



Line Tracking Robot Utilizing Arduino UNO Microcontroller

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Abstract

Line follower is a like a robot which is made using Arduino UNO, and IR sensors. Evolution of line follower robot starts basically with simple idea and go on with advanced technology it is applicable in different fields like commercial, industrial, medical and educational. It is designed to follow the defined path given by anyone. The Arduino Uno processes sensor data and controls the robot's movement using a motor driver. The robot employs a PID control i.e. Proportional-Integral-Derivative algorithm to enhance precision and smooth movement. We choose this because of following Characteristics: cost effectiveness, simplicity, adaptability.

Keywords: Arduino UNO, IR Sensors, Industrial automation robot education.

1. Introduction

Line follower robot is prepared to follow predefined path which is given by user. Which is typically marked by a white or black line on a floor. It is fundamental project widely used in industrial applications, education, and competitions. Robot uses Infrared sensor i.e. is IR sensor to detect line and adjust its direction and movement according to given path. These sensors are help to detect the line with its contrast path, enable the robot to follow the predefine path without the help of human.

The basic line follower robot consists of some essential components which is given in Table 1. it include IR sensors, a microcontroller (Arduino), a motor driver (L298N), DC motors, a chassis, and a battery. The IR sensor detect the line, Microcontroller acts as a brain of the robot. Motor driver controls the speed and direction of the motors. The chassis is used as a body that holds all the components together, and battery provides the power supply.

These robots have wide scope including industrial automation, educational purpose and robotics competition also.

2. List of Components

Table 1: List of Component.

Name of the component	Quantity
Arduino uno	1
Motor driver (L298N)	1
DC gear motors	2
Wheels	2
Caster Wheel	1
Chassis	1
IR sensors	2
IR array module	1
Battery	1
Switch	1
Jumper wires	15-20

3. Information About Components

A) ARDUINO UNO

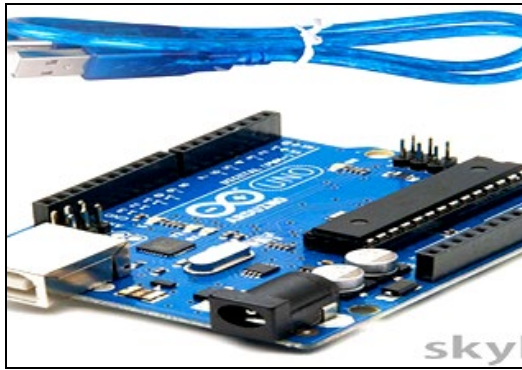


Fig 1: Arduino UNO

Arduino uno which is given in Fig.1 is an open source most commonly used microcontroller. This is one of the most widely used Microcontroller in projects. Examples robotics, IoT automation, dry electronics projects home appliance's etc. Also the research of S. Shirmohammadi and F.Baghbani ^[1]. There are 32 pins in Arduino UNO. It has a microcontroller named as ATmega328P (8-bit AVR). It works on 5-12V, its input voltage is 7-12V. Also, it has 14 digital I/O pins, 6 analog pins, 32KB flash memory and 1KB EEPROM. Its is very easy to used and also potable in size so we can easily used in any project. It has a dimension of 68.6mm × 53.4mm. It also include GND, Vin, 5V, 3.3V, Reset, IOREF, AREF pins and other pins which are given in Table 2.

Table 2: Specification of Arduino.

Specifications	Details
Microcontroller	ATmega328P (8-bit AVR)
Operating voltage	5V
Input voltage	7-12V
Digital I/OP pins	14(6 PWM)
Analog input pins	6
Flash memory	32 KB
EEPROM	1 KB
SRAM	2 KB
Clock speed	16MHz
Communication	UART, I2C, SPI
Dimensions	68.6mm × 53.4mm

B) Motor Driver

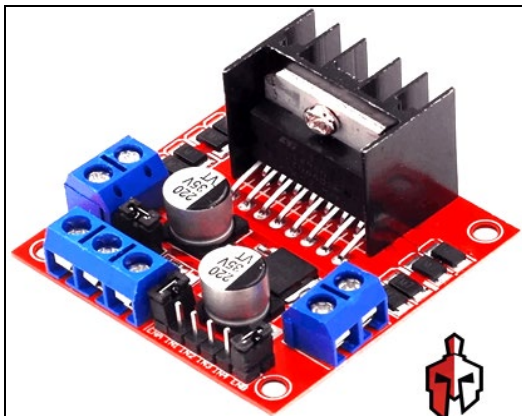


Fig 2: L298N Motor Driver

We know different types of motor drivers like L298N, L293D, TB6612FNG and many more but in our line follower we use L298N motor driver which we shown in fig.2 so we see all information about only L298N motor driver. Motor drivers used to control DC motors, stepper motors and servos in robotic projects like drone, line follower and robotic arms. We use it also because motors required high voltage and we can't give it through microcontroller because microcontroller has its input voltage range 3-12 V. also the research of M. Karthik, M. G. Nathan, R. Dhinesh and S. Ashwin ^[2]. There are total 12+ pins in L298N motor deriver. Also, it needs a power supply of 12V over that it gets burst. It has 4 input pins i.e. IN1, IN2, IN3, IN4. Also 2 enable pins i.e. ENA, ENB. Also 4 output pins i.e. OUT1, OUT2, OUT3, OUT4. 12v pin is connected to battery, GND is connected to battery and Arduino, 2 input pins i.e. IN1, IN2 is connected to Arduinos D8, D9and many more connections are given in Table 3.

Table 3: Pins of Motor Driver & their connections.

L298N PINS	Connected to
12V	Battery (7V-12V)
GND	Battery and Arduino GND
5V	Arduino 5 V
IN1, IN2	Arduino D8, D9
IN3, IN4	Arduino D10, D11
ENA, ENB	Arduino D3, D5
OUT1, OUT2	Motor A
OUT3, OUT4	Motor B

C) DC Gear Motors



Fig 3: DC motors

DC motors which are given in fig.3 are used in many projects. DC gear motors are essential components in robotics, and DIY projects like line followers. A DC gear motor combines a DC motor with a gear reduction system to increase torque and reduces speed. It converts electrical energy to mechanical rotation. Gearbox present in DC motor can Reduces rotations per minute and it increases torque. Output Shaft is used to Connect the wheels, pulleys, or other mechanisms.

We can't use microcontroller directly we need Motor driver and Motor driver is use to give power to our DC motors. There are many types of DC motors are present in market but most commonly used motors are Brushed DC gear motor, Brushless DC gear motor, planetary gear motor, Spur motor, Encoded gear motor etc.

D) Wheels and Caster Wheel



Fig 4: Caster wheel

For moving our Line Follower we use two wheels which is attached to chassis through DC gear motors also we use one caster wheel which is shown in fig.4 give flexible move to follow the given path easily.

E) IR Sensors

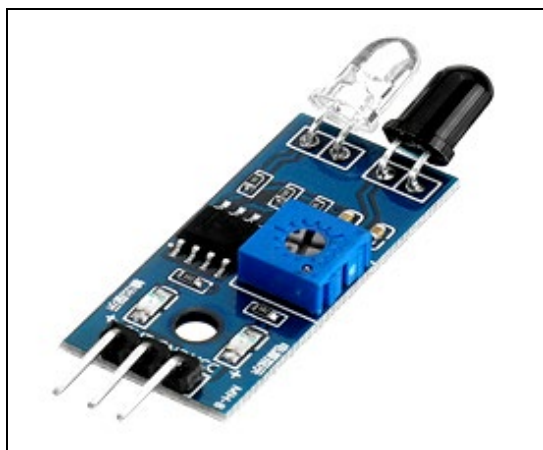


Fig 5: IR sensors

IR Sensor is infrared signal which is widely used in line follower robots, object detection. IR sensor Detect the infra light which human can't see through necked eyes. Though which he can measure distance. In this IR LED is present which radiate IR radiations and the photodiode/phototransistor acts as receiver through this technique we can measure distance. IR sensors has only 3 pins i.e. VCC, GND and OUTPUT pin. Also, IR Sensor's connections are given Table 4 and how it looks is given in fig.5

Table 4: Connections of IR sensors with Arduino.

IR sensor pin	Arduino pin
VCC	5V
GND	GND
OUTPUT	Any Digital pin

F) Battery



Fig 6: Battery

Batteries are a critical power source for Arduino, Raspberry Pi, motor drivers, and sensors in robotics projects. We use (9-12V) LIPO battery here which is shown in fig.6.

4. Connection Diagram

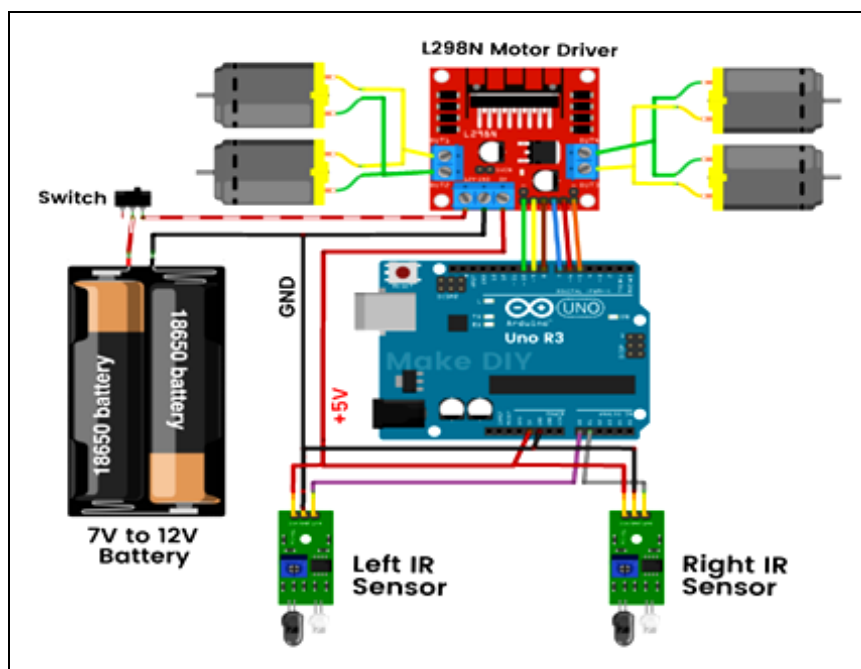


Fig 7: Line Follower connection diagram.

Conclusion and Future Scope

Line follower is successfully constructed and worked by using IR sensors, Motor driver, Arduino UNO, DC gear motors and many other components also contribute for constructing line follower. Line follower is a like a robot which follow the given path by the user.

Future work could focus on improving robustness, intelligence, and real-world usability. Future scope of this line follower is we can design more complex and advance bot by using new technologies.

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