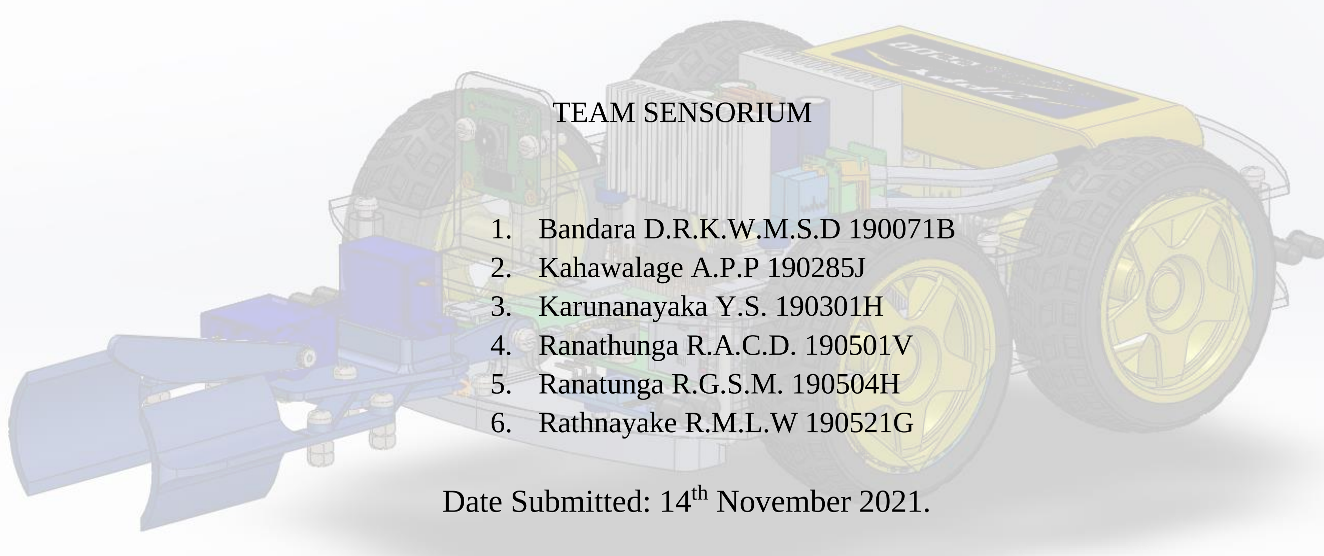
DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING
UNIVERSITY OF MORATUWA
EN2532 – ROBOT DESIGN AND COMPETITION

<u>INITIAL CAD DESIGN FOR THE PROTOTYPE</u>



TEAM SENSORIUM

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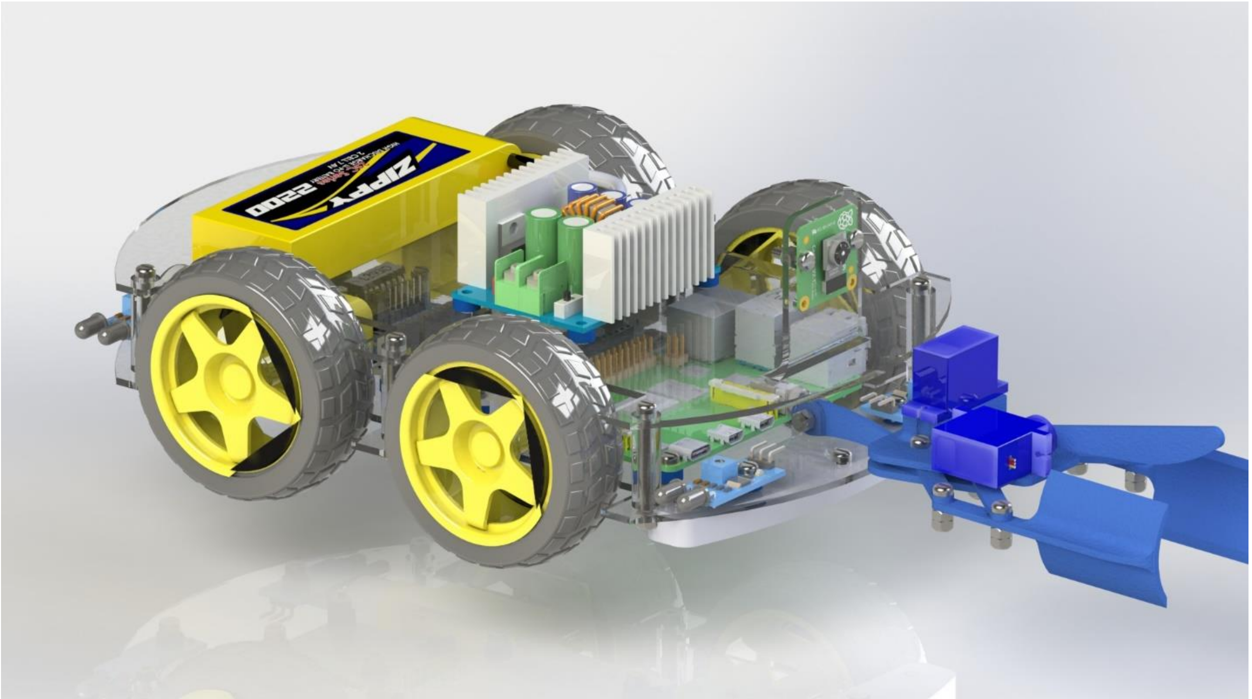

Figure 1: Rendered SOLIDWORKS Design

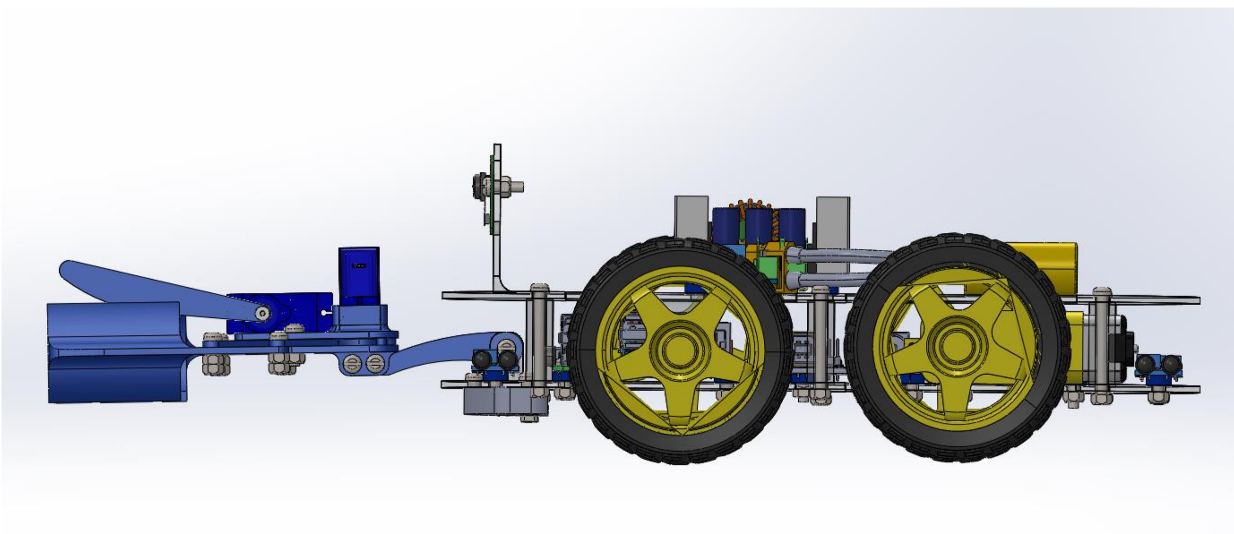

Figure 2: Side view

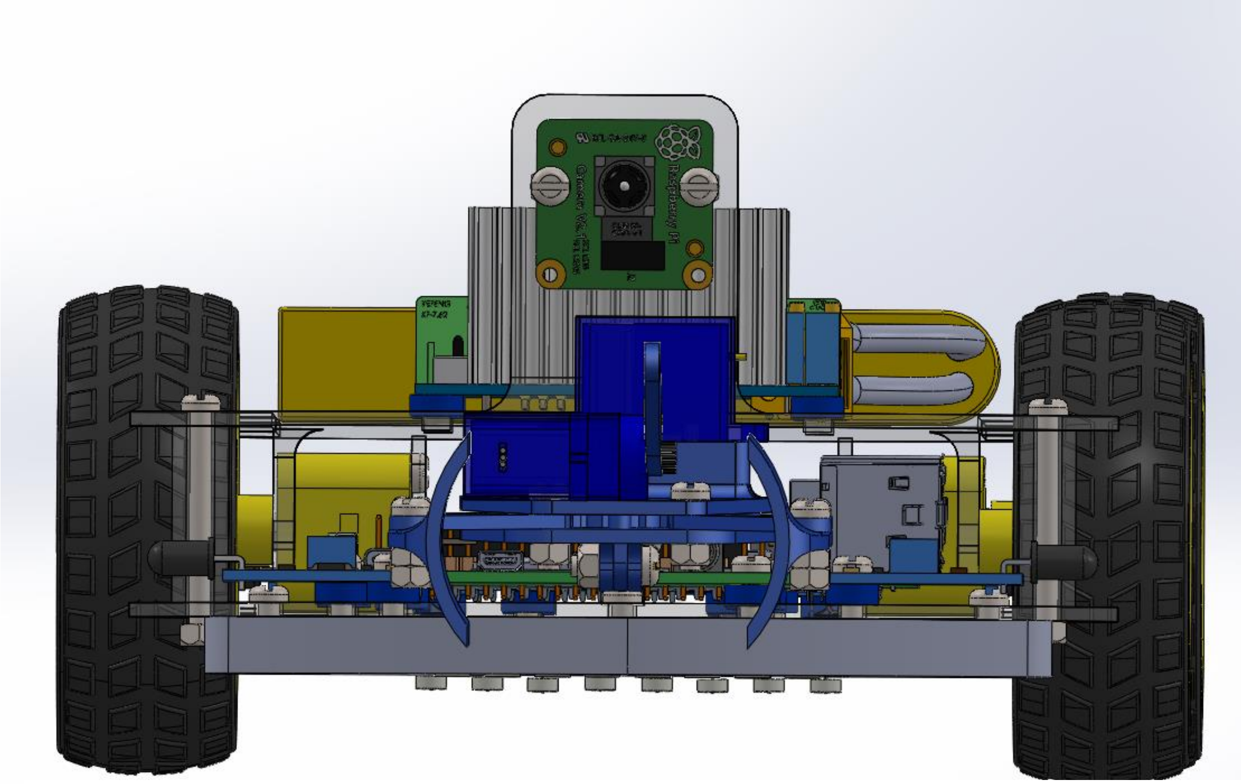

Figure 3: Front view

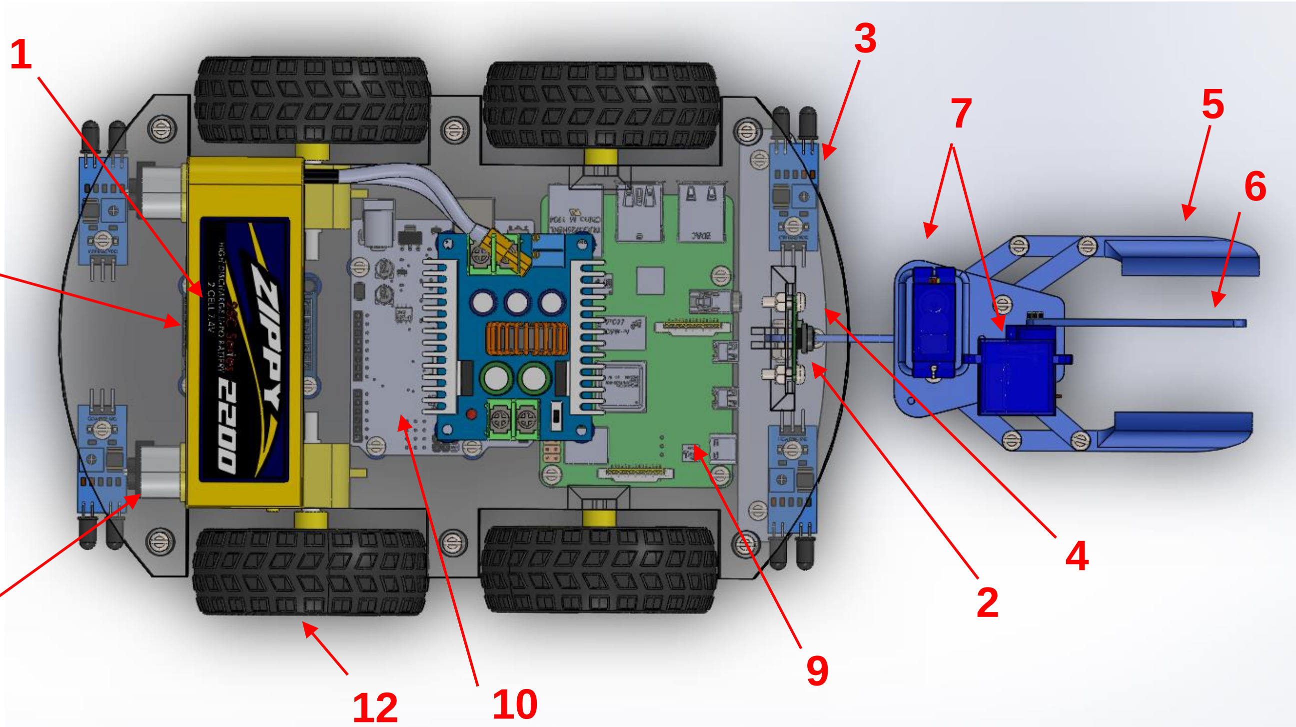

Figure 4: Top view

1. **LIPO - Power supply**

Compared to other batteries LIPO batteries has significant advantages such as: discharge-charge efficiency, longer lifespan. Here we are planning to keep the battery in the top, considering the ease of replacing with a new battery.(We gave the priority to the battery, when we allocate spaces in the top chassis.

2. **Camera – Image acquisition**

We selected RASPBERRY Pi camera (5MP) for all the image acquisition purposes because of the advantages such as less power consumption, minimal physical size, faster bandwidth, higher resolutions of images, higher framerates (for video) , and reduced latency. (Because we are using Raspberry pi processor, it is better to use the Pi camera rather than using a USB-webcam.)
There are two stages we are hoping to use the camera: identifying the shape of the object and color of the ball. For both cases, camera will be observing the front of the robot and thus no need of changing the observing angle of the camera. (Camera is fixed in position and direction.)

3. **IR - Wall following**

We are using 4 Infrared sensors (TCRT5000) for distance sensing in the maze solving part.
Positions of sensors: 1 at front of the robot directed to front, 2 at front but directed to sides left and right.(The sensors for sided should be places near to the front so robot can detect deviations soon as possible.)Final sensor is placed at the rear of robot and directed to back, just in case if we need to go in reverse direction.
We considered that we do not need to know the exact distance but only to get a rough estimate to the walls in this process. So we choose this sensor because it is low in cost and less power consuming.

4. **Line sensor- Line following**

For the line following task, we are planning to design a sensor using a CD4503 multiplexer, 9 LDRs, 8 LEDs, a LM311 comparator and a 74LS90 3-bit counter IC. As the readings are taken by using the LEDs and LDRs; the parallelly placed LEDs and LDRs should be fixed under the mobile robot to sense the solid/dash lines. For that purpose, a separate part should be designed to fix the LEDs and LDRs as required. This part is fixed to the bottom side of the robot in front the front wheels. (Processing is done in the Arduino board.)

5. ARM-Use to pick ball and cube

We implemented a 6-link system (parallelogram mechanism – 1DoF) with 2 gear wheels to grab the cube and the ping-pong ball. The servo-motor is connected to one gear wheel in a way that system end up giving a linear motion to the arm. The curved surface is designed to hold the ping-pong ball and direct it to the required direction in the final stage. Same mechanism is used to release the grabbed object at right moment.
This arm is mounted in front of the robot using hinge. There is a small bearing Infront of the arm to let the arm automatically bend, when the robot is passing the bridge.

6. Bat- use for kick the ball

To hit the ball, we use a small bat attached to a servo motor. Before hitting the ball, the bat is directed upward. When we want to hit the ball, the servo will bring down the bat downward. The bat is a little bit curved at the end. The tunnel of the arm helps the ball to move straight.

7. Servo- Arm controlling, rotate the bat

Because both arm controlling and batting need well- controlled motions we selected servo motors for that task.

8. DC motor- Drive the robot

To achieve a translational motion with a manageable speed while keeping the complexity at a low level we came up using DC motors.

9. RPI- use for image processing

We calculated the required minimum RAM for processing the images using the Arduino and a suitable camera and were convinced that requirement cannot be met with the Arduino board. So we switched to RPI for image processing. We expect to do all the processing in the RPI and take the decision outputs for the Arduino.

10. Arduino Board

For processing purposes in line following, maze solving and motor controlling (driving the robot and batting in the final part) we are planning to use an UNO-board. The line detector and IR sensors are also connected to this.

11. Motor driver

Because DC motors demands high currents, we can not connect motors directly to the board. So as the solution we are using a motor driver to control motors easily. (Motor driver is consisting with an H bridge for direction control.)

12. Wheels

We selected 4-same sized wheels with good grips and required diameters.

(Note: We included our zipped CAD files in the submission.)