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# LINE FOLLOWER ROBOT

A PROJECT REPORT

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# 1.Introduction:

## 1.1. About The Project

For our final project, we decided to make a line-follower  robot. This simple robot is designed to be able to follow a black line on the ground without getting off the line too much. The robot has two sensors installed underneath the front part of the body, and two DC motors drive wheels moving forward. A circuit inside takes an input signal from two sensors and controls the speed of wheels' rotation. The control is done in such a way that when a sensor senses a black line, the motor slows down or even stops. Then the difference of rotation speed makes it possible to make turns. For instance, in the figure on the right, if the sensor somehow senses a black line, the wheel on that side slows down and the robot will make a right turn.

### What is a robot?

A Robot has been defined by the Robot Institute of America as:

"A robot is a reprogrammable, multifunction, manipulator designed for moving materials, tools,

parts etc. through various programmed motions to perform a variety of tasks ".

A Robot has been defined by Webster dictionary as:

“A robot is an automatic device that performs functions normally ascribed to humans or a

machine in the form of a human.” Generally, robots have three main parts which include processor, sensor and motor control system. Robot sensors represent eyes while actuators act as legs and controller acts as the brain

of a human.

**What is an Autonomous Robot?**

Autonomous robots are the robots that can perform desired tasks in any environment without

continuous human guidance. In fields like space exploration high degree of autonomy is required

where communication and delays are unavoidable.

In the real world a fully autonomous robot has the ability to gain information about the environments and to work for months without human intervention. It can travel from one location to the other without navigation assistance. It can avoid situations that are harmful to any property or itself and can repair without external assistance.

**What is a line follower?**

Line follower is a machine that can follow a path. The path can be visible like a black line on a white surface (or vice-versa) or it can be invisible like a magnetic field.

## Why build a line follower?

Sensing a line and maneuvering the robot to stay on course, while constantlycorrecting wrong moves using feedback mechanism forms a simple yet effective closed loop system. As a programmer you get an opportunity to 'teach' the robot how to follow the line thus giving it a human-like property of responding to stimuli.

Practical applications of a line follower: Automated cars running on roads withembedded magnets; guidance system for industrial robots moving on shop floor etc.

1.2.Objective:

The objectives of this project are:

1. Scalability must be a primary concern in the design.
2. To make the device automatically tracking the particular path.
3. To design prototype of the robot that can follow the line.
4. To develop a robot that moves through a dark line on light back ground.

# 2. Description of Components

## 2.1. List of Component:

- Chassis
- Arduino Uno r3
- L298N H-Bridge Motor Driver
- Infrared Tracking Sensor FC 123 x 2
- DC Motors x 2
- Wheels x 2
- Caster Wheel
- 9V Batteries
- 9V Battery Connectors
- Jumper Wires
- Switches

## 2.2. Components Description

- ***Chassis***

It is a special design robot body that you can use for Line Following Robot projects

- ***Arduino Uno r3***

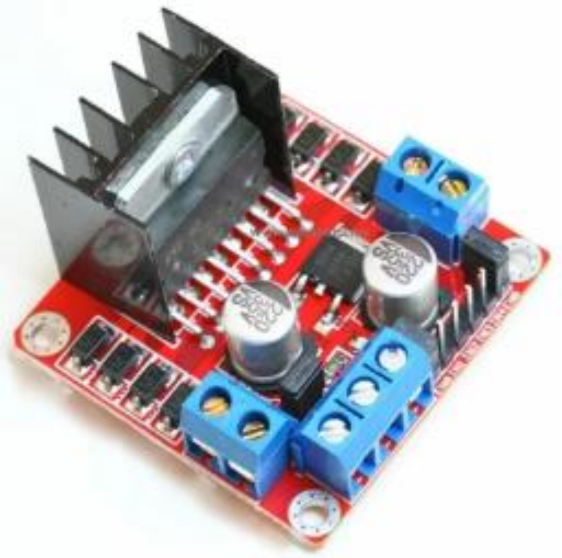
In our Project, we have used a microcontroller to control whole the process of system that is **ARDUINO**. Arduino is an open-source hardware and very useful for project developments.

There are any types of Arduinos like Arduino UNO, Arduino mega, Arduino pro mini, Lilypad etc. available in the market. Here we have used Arduino pro mini in this project as Arduino pro mini is small and so breadboard compatible. To burn the line follower robot Arduino code, we have used an FTDI burner.

- ***L298N H-Bridge Motor Drive*r**

  The H-Bridge Motor Drivers L298N is used to drive DC motors as they require much more current that the Arduino can provide.

  The L298N motor controller follows the H-bridge configuration, which is handy when controlling the direction of rotation of a DC motor. The other benefit of using an H-bridge is that we can provide a separate power supply to the motors. This is very significant especially when using an Arduino board where the 5V power source is simply not enough for two DC motors.



- ***Infrared Tracking Sensor FC 123***

The concept of working of a line follower robot is based on the phenomenon of light. This product applies TCRT5000 infrared ray reflection sensor that has the functions of both emitting and receiving. The module has a build in 74HC14 Schmitt-trigger inverter, so it has clean signal, standard wave form, and strong driving ability. The module can detect a reflective range from 1mm to 25mm. Besides, a M3 mounting hole is available and it is used to adjust directions and so on.

- ***DC Motors***

  The DC motor is a device that converts electrical energy into mechanical energy. The DC motor consist a rotating armature in the form of an electromagnet. A rotary switch known as commutator reversing the direction of the electric current twice every cycle to flow through the armature so that the poles of the electromagnet push and pull against the permanent magnets on the outside of the motor. The armature electromagnet passes the poles of the permanent magnets, since using the poles, the commutator reversing the polarity of the armature electromagnet. During that instant switch of polarity, inertia actuates the classical motor going in the proper direction.

**Why DC motors?**

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.

**Why two motors?**

By using two motors, we can move our robot in any direction. **Differential drive is the steering mechanism of robot**

- ***Wheels***

  These are robot wheels for our DC robot motors. These robot tires are press-fit directly onto the without the need for couplers or screws. Simple assembly is required for all types. Mix and match to create some very peculiar looking robots.

- ***Caster Wheel***

When our little robot needs something to lean on, it can lean on this support wheel. Perfect for use with 2-wheeled robots that need a third-point of support, this Support Wheel comes attached to a mounting plate and with M4 screws hole for fastening to any robot or project. It can rotate a full 360° on the plate and the sleek silver metal look suits any robot**.**

- ***9V Batteries***

Long Life 9V 6F22 29312 HW Hi Watt Carbon Zinc Battery.

- ***9V Battery Connectors***

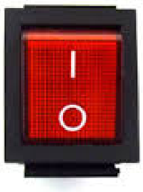
  The 9v Battery Snap Connector with DC Jack with Battery Connector Cap is widely used for project purposes. The 9V Battery Snap Connector with Power Plug provides the ability to conveniently use a 9V battery to power many common boards and modules such as the popular Arduino and compatible microcontrollers.

- ***Jumper Wires***

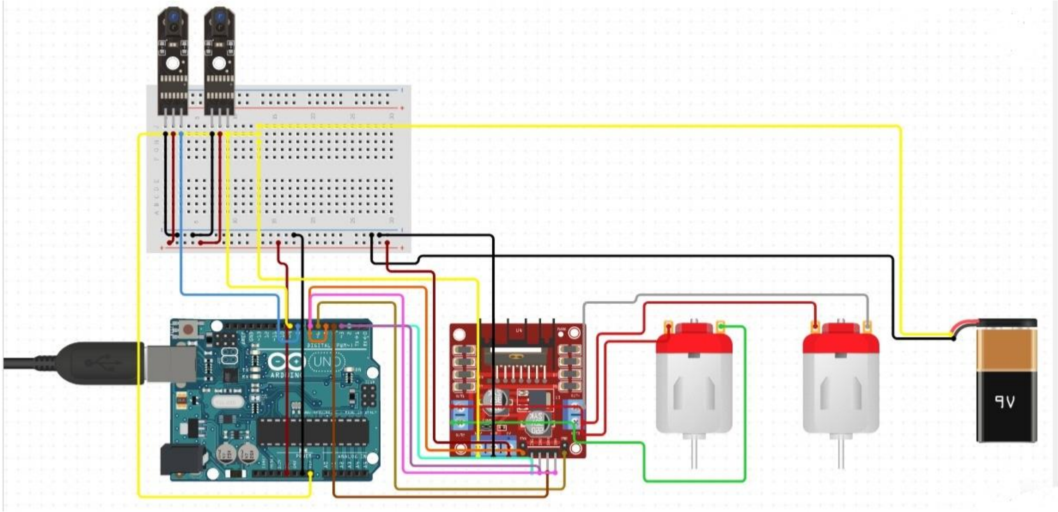
The jumper wires provide an easy way for us to build our own circuitry on a breadboard. These cables are flexible with both ends of a prototyping board connector. The jumper cable is ideal for creating circuits between your microcontroller and the breadboard on the bots.

- ***Switches***

  Power switches provide an electrical connection from a voltage source or ground to a load.



## 3. Circuit Diagram



## 4. Explanation of The Circuit and How our Robot Works

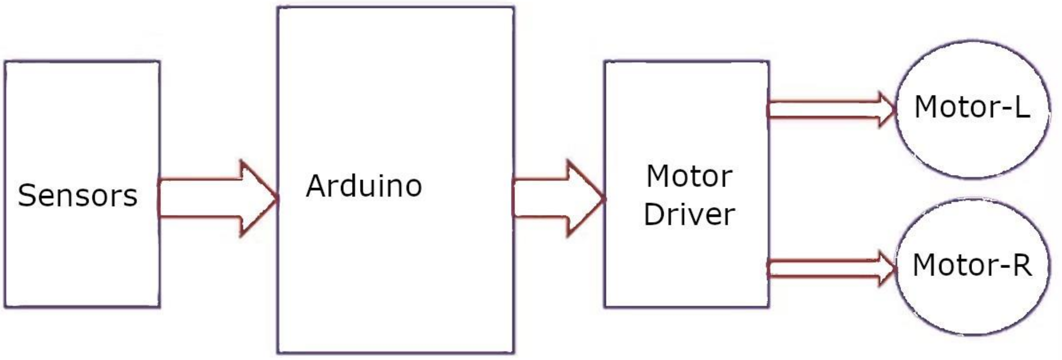
The robot uses a combination of IR Photo diode and IR-LEDs to sense the presence toa line. An IR Photo diode is a resistor whose resistance is proportional to the light falling on it- greater the light, lesser the resistance and visa-versa. The basic principle underlying this project is that objects light in color radiate the light falling on them while dark colored objects don’t.

So, when the sensors are above the black line the light emitted by the IR- LED is not radiated by the floor, hence the resistance of the Photo-diode increases. The opposite happens when the robot back on the white surface.

In our robot the IR Photo diode is used part of a voltage divider circuit.

When the robot is on white surface emitted by the IR LEDs fall on the IR Photo diode and decreases its resistance. This in turn reduces the voltage at V out. When the robot is on the black line, the light emitted by the IR- LEDs does not reach the IR Photodiode, hence its resistance increases.

This in turn increases the voltage at V.



This Arduino-based line tracker robot we used also called IR transmitters and IR receivers called photo diodes. They are used to send and receive light. Transmits IR, infrared rays. When the infrared light hits a white surface, it goes back and connects to the photodiodes, causing some voltage changes. When the IR light hits a black surface, the light is absorbed by the black surface and no light is reflected back, so the photo diode does not receive any light or rays.

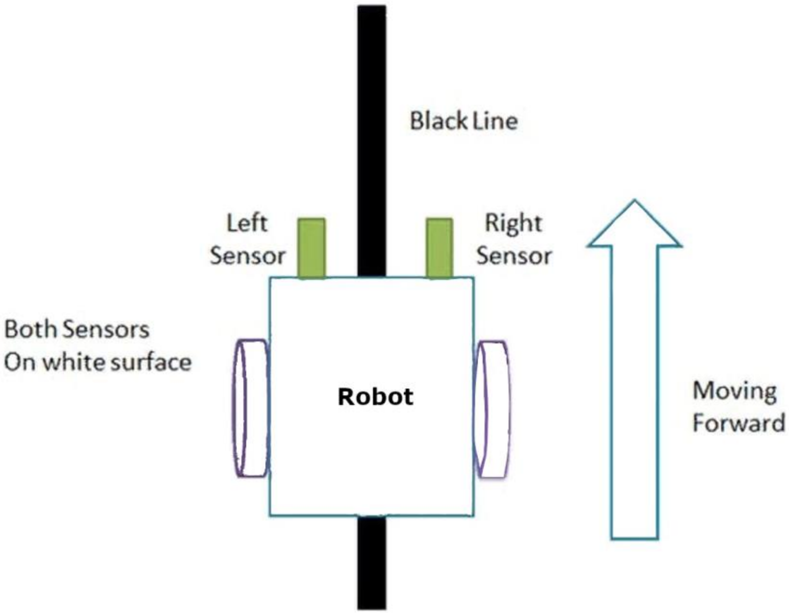
Here this arduino line follower robot senses the white surface of the sensor, then when the arduino takes1 input and senses the black line informs the arduino.

The line follower job is a lot of fun. The line tracker senses the black line using a robot sensor and then sends a signal to the arduino. The arduino then drives the motor along the output of the sensors

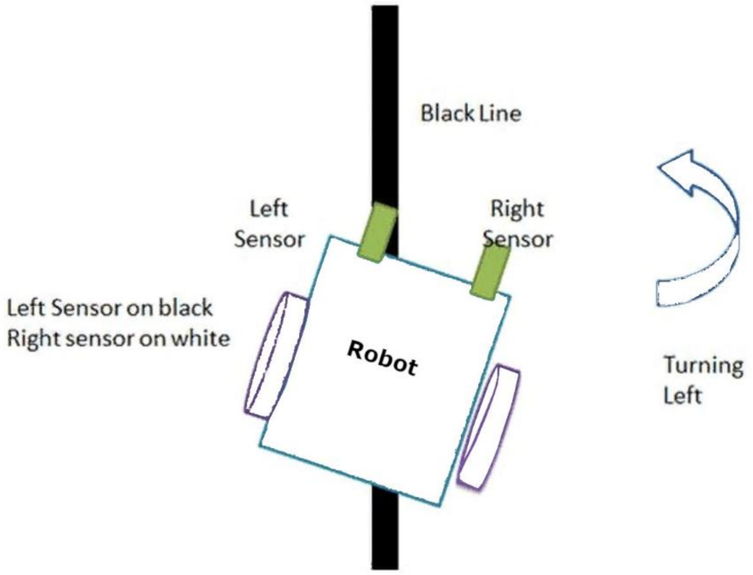
**Sensor section :**

This section includes iq-diodes, potentiometer, Comparator (Op-Amp) and LED's. The potentiometer is used to determine the reference voltage at one terminal and the IR sensors are used to detect the line and provide a change in voltage at the second terminal of the comparator. The comparator then compares the two voltages and generates a digital signal at the output. Here in this line follower circuit we used two comparators for the two sensors. The LM 358 is used as a comparator. The LM358 has two low noise inbuilt Op-amps.

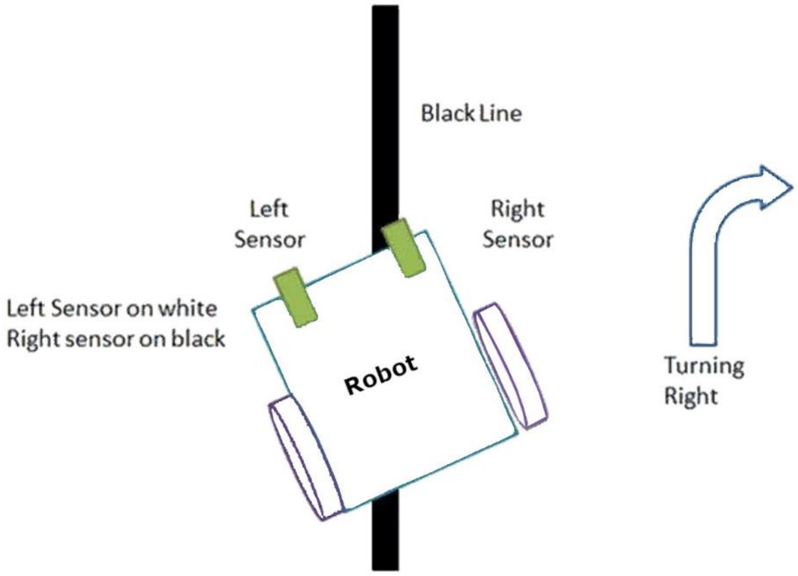
In this project we will use two IR sensor modules i.e. left sensor and right sensor. Both the left and right sensors detect white, then when the robot moves forward.



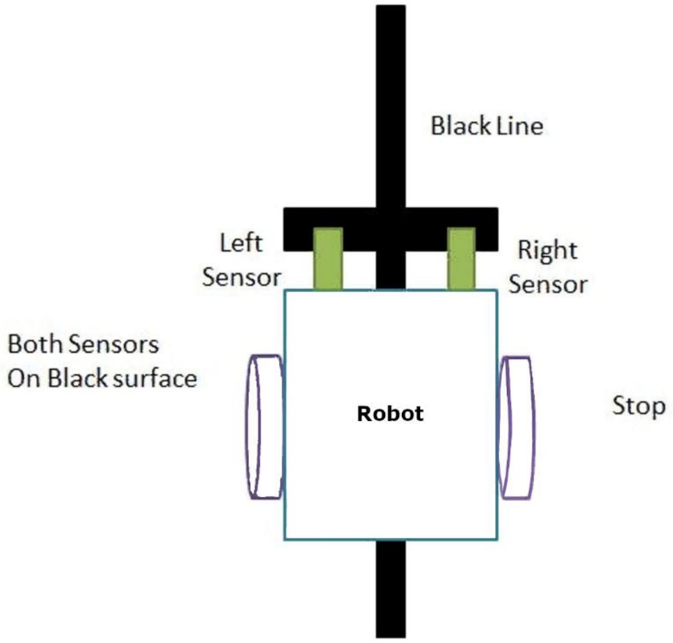
If the left sensor is on the black line, the robot turns to the left.



If the right sensor black line then turns the robot to the right, both sensors will come to a white surface. When the white surface arrives, the robot starts moving forward again.



If they both see a black outlet



## 5. Program Explanation

```
#define capteurGauche 11
//the output of the left sensor is connected with analog (11)

#define capteurDroite 12
//the output of the right sensor is connected with analog (12)

//if the sensors feel the black colour, the led light of the sensors
will turn off, which means that valeurDroite==0 && valeurGauche == 0


//in here we define the connection between the Shield Driver of
motors with the Arduino UNO
#define brocheMoteur1a 3 // first motor

#define brocheMoteur1b 4 // first motor

#define brocheEnable1 9  // broche enable du L298N for the first
motor

#define brocheMoteur2a 5 // second motor

#define brocheMoteur2b 6 // second motor

#define brocheEnable2 10 // broche enable du L298N for the second
motor
```

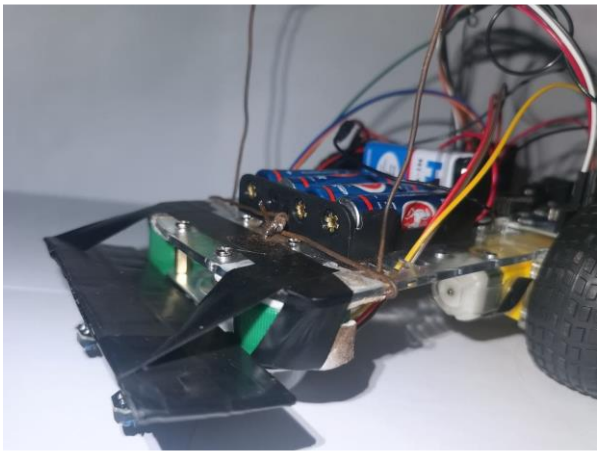
```
int initialDroite; // primary state for the sensor in the right
int initialGauche; // primary state for the sensor in the left


int vitesse = 180; // we initialise the pace of the motors and set
it to 180
int turn_speed = 20;  //we initialise the pace of the motor in the
axe of rotation (for example if we want to turn right we set the
left motor to 20)
int turn_delay = 10;



void setup() {


  // setting the outputs
  pinMode(brocheMoteur1a, OUTPUT);
  pinMode(brocheMoteur1b, OUTPUT);
  pinMode(brocheEnable1, OUTPUT);
  pinMode(brocheMoteur2a, OUTPUT);
  pinMode(brocheMoteur2b, OUTPUT);
  pinMode(brocheEnable2, OUTPUT);


  // we start in the state of no movement
  digitalWrite(brocheEnable1, 0);
  digitalWrite(brocheEnable2, 0);


  // settings in the drive forward mode
  digitalWrite(brocheMoteur1a, LOW);
  digitalWrite(brocheMoteur1b, HIGH);
  digitalWrite(brocheMoteur2a, LOW);
  digitalWrite(brocheMoteur2b, HIGH);
  delay(2000); // we set a delay of 2 seconds for the user to place
the robot, then start functioning.


  // reading the first values
  initialDroite = analogRead(capteurDroite);
  initialGauche = analogRead(capteurGauche);


}


void loop() {
  int valeurDroite, valeurGauche;


  valeurDroite = digitalRead(capteurDroite);
  valeurGauche = digitalRead(capteurGauche);


  if (valeurDroite==0 && valeurGauche ==0) {
    //we keep moving forward
    analogWrite(brocheEnable1, vitesse);
    analogWrite(brocheEnable2, vitesse);
  }
  else if (valeurDroite==1 && valeurGauche == 0) {
    // if we want to turn left
    digitalWrite(brocheEnable1, 0);
    digitalWrite(brocheEnable2, 0);
    // to give an exact calculation in each loop, we stop the motors
for 150ms and then we turn left, and so on
    // this spec give an harmony between rapidity, stability, and
exact states.
    delay(150);


    digitalWrite(brocheEnable1, 180);
    analogWrite(brocheEnable2, turn_speed);
  }
  else if (valeurDroite==0 && valeurGauche ==1) {
    // to give an exact calculation in each loop, we stop the motors
for 150ms and then we turn right, and so on
    // this spec give an harmony between rapidity, stability, and
exact states.
    digitalWrite(brocheEnable1, 0);
    digitalWrite(brocheEnable2, 0);


    delay(150);


    digitalWrite(brocheEnable2, 180);
    analogWrite(brocheEnable1, turn_speed);


  }


  else if (valeurDroite==1 && valeurGauche == 1){
    // we stop because there is black line (end of path)
    digitalWrite(brocheEnable1, 0);
    digitalWrite(brocheEnable2, 0);
  }
  delay(100);
}
```

-Assembling the robot

We will show here, the important steps we did to assemble our robot.

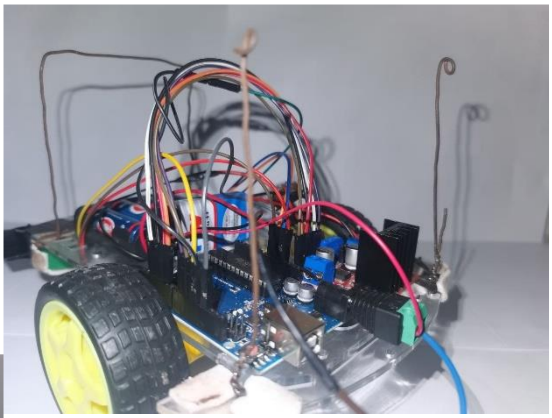
After fixing the main components (Driver, motors, sensors, Arduino, …)

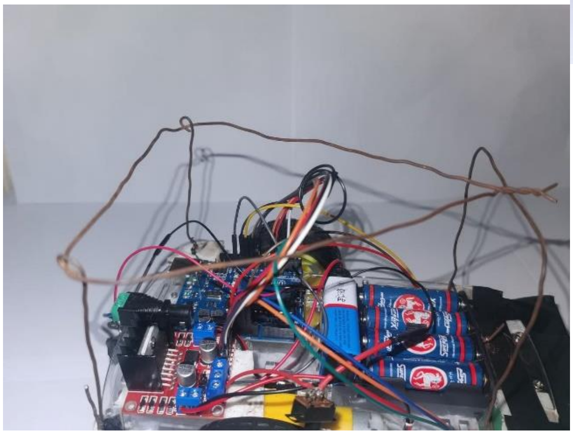
We come now to make a simple cover for our fabrication.



We created a simple bumper to protect our sensors from destruction.

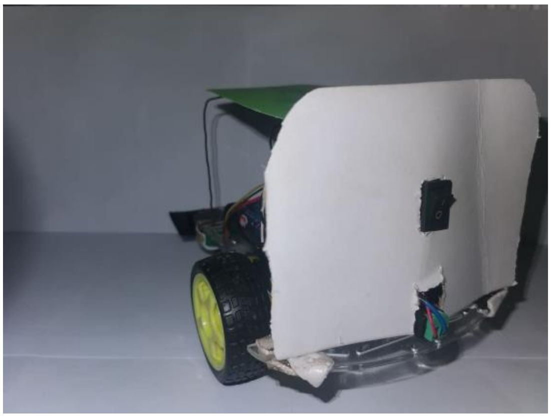
We created 4 bars in which we will put on our shield.





In here, we created a base in which we will stick our bonnet door, in order to change batteries and check on the components.

we created a spot to make the (on/off) more practical



## 6.Applications of line follower robot:

Line follower robot which is usually make at university level is just to make students familiar with the field of robotic. But actual robots use in fields are much more complex and they can perform very complicated task in industry. It is not possible to make a practical robot at university level. That’s we want to encourage students to make simple robots like Liner follower robot that we made, obstacle avoided robot, metal detection robot to get basic understanding of practical robots. In this report we have presented you an idea of Liner follower robot. How to make line follower robot using Arduino.

Also, for repetitive tasks which use the same path things like following one on the floor of a factory to remove the need for a human operator also lines of metal place under lawns can be used as a guide for a robot lawnmower. There are cases where smarter versions of line followers are used to deliver mail with in an office building and deliver medications in a hospital. The technology has been suggested for running buses and other mass transit systems, and may end up as part of autonomous cars navigating the freeway.

## 7. Conclusion

The Track Follower robot is one of the outcomes of implementation of with microcontroller on single board. This robot can be autonomous if it is run by 4 AA batteries.

There are certain advantages of this robot. They are as:

Increased productivity, safety, efficiency, quality of products Can work in hazardous environments.

No need for support, need no environmental comforts.

Have repeatable precision at all times, can be more accurate than humans.

Have many capabilities beyond those of humans, can process multiple stimuli/tasks simultaneously.

A robot can work without sleep. So, it can work 24/7/365.

A part from advantages there are some disadvantages too. They are as follows:

Robots take the place of many humans in places like factories. So, the people have to find new jobs or be retrained. So, a MAJOR disadvantage is that the robots take the place of humans in several situations.

Another disadvantage is that there is quite a high initial cost for the robot and the software and equipment that you need to use with the robot.