

# Report on Selecting Suitable Sensors for the Mobile Robot to Fulfill the Given Sub Tasks

Team Name: Cosmo

210069F, 210174X, 210205V, 210258J, 210542B

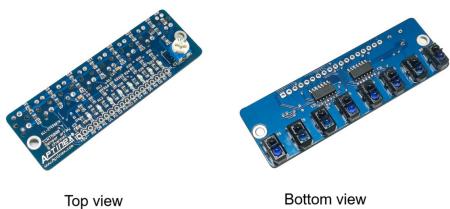
## 1 Introduction

This report focuses on selecting the most appropriate sensors for the robot to complete the given set of sub tasks. Some sensors have been used in more than one sub-task and hence categorized as common sensors. This report analyzes the pros and cons of the potentially available sensors and the reasons for selecting the most suitable sensor out of them.

## 2 Common Sensors

### 2.1 Raykha S8 - IR Array

Raykha S8 by Aptinex, a TCRT5000 based 8-channel reflective IR sensor array is used as the main sensor to navigate along the line. This IR array emits infrared (IR) waves, measures the intensity of the reflected waves, and gives both analog and digital outputs. Considering the cost and the expected behaviour, this sensor suits best to our requirements.



Top view

Bottom view

| Alternative Sensor    | Image | Advantages                      | Disadvantages   |
|-----------------------|-------|---------------------------------|---|
| Individual IR modules |       | Cheap, Good for small distances | Many individual modules needed for our task, High error rate, Difficult to identify darker colors |
| Pololu QTR-8RC        |       | High accuracy and precision     | Expensive, More robust than required  |

### 2.2 Magnetic Encoders



Magnetic encoders are used with the DC motors to precisely and separately measure the amount of which the wheels have rotated. These data are used to turn the robot in precise angles (e.g.: 90°), move precise distances (e.g.: 60cm), and detect slipping of the wheels. Measuring of precise distances and ensuring straight movement is specially useful in the sub task 3.

Many alternative types of rotary encoders available in the market such as optical encoders, but as these magnetic encoders come pre-attached to the DC motor, using them is relatively easy for us as beginners.

## 2.3 SHARP GP2Y0A21YK0F - Sharp IR Sensor

Sharp IR sensors are used to measure the distances to the external objects. This sensor is used mainly in sub task 2 for the wall detection and following, and sub task 6 for detecting the presence and the motion of the guard robot.



| Alternative Sensor          | Image | Advantages                                 | Disadvantages   |
|-----------------------------|-------|--|---|
| HC-SR04 Ultrasonic Sensor   |       | Independent on the lighting condition      | Difficult to measure distance to slanted surfaces   |
| TOF (Time Of Flight) Sensor |       | Cheap, Smaller size, Considerable accuracy | Not accurate on slanted surfaces, Complex libraries, Significant delay in processing data |

## 3 Task Specific Sensors

### 3.1 Sub Task 1 - Line Following

Raykha S8 IR array and magnetic wheel encoders (above discussed) are used.

### 3.2 Sub Task 2 - Avoiding Wall Segments

Raykha S8 IR array, SHARP GP2Y0A21YK0F sharp IR sensor, and magnetic wheel encoders (above discussed) are used.

### 3.3 Sub Task 3 - Surmounting the Bridge and Opening the Path

#### 3.3.1 MPU-6050 - Gyroscope, Accelerometer



MPU-6050 comes with a 3-axis gyroscope, a 3-axis accelerometer, and a temperature sensor. The 3-axis accelerometer is used to detect the angle of the ramp (bridge) surface to adjust the motor torques accordingly. Additionally, it can also be used to find whether the robot goes straight on the ramp in the absence of the guiding line.

#### 3.3.2 MG90S - Metal Gear Servo Motor

MG90S is a 180° servo motor with metal gears. It is used to control the mechanical arm which is used to grab and manipulate objects.

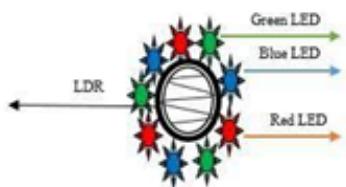
This servo motor with metal gears is specially selected in order to enable to lift and carry the weight of the object. Withstanding against the weight of the arm itself is also considered.



| Alternative Sensor                    | Image   | Advantages     | Disadvantages                           |
|---------------------------------------|---|----------------|---|
| SG90 - Servo Motor with plastic gears |  | Cheap, Smaller | Low torque and low strength of the arms |

### 3.4 Sub Task 4 - Identifying Color and Placing the Box

#### 3.4.1 Custom Built Color Sensor



A custom built color sensor is planned to be used for identifying the color of the box. The sensor consists of LEDs of different colors and LDR(s) to detect the reflected light intensity. Through data processing and calculations the color is expected to be identified accurately enough.

### 3.5 Sub Task 5 - Responding to the Sound

#### 3.5.1 LM393 - Sound Sensor

The LM393 sound sensor is used to capture the sounds in the surrounding.



### 3.6 Sub Task 6 - Avoiding the Guard Robot

SHARP GP2Y0A21YK0F IR sensors are used to detect the presence of the guard robot after getting closer to the guard robot's path.

Alternatively, ultrasonic or TOF sensors can be used. However, due to the same reasons mentioned under section 2.3, sharp IR sensors become the best option.