# INDIAN INSTITUTE OF TECHNOLOGY MANDI
## KAMAND, HIMACHAL PRADESH – 175005
### Fundamentals Of Design Practicum



**IC-102P**

A Report on

# LINE FOLLOWER ROBOT

## (CURVED LINES)

Presenyted By

GROUP NO. 36

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# ABSTRACT

The line follower robot is an automated vehicle that follows a visual line embedded on the surface. This visual line is a path on which the line follower robot runs. Generally, it uses a black line on a white surface,
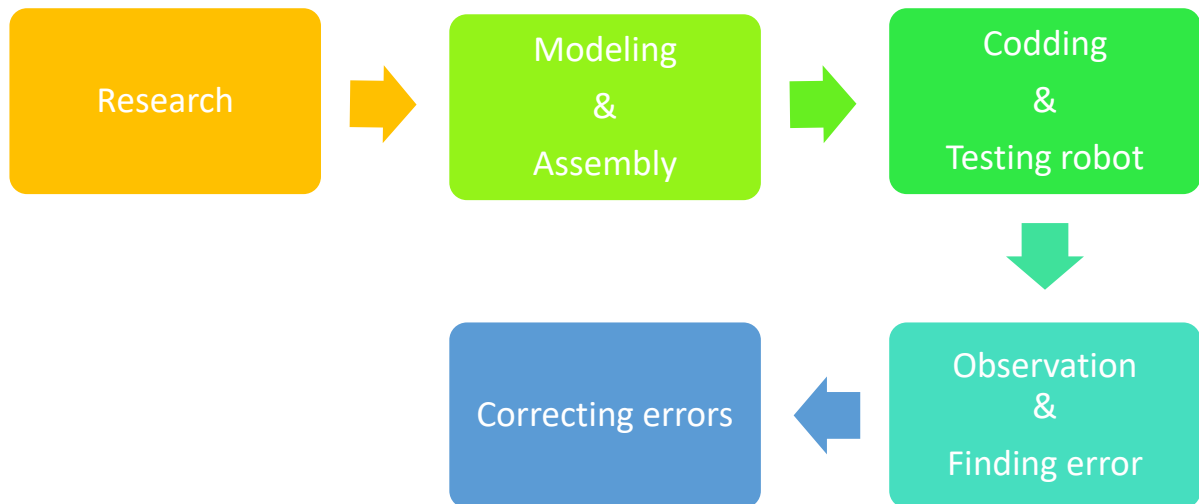Or you can adjust it as a white line on a black surface.
The concept of the line follower robot is related to light. Here, we use the behavior of light on the black-and-white surface. The white color reflects all the light that falls on it, whereas the black color absorbs the light.
We use IR transmitters and receivers
(photodiodes) in this line follower robot. They are used to send and receive the lights. When IR
rays fall on a white surface, it is reflected towards the IR receiver, generating some voltage changes.
When IR rays fall on a black surface, it is absorbed by the black surface,
and no rays are reflected; thus, the IR receiver doesn't receive any rays.

In this project, when the IR sensor senses a white surface, an Arduino
gets 1 ( HIGH ) as input, and when it senses a black line, an Arduino
gets 0 ( LOW ) as input. Based on these inputs, an Arduino Uno provides the proper output to control the bot.

# The Steps We Follow

| | | |
|---|---|---|
| Research | Modeling & Assembly | Codding & Testing robot |
| Correcting errors | | Observation & Finding error |

## Summary:

Step-1 : First we research for manufacture and working principles of line following robot

Step-2 : After research about line following robots we design our model and assemble them with the help of solid works.

Step-3 : After modelling and assembly we jump to the coding part and testing our robot.

Step-4: After completing the coding part and testing we observe some errors and improper work of our robot and note down errors and solutions of those errors.

Step-5: Finally we correct our errors and our line follower robot is completed.
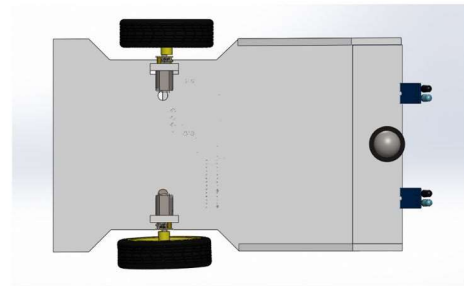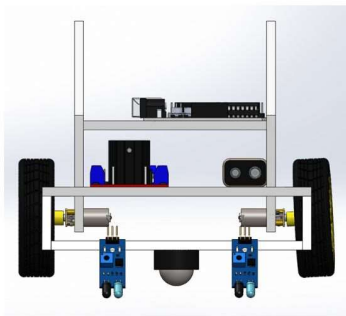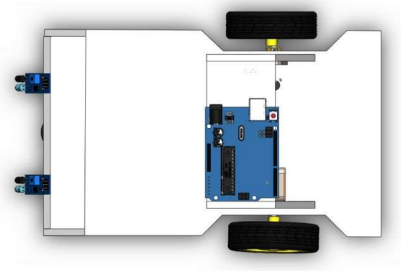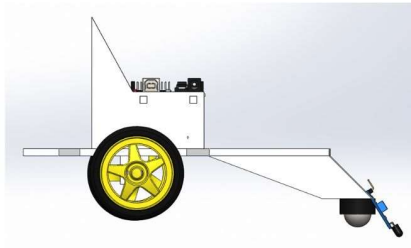
# Components List:

| S.No. | Item | Quantity |
|-------|------|----------|
| 1 | Arduino UNO (with Cabel) | 1 |
| 2 | 6-12 V Geared-Encoder Motor 60 RPM | 1 |
| 3 | Castor Wheel | 1 |
| 4 | 75mm Rubber Wheels | 2 |
| 5 | Buck Converter | 1 |
| 6 | Battery 12V LIPO | 1 |
| 7 | XT 60 M-F Connector | 4 |
| 8 | Acrylic Sheet 5MM (2x2 feet) | 1 |
| 9 | Jumper Wire M-M, M-F, F-F | - |
| 10 | L298 Moter Driver (Data Sheet) | 1 |
| 11 | Switch | 1 |

# Connections:

# CAD Model

# 2D Drawing

## Model:

# Parts:

Q-2

Q-2
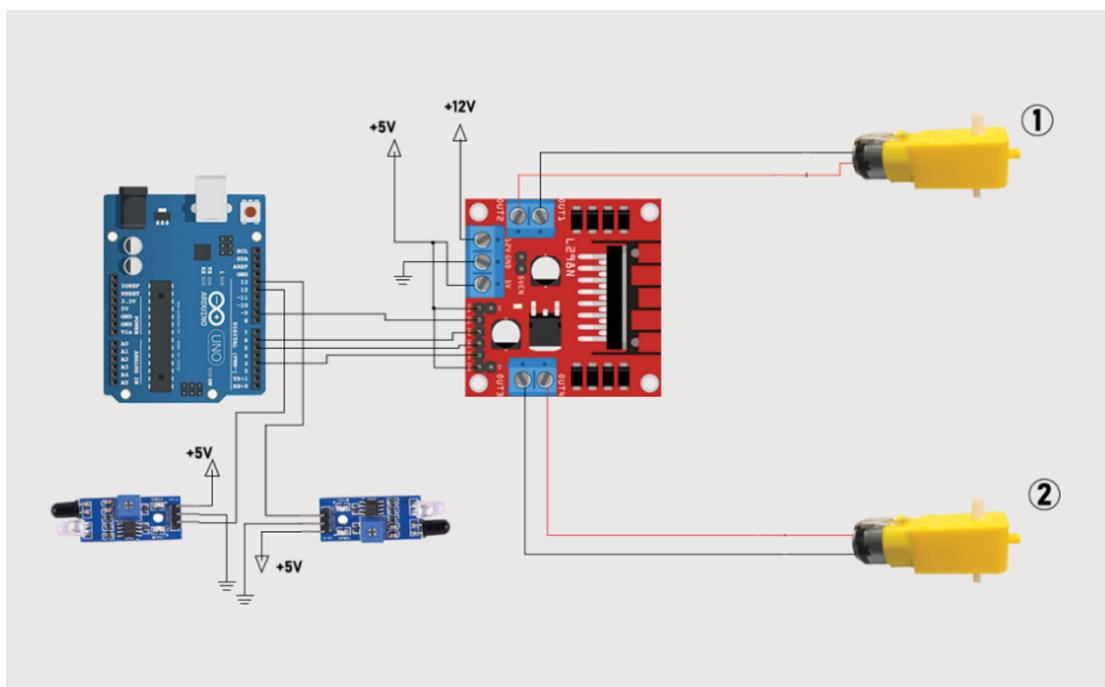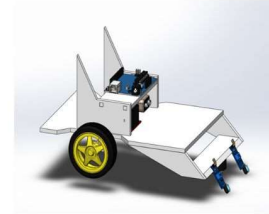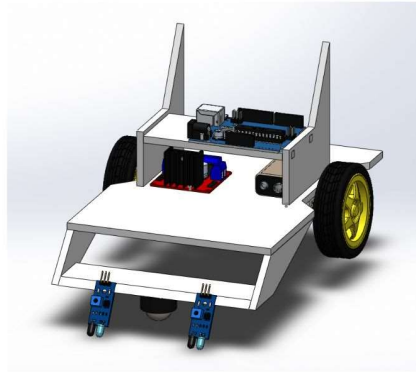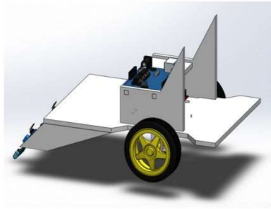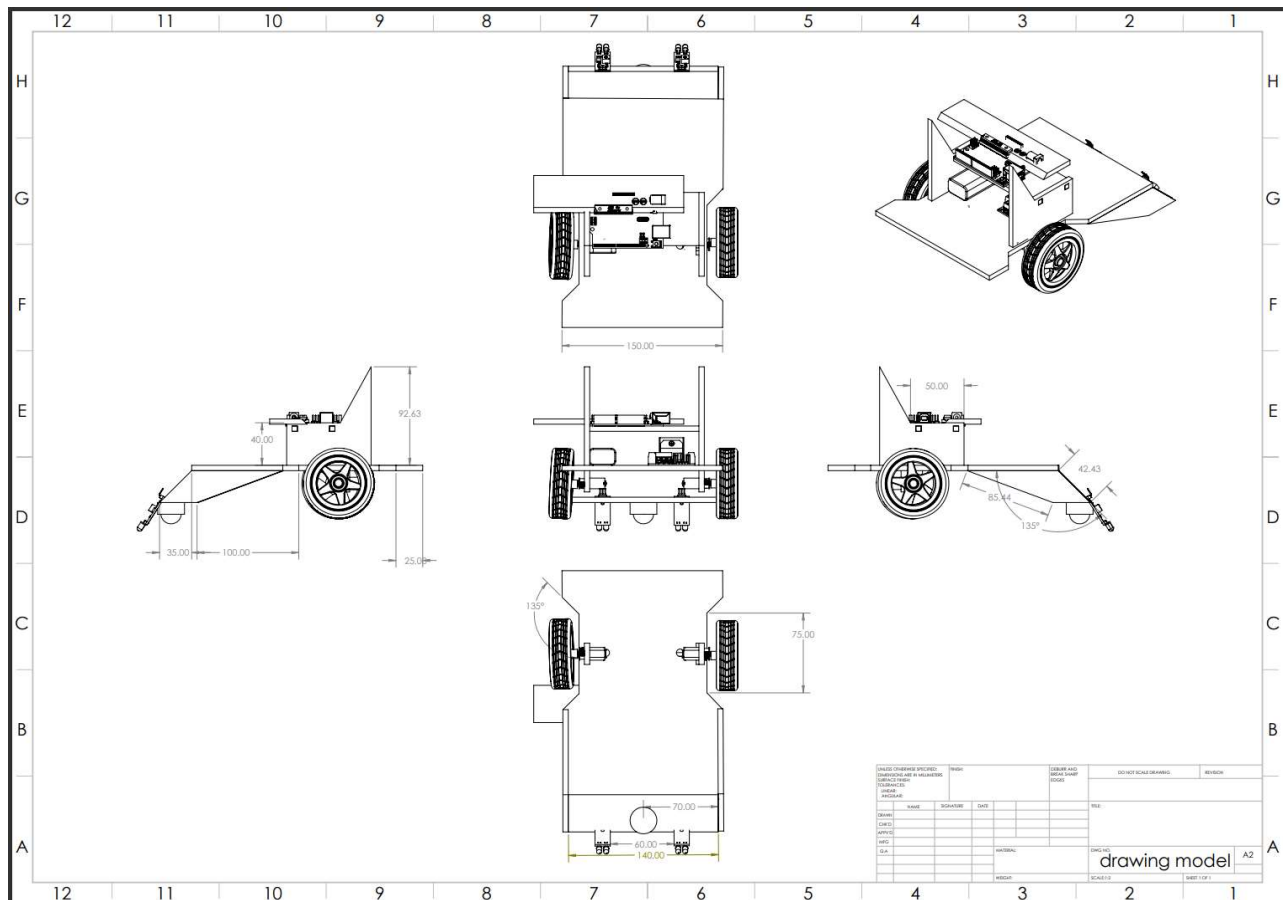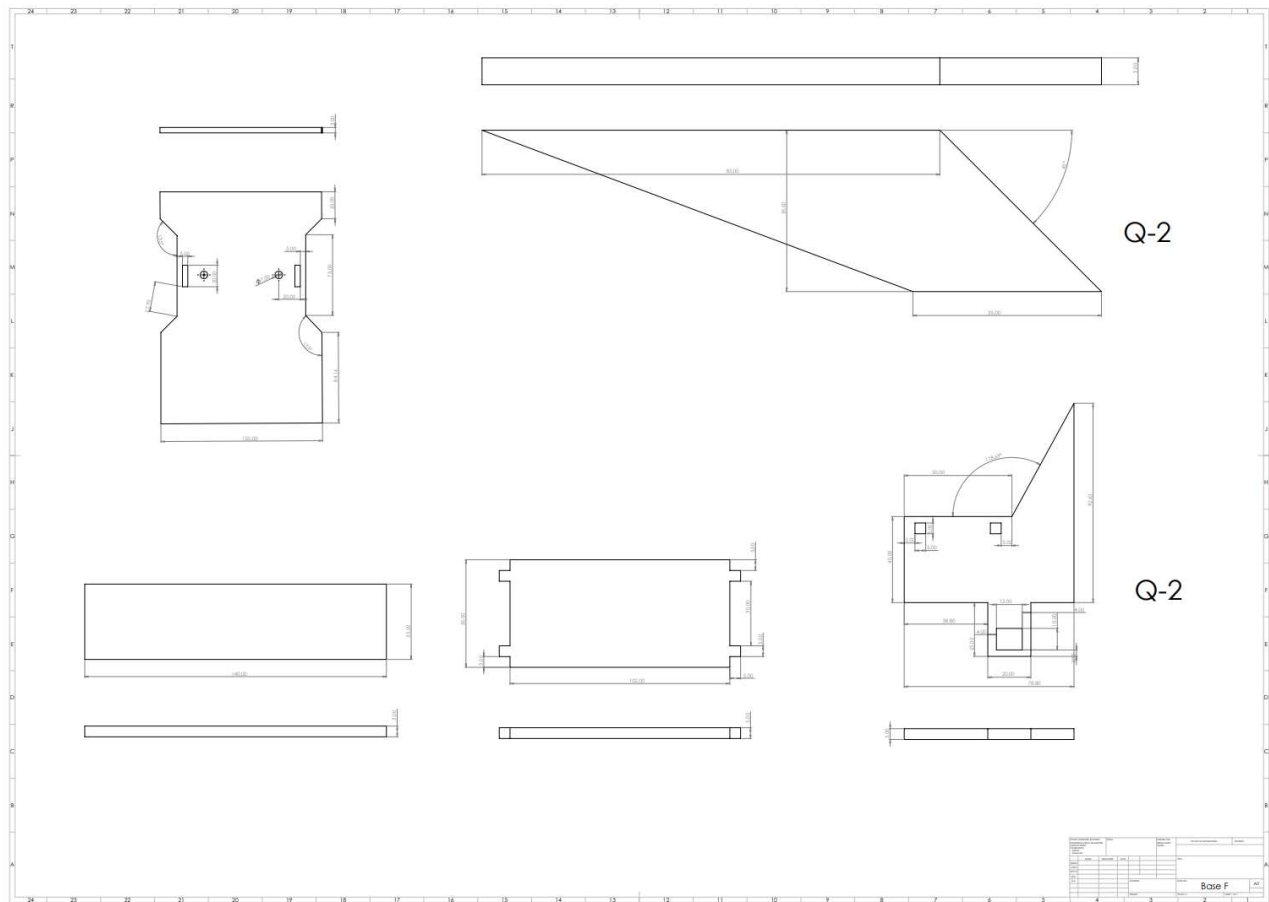
# Systematic

**Data Flow:**
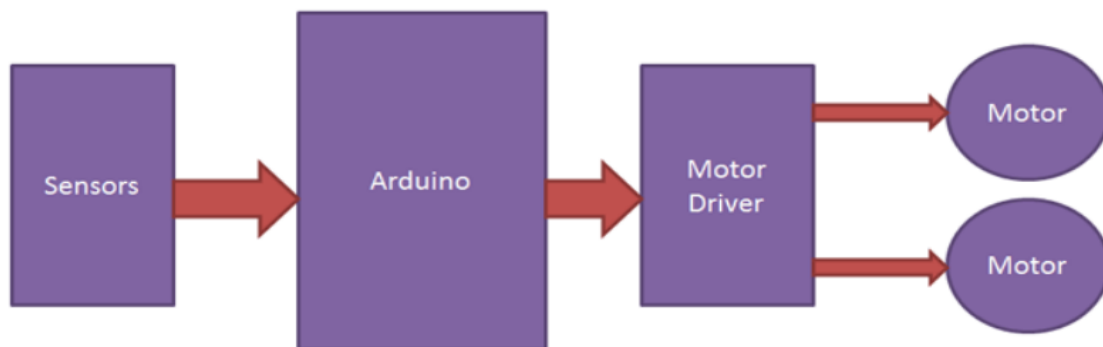


**Pseudo Code:**

1) At first, we initialize the Sensors that are connected to the robot.
2) Then we have to define variables for storing sensor data.
3) After defining variables we have to run the below logic in the loop to react according to the sensor data.
4) Logic
   a. Read sensor values.
   b. If both sensors detect the line, move forward.
   c. If only the left sensor detects the line take a left turn.
   d. If only the right sensor detects the line take a right turn.
   e. If both don't detect the line stop the robot.

## Logic Table:

| L Sensor | R Sensor | L Moter | R Moter | Action (Turn) |
|----------|----------|---------|---------|---------------|
| 0 | 0 | 0 | 0 | Stop |
| 1 | 0 | 1 | 0 | Right |
| 0 | 1 | 0 | 1 | Left |
| 1 | 1 | 1 | 1 | Forward |

## Reference Images:

# Flow Chart

START

right sencer and left sencer bothh not detect black — **YES** → FORWARD (both motor same speed and direction)

**NO** ↓

left sencer detect black — **YES** → LEFT TURN (left moter minimised)

**NO** ↓

right sencer detect black — **YES** → RIGHT TURN (right motor minimised)

**NO** ↓

both detect black — **YES** → REVERSE (both moter have same speed and direction )

**NO**
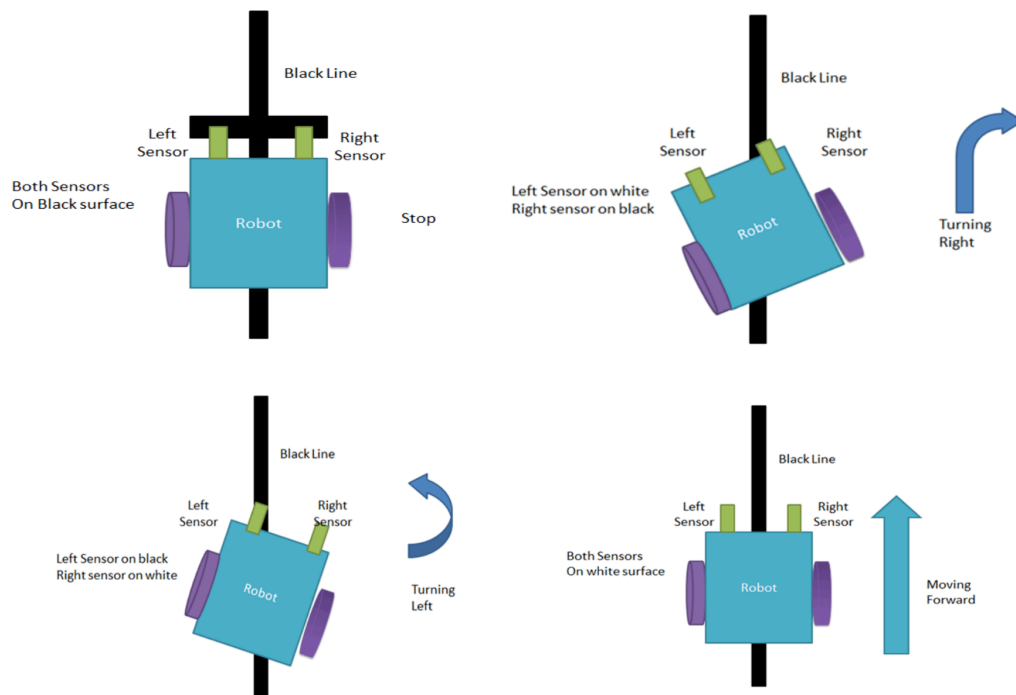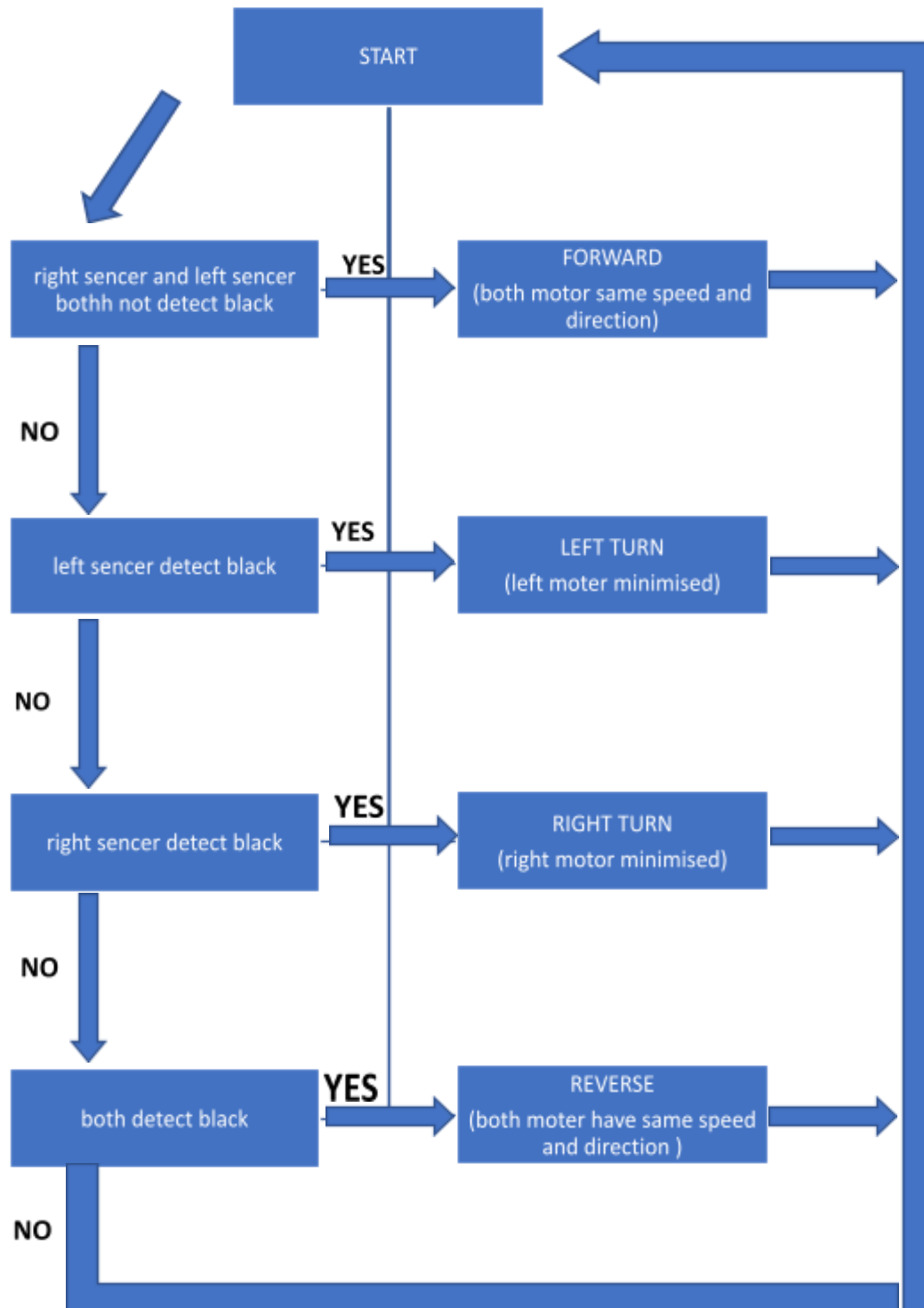
# APPLICATIONS:

The line follower robot is used in the modern days which helps the company to complete the work fast and save time. the robot can do work many more times instead of the people so in a short period of time it developed. The sensor-based black line follower robot is one of the most basic robots used to follow the black line on the white background or the white line on the black background. this robot can be used for various things that carry goods, floor cleaning, delivery service, and transportation.

The applications of line follower robot are:

1) Industrial applications
2) Automobiles applications
3) Domestic applications
4) Guidance applications

## Industrial applications:

Line follower robots have been used extensively in various industrial applications due to their ability to automate tasks and improve efficiency. Some of the common uses of line follower robots in industrial settings include:

Material handling:  Line follower robots can be used to transport materials such as raw materials, work-in-progress, and finished products within the manufacturing plant.

Inspection: Line follower robots can be used to inspect and verify the quality of products during production.

**ASSEMBLY:** Line follower robots can be used to assemble components and products by following a specific path.

**Packing:** Line follower robots can be used to package products by following a pre-determined path.

## limitations:

**Limited flexibility:** follower robots are designed to follow a specific path, which limits their flexibility and ability to adapt to changes in the environment.

**High-cost initial:** The initial cost of line follower robots can be relatively high, which may not be feasible for small and medium-sized businesses.

**Limited range of applications:** Line follower robots are suitable for applications that involve following a predetermined path, which limits their range of applications.

**Susceptibility to changes in the environment:** Line follower robots rely on sensors to detect and follow the line, which can be affected by changes in lighting, floor surfaces, and other environmental factors.

Therefore, while line-follower robots can be useful in certain industrial applications, it is important to carefully consider their limitations before implementing them in a specific setting.

## AUTOMOBILES APPLICATIONS:

Line follower robots can be used in automobile purposes for a variety of applications such as automated manufacturing, material handling, and inspection. Here are some of the uses and limitations of line follower robots for automobile purposes:

**Automated Manufacturing:** Line follower robots can be used in automobile manufacturing for tasks such as welding, painting, and assembly. These robots can follow a predetermined path to perform tasks with high precision and accuracy.

**Material Handling:** Line follower robots can also be used for material handling tasks such as loading and unloading parts on an assembly line. They can move materials along a set path, which reduces the need for manual labor and increases efficiency.

**Inspection:** Line follower robots can be used to inspect parts for defects or quality control purposes. They can follow a path and scan parts for defects, which helps to ensure that only high-quality parts are used in the manufacturing process.

## Limitations:

**Limited to specific paths:** Line follower robots can only follow specific paths that are predefined, which limits their flexibility. If the path needs to be changed, the robot needs to be reprogrammed or adjusted, which can be time-consuming.

**Limited to a specific environment:** Line follower robots are designed to operate in a specific environment, and any changes to the environment, such as lighting or floor conditions, can affect the robot's performance.

**Limited to certain speeds:** Line follower robots are limited in speed and may not be suitable for applications requiring high-speed movement. This can limit their use in some automobile manufacturing applications.

I-line follower robots can be useful in automobile manufacturing for automated manufacturing, material handling, and inspection purposes.

They have limitations in flexibility, speed, and environmental requirements, which may impact their effectiveness in certain applications.

## DOMESTIC APPLICATIONS:

Line follower robots can have several uses for domestic purposes, such as:

FLOOR CLEANING: Line follower robots can be used to clean floors in homes, particularly hard floors like wood or tile. The robot follows a pre-determined path and cleans as it moves along.

Lawn care: Line follower robots can be programmed to mow lawns, reducing the amount of manual labor required.

Security: Line follower robots equipped with cameras can patrol the perimeter of a home, detecting and reporting any unusual activity.

## Limitations:

Limited flexibility: Line follower robots are programmed to follow a specific path, so they may not be able to adapt to changes in the environment or unexpected obstacles.

Limited functionality: While line follower robots can perform specific tasks like cleaning or mowing, they may not be able to perform more complex tasks like cooking or laundry.

Cost: Line follower robots can be expensive, particularly those with more advanced features. This may make them cost-prohibitive for some households.

Maintenance: Line follower robots require regular maintenance, including battery replacement and cleaning, to ensure they continue to function properly.

GUIDENCE APPLICATIONS;

Line follower robots can be used for guidance purposes in a variety of applications such as warehouse automation, agriculture, and transportation. Here are some of the uses and limitations of line follower robots for guidance purposes:

Warehouse Automation: Line follower robots can be used in warehouses to guide automated vehicles transporting goods. They can follow a path and guide the vehicle to its destination, reducing the need for manual labor and increasing efficiency.

Aicultgrure: Line follower robots can be used in agriculture for tasks such as crop monitoring and harvesting. They can follow a path and scan crops for defects or to detect ripe fruits or vegetables.

Transportation: Line follower robots can be used in transportation to guide autonomous vehicles, such as self-driving cars or drones. They can follow a path and help the vehicle to navigate through complex environments.

**Limitations:**

Limited to specific paths: Line follower robots can only follow specific paths that are predefined, which limits their flexibility. If the path needs to be changed, the robot needs to be reprogrammed or adjusted, which can be time-consuming.

Limited to a specific environment: Line follower robots are designed to operate in a specific environment, and any changes to the environment, such as lighting or floor conditions, can affect the robot's performance.

Limited to certain speeds: Line follower robots are limited in speed and may not be suitable for applications requiring high-speed

movement. This can limit their use in some transportation applications.

Limited to certain types of surfaces: Line follower robots may not work well on surfaces that do not provide sufficient contrast between the line and the background, such as shiny or reflective surfaces.

line follower robots can be useful in guidance purposes for warehouse automation, agriculture, and transportation. However, they have limitations in terms of their flexibility, speed, environment, and surface type, which may impact their effectiveness in certain applications.

## Video References:

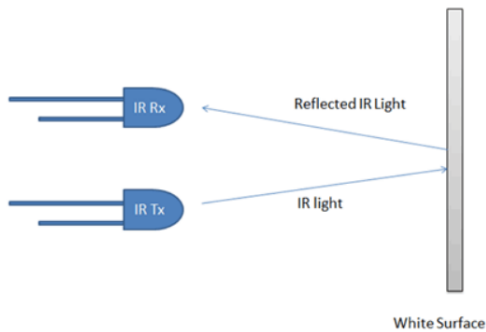Build a Raspberry Pi Line Following Robot! - Latest Open Tech From Seeed

▶ Industrial Line Follower Robot l alauddin28 | HTECBD

robot race. line follower robot with arduino program - YouTube

▶ Fast line follower Robot

▶ AGV-INDUSTRIAL LINE FOLLOWER ROBOT | AEH FACTORY | ARV

# Working of IR Sensor



Active infrared sensors work with radar technology and they both emit and receive infrared radiation. This radiation hits the objects nearby and bounces back to the receiver of the device. In this way, it detects there is no black line. When there is a black surface, the infrared beam is absorbed by the black surface, so the receiver can't get the reflection back in this way Sensor detects there is a black line.
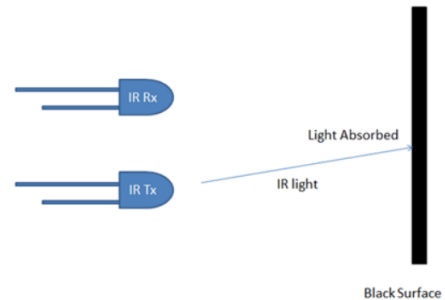
# Future Scope

The Line follower which we are developing in this project has more scope of Further development. The line follower which we developed in this prototype can follow only curved and straight lines, it can further be developed as follows,

- We can develop this robot for the following intersection, right angle, and V-shaped lines.
- Including Ultra Sonic Sensor for obstacle avoidance with line follower.
- The Robot can be further developed by using more IR Sensors for accuracy.
- The Robot can be further developed for following colour lines.

# REFERENCES

- Arduino Programming Book.
- Inventor Lab Book.
- https://robu.in/
- https://www.educba.com/