EN2533 Robot Design and Competition
Team AGNI

Sensors

Ultrasonic Sensor

We selected an Ultrasonic sensor for obstacle detection and guard bot part tasks.

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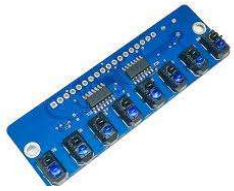
Reasons for Selection:

- **Low Cost**: Ultrasonic sensors are relatively affordable. Since we use 5 ultrasonic sensors we have to consider the cost of sensors considering our budget.
- **Relatively High Range**: Ultrasonic sensors are capable of providing a relatively long-range detection capability. This makes them suitable for detecting obstacles at a distance.

IR Sensor



We decided to use an IR array for line following and coloured line following

Reasons for Selection:

- **Line Detection Coverage**: An IR Array provides a wider coverage area for detecting lines or tracks, making it more efficient for line-following tasks.
- **Simplicity**: Using an IR Array simplifies the sensor setup as it typically contains multiple IR sensors in a single package, reducing wiring and complexity.

Colour Sensor TCS230

We selected the TCS230 Colour Sensor for colour detection.

Reasons for Selection:

- **Range**: TCS230 has a better range than TCS3200, which is important in sensing colour easily.

- **Versatility**: It can detect a wide range of colours, making it versatile for tasks that require distinguishing between different hues.

Sound Detection Sensor MD0220

We selected the MD0220 Voice Sound Detection Mic Sensor for sound detection.

Reasons for Selection:

- **Purpose-Specific**: MD0220 is designed specifically for voice and sound detection, making it a suitable choice for applications where you need to respond to sound cues or commands.
- **Voice Detection:** This sensor is optimised for voice detection, which can be advantageous in scenarios where the robot needs to react to voice commands or environmental sounds.

Actuators

We used two 6V 100 rpm N20 motors for our robot.

Reasons for Selection:

- **Higher Efficiency**: N20 motors are known for their efficiency. They can convert a larger portion of electrical energy into mechanical work. This is advantageous for achieving better performance while optimising power usage.
- **Low Power Consumption**: N20 motors typically have low power consumption, making them suitable for our robot where energy efficiency is crucial. This helps to extend the robot's operating time on a single charge.
- **100 rpm**: This rpm value is enough to complete the ramp part without much trouble.

Batteries

We used an 11.1V 3300mAh 3S 40C LiPo battery pack as the power source for the 12V DC motors, servo motors which control the arm, and PCB with sensors.

Reasons for Selection:

- **High Energy Density:** This battery offers a high energy density, it can store a significant amount of energy in a compact form. This is essential for powering various robotic components efficiently.
- **Optimal Voltage Output**: With an output of 11.1 volts, this battery is well-suited for powering our robotic components, ensuring they operate with optimal performance.
- **Lightweight:** LiPo batteries are known for being lightweight, contributing to the robot's agility and overall mobility. The reduced weight makes it easier for the robot to move and respond quickly.

Wheels

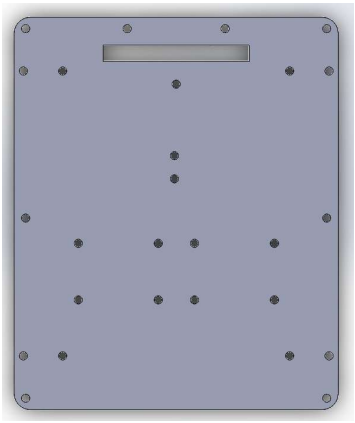
We used 4 D-axis 43mm Rubber Tire Wheels (54mm diameter) for our robot.

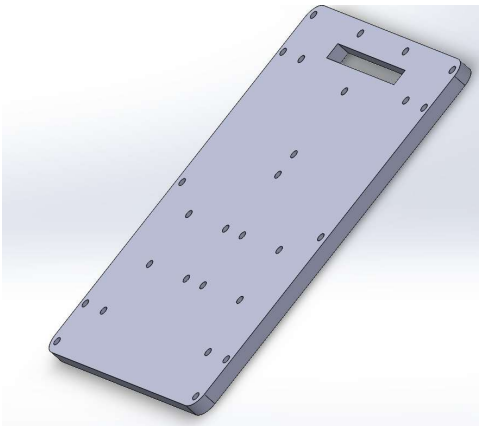
Reasons for Selection:

- **Stability and Weight Distribution**: Implementing four wheels provides improved stability and even weight distribution, especially on hard surfaces. This enhances the robot's balance and performance.
- **High Grip Wheels:** The high-grip wheels were chosen for their ability to deliver strong adhesion and traction. They play a crucial role in maintaining stability and control during robot movement.
- **Slippage Prevention**: These wheels offer the necessary grip to prevent slippage, ensuring the robot follows its intended path accurately.

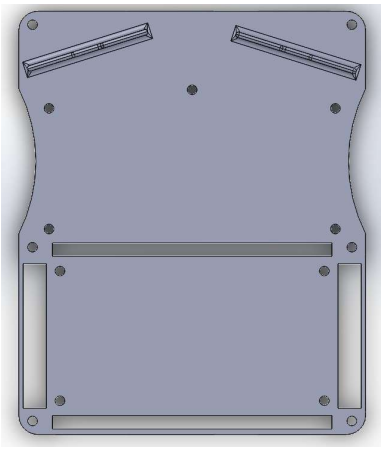
CAD Designs

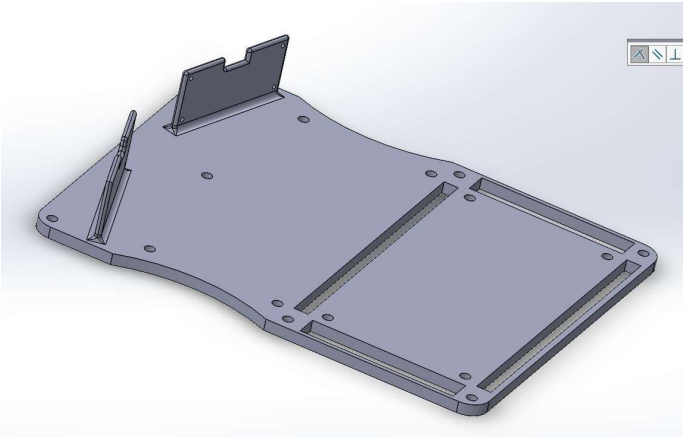
Bottom Stage





Upper Stage





Game Plan

Task 1: Line Following
For the initial task of the competition, the robot needs to follow the white line on the black background. To detect the line with better accuracy we used an IR array with 8 IR modules. For smoothing the movement of the robot we added a PID controller. The PID control processes the IR sensor data and makes real-time adjustments to the robot's motor output, ensuring that it stays on the line with precision.

Task 2: Wall Following
In this task, the white line is disturbed by walls at some points and the robot needs to follow the white line, avoiding the walls. To detect walls we used ultrasonic sensors. The robot manages to keep a constant distance from the walls in disturbed areas and comes back to the white line after that according to the algorithm.

Task 3: Ramp Navigation
To go through the ramp we focused on what needed to be done by the mechanical design side. We calculated the height that the chassis needs to be from the ground and where the tyres should be situated relative to the chassis. The PID controller is adjusted for this task to slow down the robot when it comes near the ramp, so the robot can smoothly enter the ramp.

Task 4: Box Manipulation
To tackle the box manipulation challenge, we added a robotic arm with stepper motors equipped with joints for precise movements. We used ultrasonic sensors to detect the presence of the box. After the box is detected, the arm grabs the box according to the code.

Task 5: Coloured Line Following
For this task, the robot needs to identify the colour of the box and follow the path with the same colour as the box. First, the box is picked up by the arm and then using the colour sensor, the box's colour is detected. According to the colour of the box, the robot follows the line according to the right-hand rule to reach the destination.

Task 6: Sound Detection
In this part, there is a sound-emitting tower. The robot should freeze when a sound is emitted from the tower and should move only when it's silent. With the sound sensor, the robot detects the sound and moves according to the algorithm.

Task 7: Guard Bot Avoidance
In the final task, the robot encounters a guard robot blocking its path. Ultrasound sensors are strategically positioned on the front sides of the robot to detect the movements of the guard bot. When the bot moves away from our destination, our robot successfully evades the guard robot and reaches the final destination.

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