitter have

connected to Pins 8,9. And Motor pins are connected to code specified digital pins for right motor and left motors are controlled with help of relay to overcome the voltage fluctuations. Digital pins are connected, and the right and suitable ground is chosen to avoid wiring harness. And keep serial. Begin

To get parameters from motor and sensors. Then automatically the Motor values will get initialised according to the IR sensor values specified in fig 1.4. then the movement of robot can be observed according to sensor values.

8. **Process of selecting line path:** Line follower can follow the path by carrying a load on them. Aside the robot it is similar to all around human it is implemented by using sensing the sound and sensing the path and sensing the human detection.so the suitable path is required to be selected to overcome all sensor The line can be detected using the results. Any light and distance sensor could be utilised for robot navigation based on the line's colour and its confinement. A crucial part of developing a Line follower robot is determining the track, which can be adjusted based on input from the user. One set of Infrared ray sensors were installed underneath the robot as per the requirements of our project. First, an infrared ray sensor will emit a wavelength with properties useful for detecting a black line; second, another infrared ray sensor will receive this information and send a signal to the microcontroller, which will then make a decision based on the user's code and direct the motor to rotate in accordance with the line-following robot's course. The robot is programmed to follow a black line on a white background so that the black line can be seen. All of the sensors, motor driver IC, and other electronics receive their power from a 9V DC converter. Lessening the likelihood of power outages during setup is essential. In order to ensure a steady supply, the sensor circuits' outputs are wired to the Arduino board's inputs.

IV. OPERATION

Operation is nothing but the how the power flow and signal goes from Arduino to sensors the robot will have some certain characteristics to follow the conditions which is instructed in code

1. Detect the type of the path and the state of the path.
2. self-park assists to control (Exit)
3. display the path and censored values on the LCD. At the initial position the robot will be placed at the static position.

- The robot will sense the area, sense the type and state of each slot.
- The robot will give a signal sound to clear the path
- then Arduino receives the path clear signal from sensor data and it gives the power to motor As soon as the robot reaches the user specified position it will turn off and itself

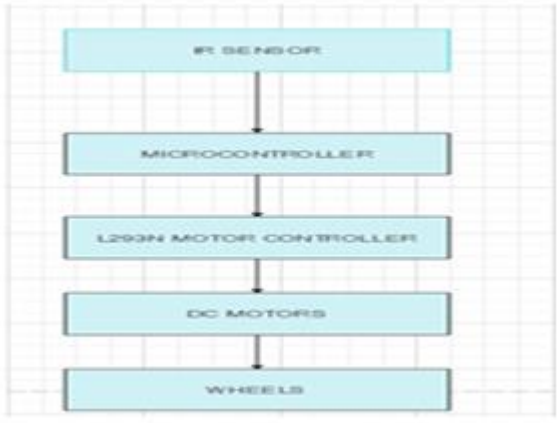


Figure: 1.3

INP1	INP2	INP3	INP4	DIRECTION OF MOTOR
0	0	0	0	STOP
1	0	1	0	FORWARD
0	1	0	1	REVERSE
1	0	0	1	LEFT
0	1	1	0	RIGHT

Figure: 1.4

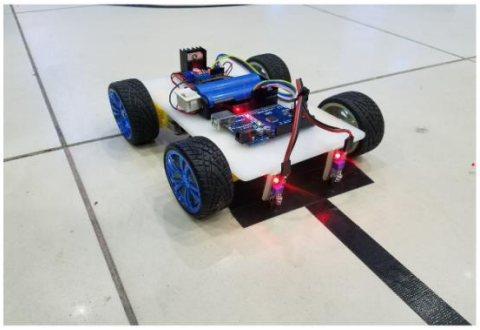
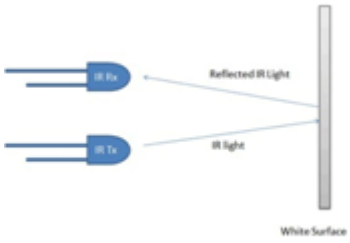


Figure: 1.5

Figure: 1.6



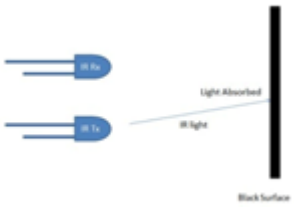


Figure: 1.7

Figure:1.8

Figure : 1.9

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VI. CONCLUSION

By this paper the idea on line following robot using Arduino and LM239D motor driver circuit is introduced, How the flow will be there from sensor to motor will be analysed including its applications in various domains. The described line follower robot creates a good cost reduction process .it creates informative and physical ideology to implement good source of project with economically. The path controlled line follower robot does not give us the position deviation from the user defined path, it creates a idea to generate future autonomous cars. Future development involves automatic error clearance using PID or FUZZY control for better approach. Also including IOT & cloud, the transportation and navigation can be easily accessible. And also enhancing circuit with distance sensors, these robot for varies application can be used. Upcoming robotic sweepers are making use of this project ideology.

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