Implementation of Line Following Robot

MTE Project Report

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Abstract—Line following robot detects any non-reflecting line in its path and follows that. Generally, we use black line on some good reflective surface. Two IR sensors attached on front of the robot senses black line and transmits data to microcontroller and as per that data microcontroller commands motor driver to move robot in required direction and thus path will be followed by the robot.

Keywords—Arduino uno, Line Following Robot, IR Sensor, Motor Driver, Motor

I. INTRODUCTION

The line following robot is self-controlled and self-operating machine which is powered by a dc source of 12 v. The basic operation of line following robot is as follows:

1. Two IR sensors mounted at front of robot reads and transmitts the data of reflecting(white base) or non-reflecting surface(black path) .
2. The micrrocontroller board which is arduino uno in our case ,interprets the data received by IR sensors and as per code uploaded gives commands to motor driver.
3. The motor driver receives instructions from Arduino board and as per that data turns both motors high or low as required.
4. When taking turns, the speed of motors are adjusted by motor driver such that robot takes smooth turns.

These kinds of robots can be specially used for delivery, transportation system and military purposes. Line following robots can also be operated at hazardous regions like mines, nuclear power plants, high temperature zones etc.

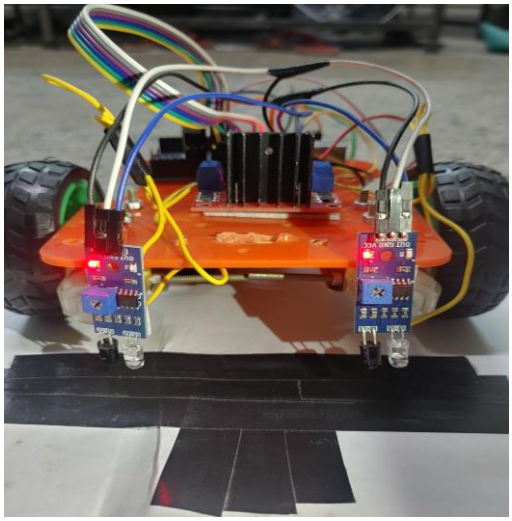

Fig. 1: Front view of LFR

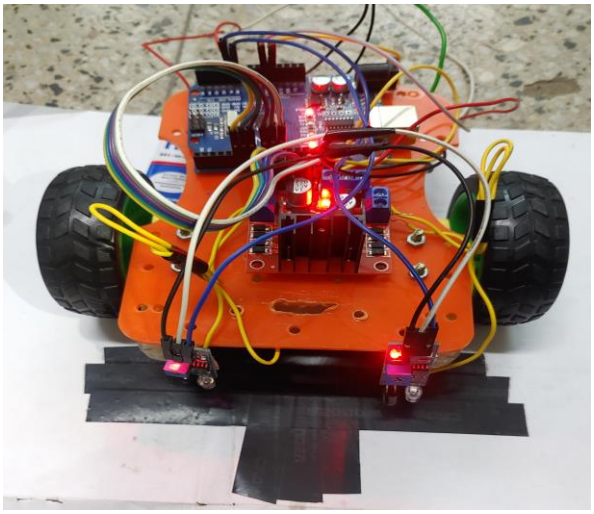

Fig. 2: Top view of LFR

II. STRUCTURE OF LINE FOLLOWING ROBOT

This robot can be divided in mainly four parts.

Arduino UNO

Motor Driver

Motors and Wheels

IR sensors

Chassis and body

Power supply (11.1V, 1.5A)

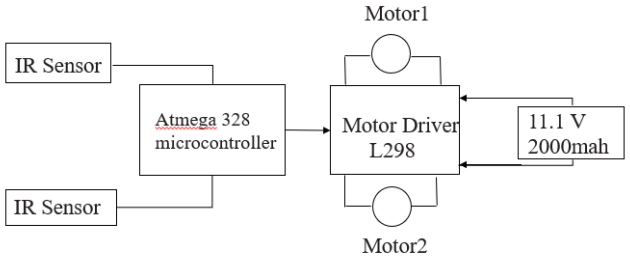

Fig. 3: Basic Block Diagram

Using 12V and 1.5A dc source we directly power motor controller and using its 5V output voltage pin we power Arduino board and through Arduino output pins we power IR sensors which gives feedback of path to Arduino which then commands motor driver to run the motors as per feedback received.

L298N Motor Driver

This L298N Motor Driver is a high-power motor driver module for driving DC and stepper Motors. This module consists of L298 motor driver IC and a 78M05 5V regulatoL298N Module can control up to 4 DC motors or 2 DC motors with directional and speed control. The L2898N Motor driver module consists of an L298N motor driver IC,78M05 Voltage Regulator, resistors, capacitor, Power LED, 5V jumper in an integrated circuit.78M05 Voltage regulator will be enabled only when the jumper is placed .When the power supply is less than or equal to 12V,then the internal circuitry will be powered by Voltage regulator and the 5V pin can be used as an output pin to power the microcontroller. The jumper should not be placed when the power supply is greater than 12V and separate 5V should be given through 5V terminal to power the internal circuitry.
EnA and EnB pins are speed control pins for motor A and motor B while IN1 & IN2 and IN3 & IN4 are directional control pins for Motor A and Motor B.

Arduino UNO

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control objects in the physical world. The heart of Arduino is the microcontroller. For Arduino Uno ATmega328 is used. It has specification of 8-bit CPU, 16 MHZ clock speed, 2 KB SRAM 32 KB flash Memory, 1 KB EEPROM.

Motors

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.

In our project we are using TT DC gearbox motor whose voltage ratings are 3V-6V,current ratings are 1A-1.5A and output torque is 0.8kg.cm

IR Sensors

The Sensors The robot uses IR sensors to sense the line, IR sensors consist of two diodes that one of them sends ray and another one must receive it. If the receiver receives the reflection ray, it means that the robot is on white and if it cannot receive it, so the robot is on black.

III. Programming

The code for our Line following robot is written on Arduino IDE in ,Arduino Programming language which is very much similar to c++ Programming language.

In programming part, we first define digital pins of Arduino which will be used to either reading any data or writing.

We define pins for IN1-IN4 and ENA and ENB of motor driver and fixed the running speed of motor at 80 Analog value. In a continuous loop code reads the value from IR sensor through a pin of Arduino then as per that data motor driver is directed to run the motors.

```
#define in1 9
#define in2 8
#define in3 7
#define in4 6
#define enA 10
#define enB 5


int M1_Speed = 80; // speed of motor 1
```

```
int M2_Speed = 80; // speed of motor 2
int LeftRotationSpeed = 250;  // Left Rotation Speed
int RightRotationSpeed = 250; // Right Rotation Speed


void setup() {

 pinMode(in1,OUTPUT);
 pinMode(in2,OUTPUT);
 pinMode(in3,OUTPUT);
 pinMode(in4,OUTPUT);
  pinMode(enA,OUTPUT);
  pinMode(enB,OUTPUT);

   pinMode(A0, INPUT); // initialize Left sensor as an input
   pinMode(A1, INPUT); // initialize Right sensor as an input

}

void loop() {

 int LEFT_SENSOR = digitalRead(A0);
 int RIGHT_SENSOR = digitalRead(A1);

if(RIGHT_SENSOR==0 && LEFT_SENSOR==0) {
  forward();
}

 else if(RIGHT_SENSOR==0 && LEFT_SENSOR==1) {
  right();
 }

 else if(RIGHT_SENSOR==1 && LEFT_SENSOR==0) {
  left();
}

 else if(RIGHT_SENSOR==1 && LEFT_SENSOR==1) {
  Stop();
 }
}



void forward()
{
        digitalWrite(in1, HIGH);
        digitalWrite(in2, LOW);
        digitalWrite(in3, HIGH);
        digitalWrite(in4, LOW);

          analogWrite(enA, M1_Speed);
          analogWrite(enB, M2_Speed);
}

void backward()
{
        digitalWrite(in1, LOW);
        digitalWrite(in2, HIGH);
        digitalWrite(in3, LOW);
        digitalWrite(in4, HIGH);

          analogWrite(enA, M1_Speed);
          analogWrite(enB, M2_Speed);
}

void right()
{
        digitalWrite(in1, LOW);
        digitalWrite(in2, HIGH);
        digitalWrite(in3, HIGH);
        digitalWrite(in4, LOW);

          analogWrite(enA, LeftRotationSpeed);
          analogWrite(enB, RightRotationSpeed);
}

void left()
{
        digitalWrite(in1, HIGH);
        digitalWrite(in2, LOW);
        digitalWrite(in3, LOW);
        digitalWrite(in4, HIGH);

          analogWrite(enA, LeftRotationSpeed);
          analogWrite(enB, RightRotationSpeed);
}

void Stop()
{
        digitalWrite(in1, LOW);
```

```
    digitalWrite(in2, LOW);
    digitalWrite(in3, LOW);
    digitalWrite(in4, LOW);
}
```

IV. MOTOR SPEED CONTROL TECHNIQUE:

A. Using PWM Signal

The speed control method using PWM (Pulse Width Modulation) is readily used various kind of motor including DC motor.

We have used 555IC for the generation of PWM Signal. Through the external circuitry IC is used as Astable multivibrator, to generate square wave.

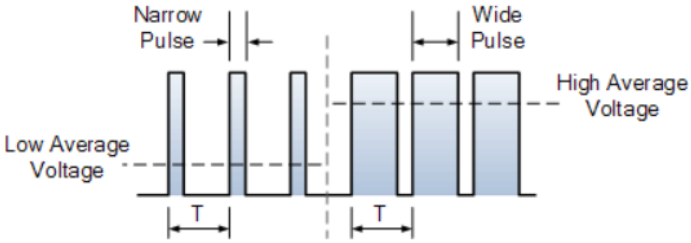

Fig. 4: PWM Signal

Standard Astable multivibrator circuit through IC 555 can not have its duty cycle below 50%. To counter this problem D1,D2 ,and RV1 are introduced to obtain required duty cycle.

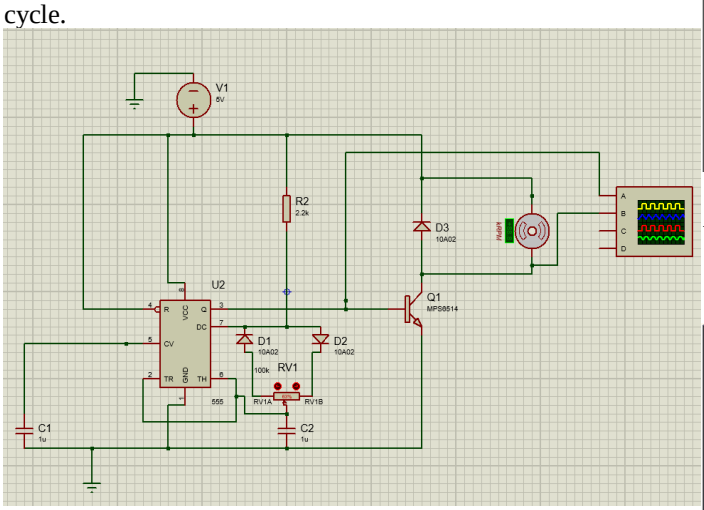

Fig. 5: Schematic for speed control of motor

The charging of capacitor C2 would be through R2 and RV1A and during that time output of pin 3 will be high. During discharging of capacitor C2 through RV1B the output of pin 3 will be low. Hence, by adjusting the value of RV1 required PWM can be achieved.

Diode D3 is used to protect electronic circuit from inductive loading of motor. Note as the output of IC 555 is not high enough to run motor we have used transistor for switching purpose and run motor.

The time, T1, for which the output is "ON" is: T1 = 0.693(R2+RV1A).C2

The time, T2, for which the output is "OFF" is: T2 = 0.693(RV1B).C2

Total "ON"-"OFF" cycle time given as: T = T1 + T2 with the output frequency being f = 1/T.

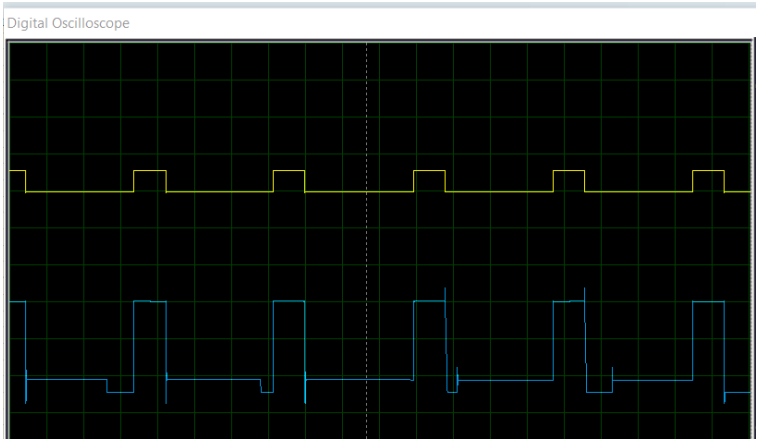

Fig 6: OUTPUT OF DSO WHEN POENTIOMETER IS SET TO 20%.(0.48krmp)

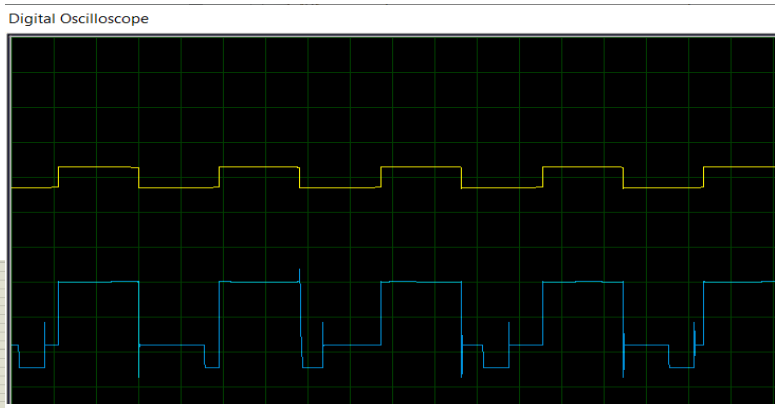

Fig 7: OUTPUT OF DSO WHEN POENTIOMETER IS SET TO 50%.(0.91krmp)

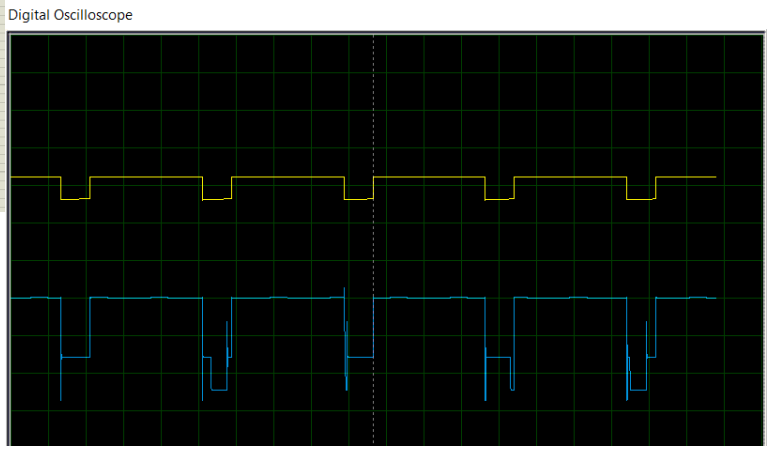

Fig 8: OUTPUT OF DSO WHEN POENTIOMETER IS SET TO 80%.(1.25krmp)

DC Motor speed at different setting			
Serial No.	*RV1A (kOhm)*	*RV1B (kOhm)*	*DC Motor speed(krpm)*
1	*100*	*0*	*0.06*
2	*80*	*20*	*0.48*
3	*60*	*40*	*0.79*
4	*50*	*50*	*0.91*
5	*40*	*60*	*1.05*
6	*20*	*80*	*1.25*
7	*0*	*100*	*1.45*

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