Simulation Task

Tasks

1. Line following
2. Segmented Wall following
3. Dotted Line following
4. Chess Board Area
5. Broken Bridge

Sensors per Task

IR Sensors

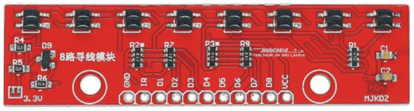
In order to tackle the line and dotted line following task, it was decided to use IR sensors.

An alternative considered was to use a colour sensor. However, the biggest disadvantage of using colour sensors is its cost. A single colour sensor would cost Rs 1050 but to increase accuracy we would be needing a large number of sensors. An 8-array IR sensor would cost Rs 1050 in total. Using 8 colour sensors would amount to a total of Rs 8,400.

Since IR sensors are the most commonly used sensors for line following, no other alternatives were considered.

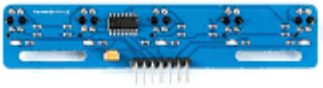
In order to increase the accuracy of the readings, it was decided to use a higher number of IR sensor pairs. The main factors taken into consideration when selecting the best IR sensor was the accuracy, line dimensions and the cost.

8-channel IR tracking sensor module:



- Length - 6.7cm
- Width - 1.7cm
- IR sensor pairs - 8
- Cost - Rs 1090.00

5-channel IR tracking sensor module:



- Length - 9.7 cm
- Width - 2 cm
- IR sensor pairs - 5
- Cost - Rs 890.00

3-channel IR tracking sensor modules:

- Length - 3 cm
- Width - 2 cm
- IR sensor pairs - 3
- Cost - Rs 740.00

The 3-channel IR tracking sensor was immediately discarded as the length of the sensor is 3 cm and the width of the line to be detected is 3 cm. The final decision came between the 8-channel and 5-channel IR sensor. the 5-channel sensor has a width of 9.7 cm, gaps between 2 IR sensors is approximately 2 cm. When considering a line of 3cm, only 1 sensor can be inside the line, others will be at the border, which would be difficult to get the accuracy. When we are using 8 channel IR, 3 IR sensors will fall

inside the line, so accuracy will be higher comparatively.

Ultrasonic Sensor module

It was decided to use ultrasonic sensing modules for the segmented wall following task and to traverse through the chess board without colliding on the chess board pieces. There was another option to use an IR sensor instead of UltraSonic, but the main challenge with the IR is, it will be affected by environmental IR. Although we can use it in the simulation, we ignored it because of the practical problems which the IR sensor has. The IR sensor emits the IR LED and receives the IR from the IR proximity sensor. But emitted IR will be absorbed by various colours in various percentages. So, it's difficult to identify when the wall is dark, since most of the emitter IR rays will be absorbed.

The Ultrasonic sensor module considered was,

HC-SR04

- Length - 45mm
- Width - 20mm
- Height - 15mm
- Range - 2cm - 4m
- Cost - Rs 650.00

RGB Sensor

Since the dotted line with the correct colour needs to be selected, it was decided that an RGB sensor should be used in order to differentiate between colours. Even IR sensors can be used for this purpose, but because of the above mentioned problems of IR, we can't get the higher accuracy of the readings. The RGB sensor module selected was TCS230.

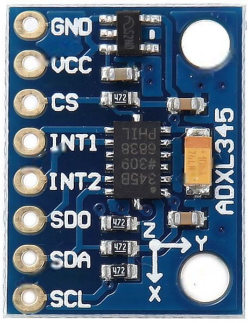
- Length - 31.6mm
- Width - 24.4mm
- Range - 10mm
- Cost - Rs 1050.00

Accelerometer

To find out the inclination angle and to ensure that the robot moves at an acceptable speed at the slope, it was decided that an accelerometer needed to be used. It measures the static acceleration of gravity, from that we will be able to detect the slope of the path and adjust the torque of the motors.

GY-291 ADXL345 3-Axis Accelerometer

- Range - all
- Cost - Rs 800.00

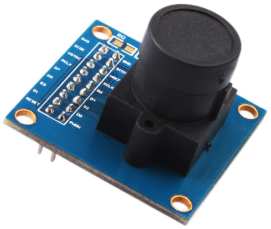


EyeCam Sensor

For the broken bridge task and to lift the chess board piece and boxes, an EyeCam sensor was

decided to be used. But the major problem with the sensor, it's difficult to use. An alternative considered was an ESP32 Cam module. Since it has a microcontroller in it, which is already programmed with AI.

EyeCam sensor:
OV-7670 Camera Module



- Cost - Rs 800.00

ESP32 cam module:

- Length - 40mm
- Width - 27mm
- Height - 12mm
- Cost - Rs 2350.00

On the basis of cost, we planned to use an Ultrasonic sensor to detect the object, and use a wider arm to pick up the object without considering the position.