



UNMESH MASHRUWALA  
**Innovation Cell**  
IIT BOMBAY

# S.T.A.R Program Team 1



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# Problem Statement

Your team is part of the tactical and procurement division of the Avengers initiative. The Avengers have almost completed the time machine to bring back the infinity stones and just require one final piece. HYDRA is guarding the part in a remote and secure place.

The place is being monitored by thermal cameras and narrow passages, thus making it inaccessible by humans. Various lethal weapons are set up to stop an intrusion. Moreover, the house is equipped with jammers; thus no signals can be transmitted in and out of the house.

Your task is to create a simple autonomous bot that should be able to navigate through the area while avoiding obstacles and procure the password of the vault in which the part is stored. The password is a 5- letter English word dispersed across the room hidden using steganography in pictures. The fate of half of the Universe is in your hands, so buckle up and save them all.



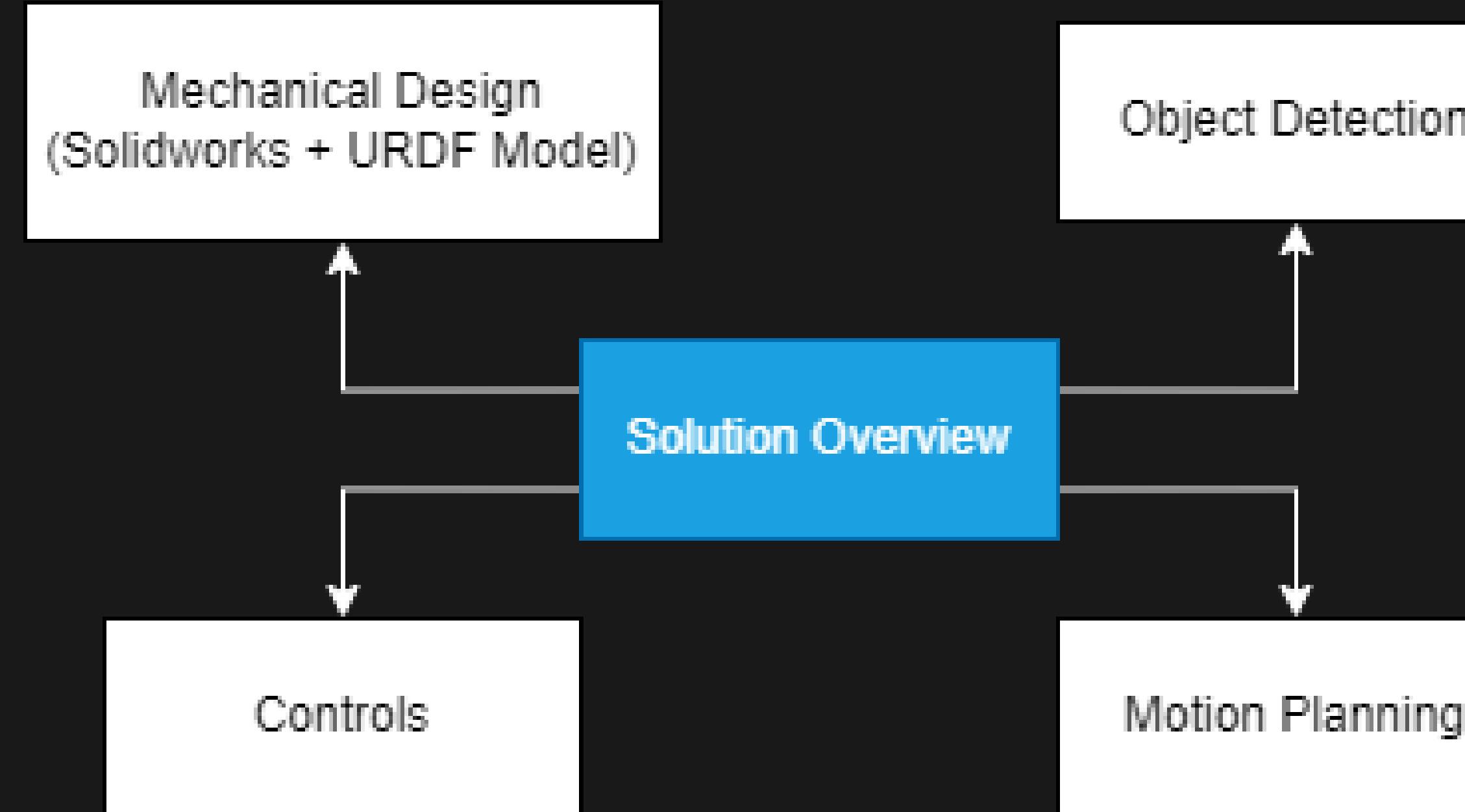
# Problem Statement

Main Deliverables :

- Avoid obstacles and get in to the room
- Detect Green Balls and collect them
- Drop Green balls inside a drop zone



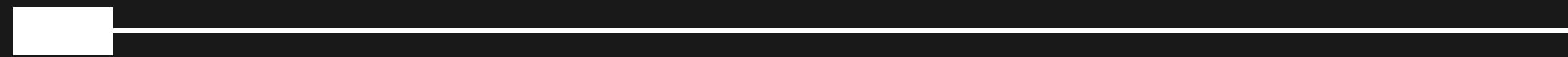
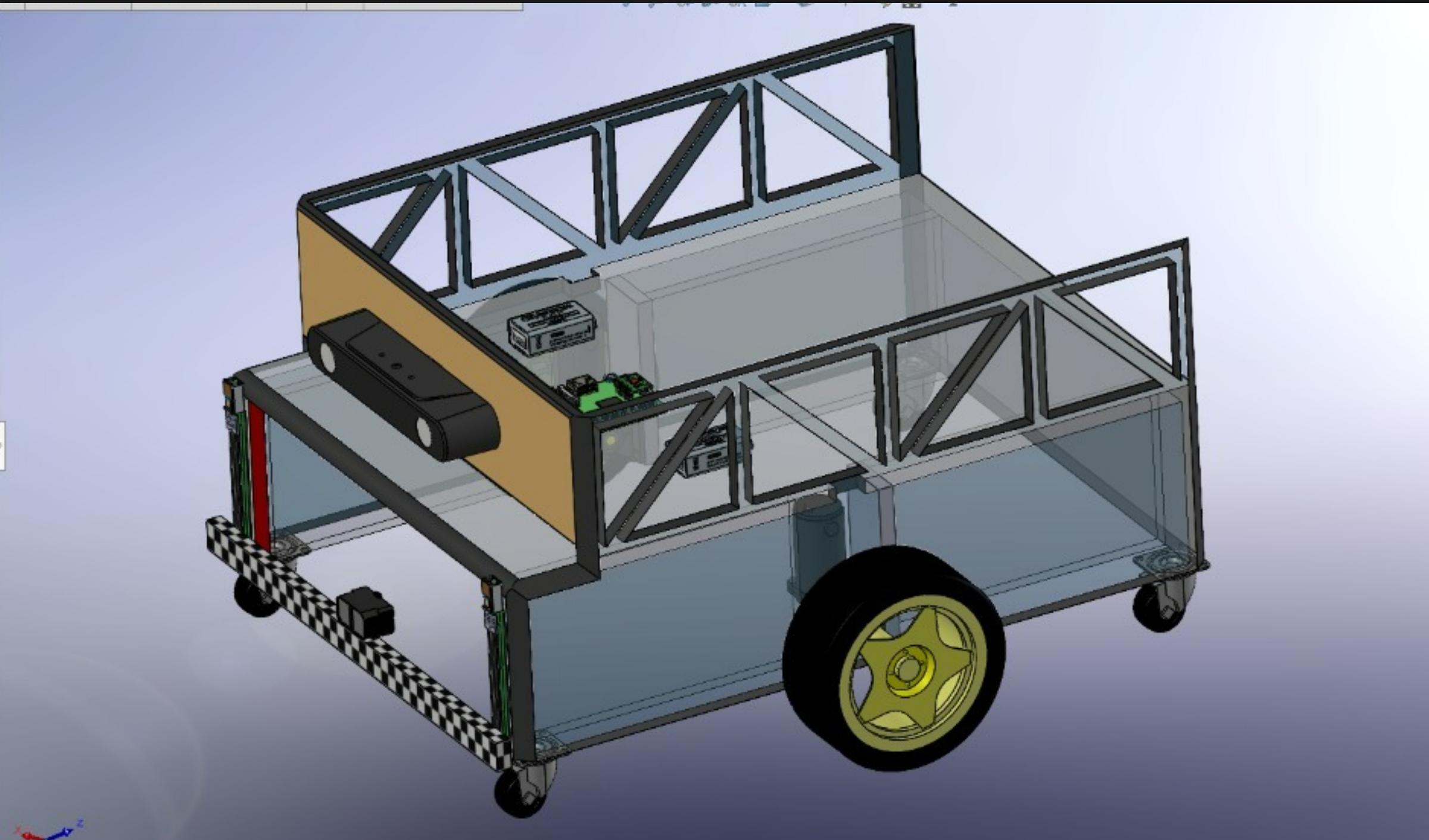
# Solution Overview

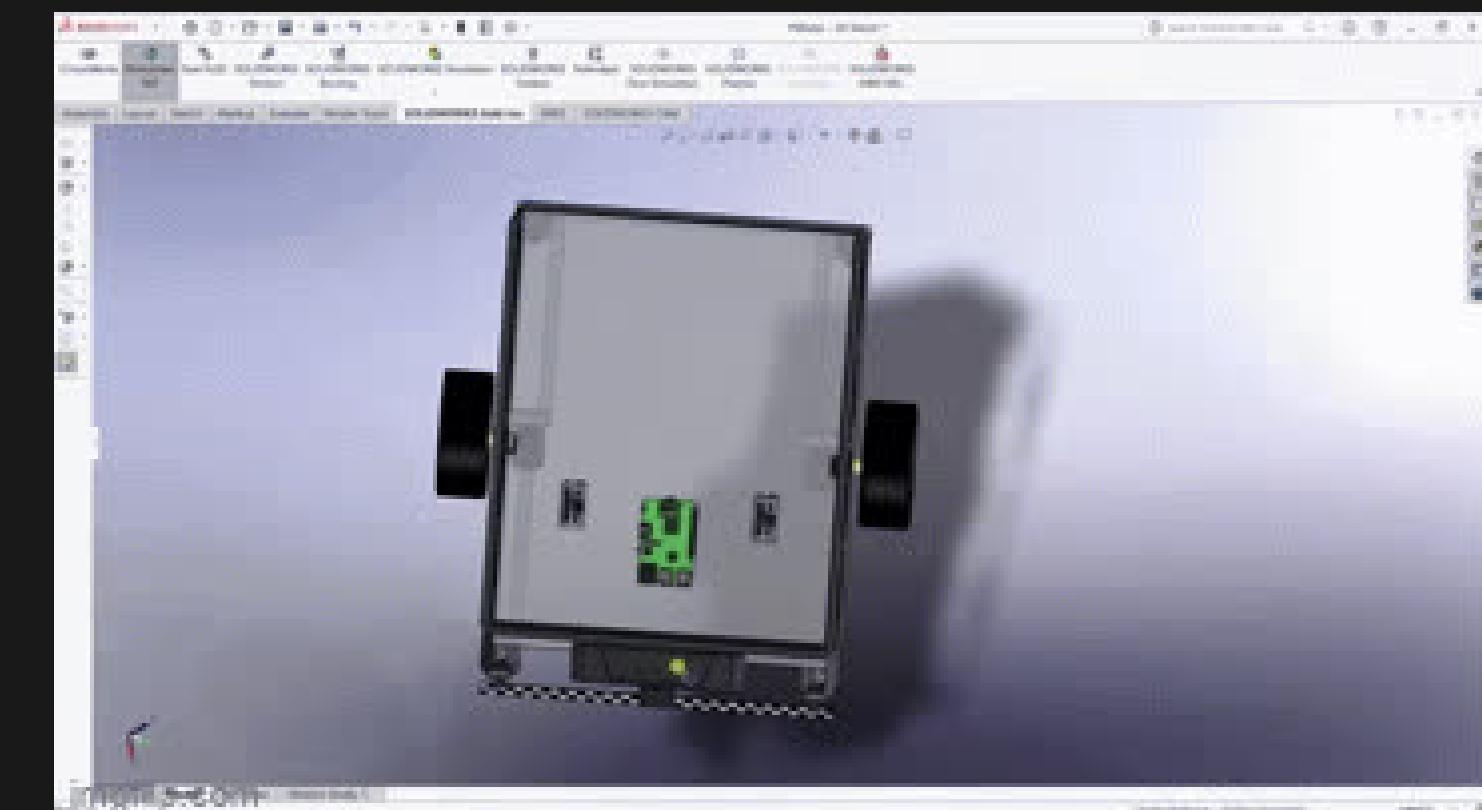
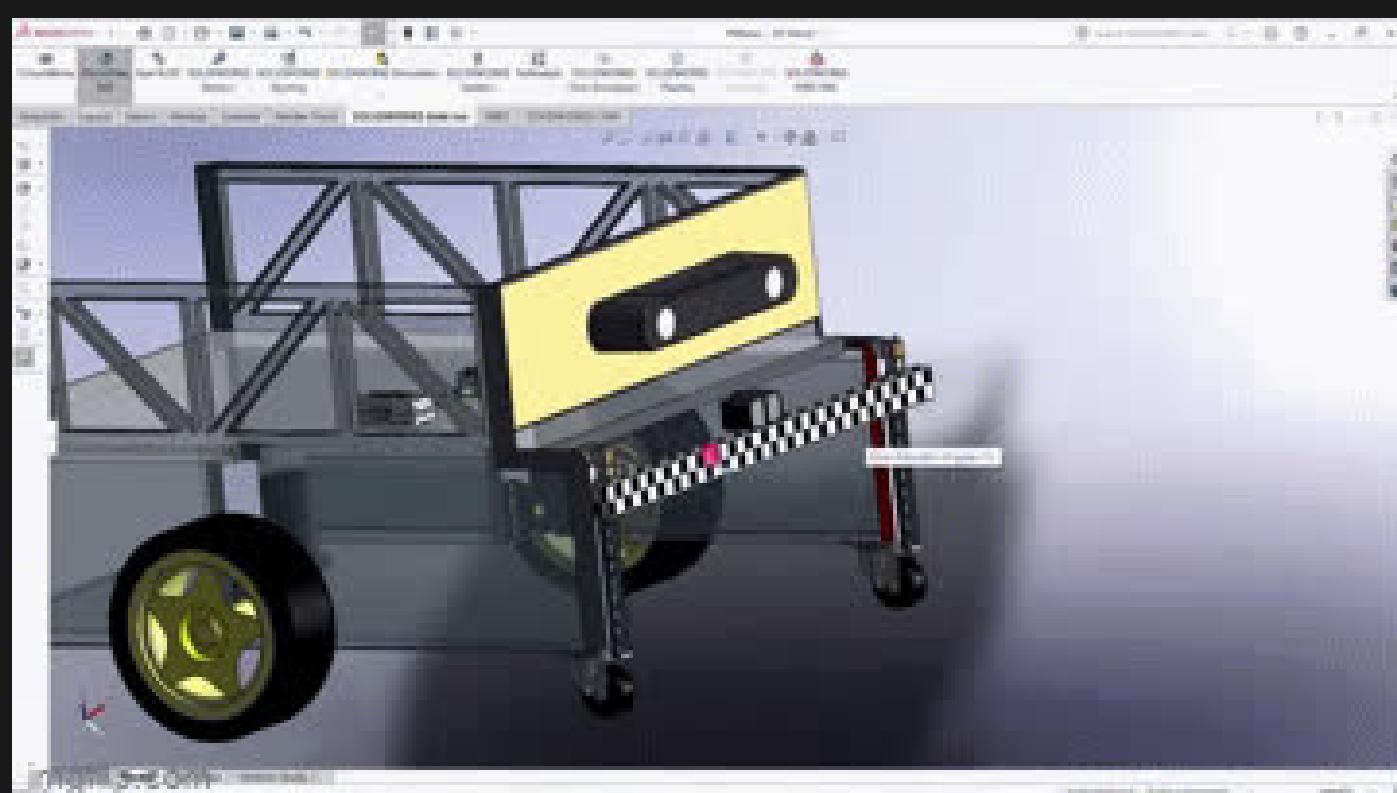
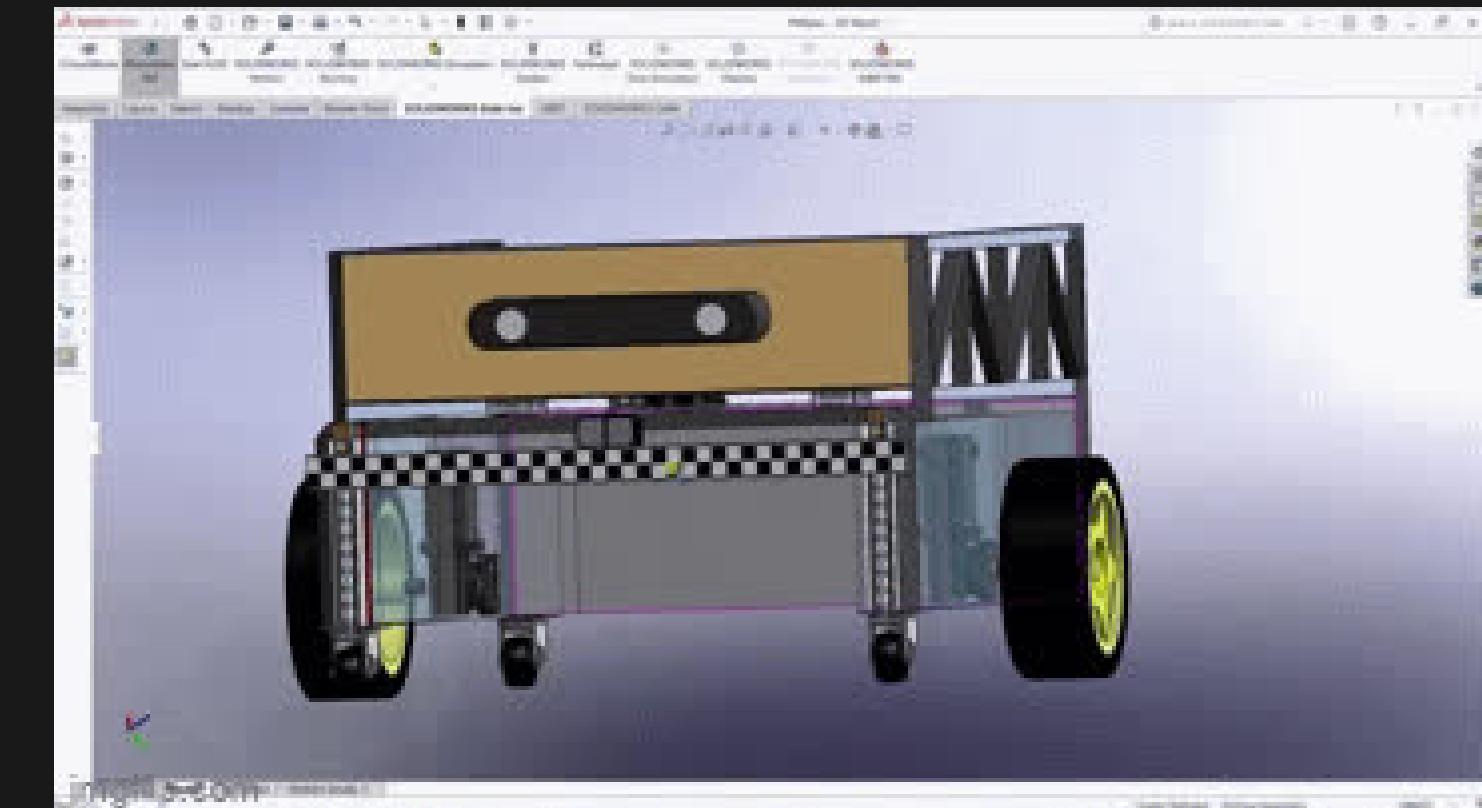
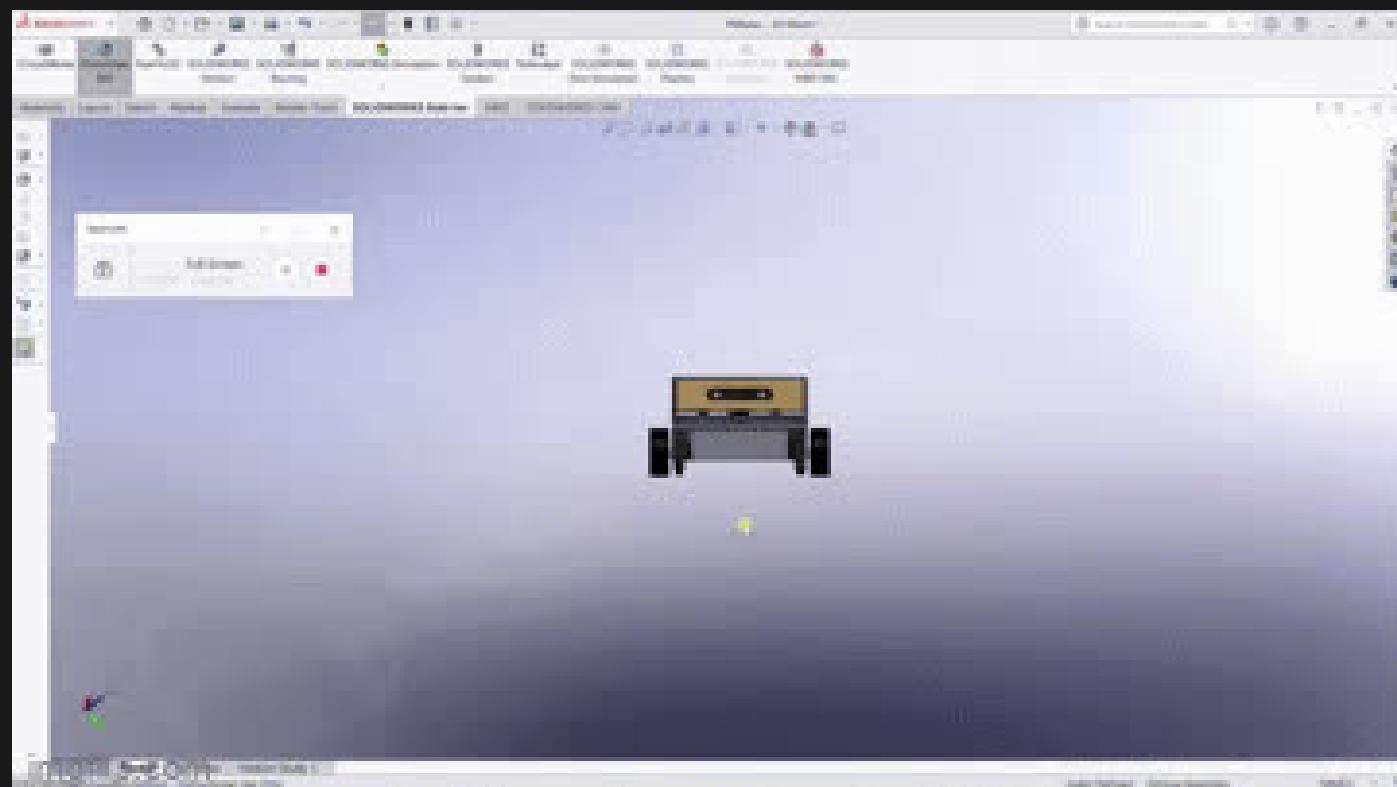


# Mechanical Design



# Final Design





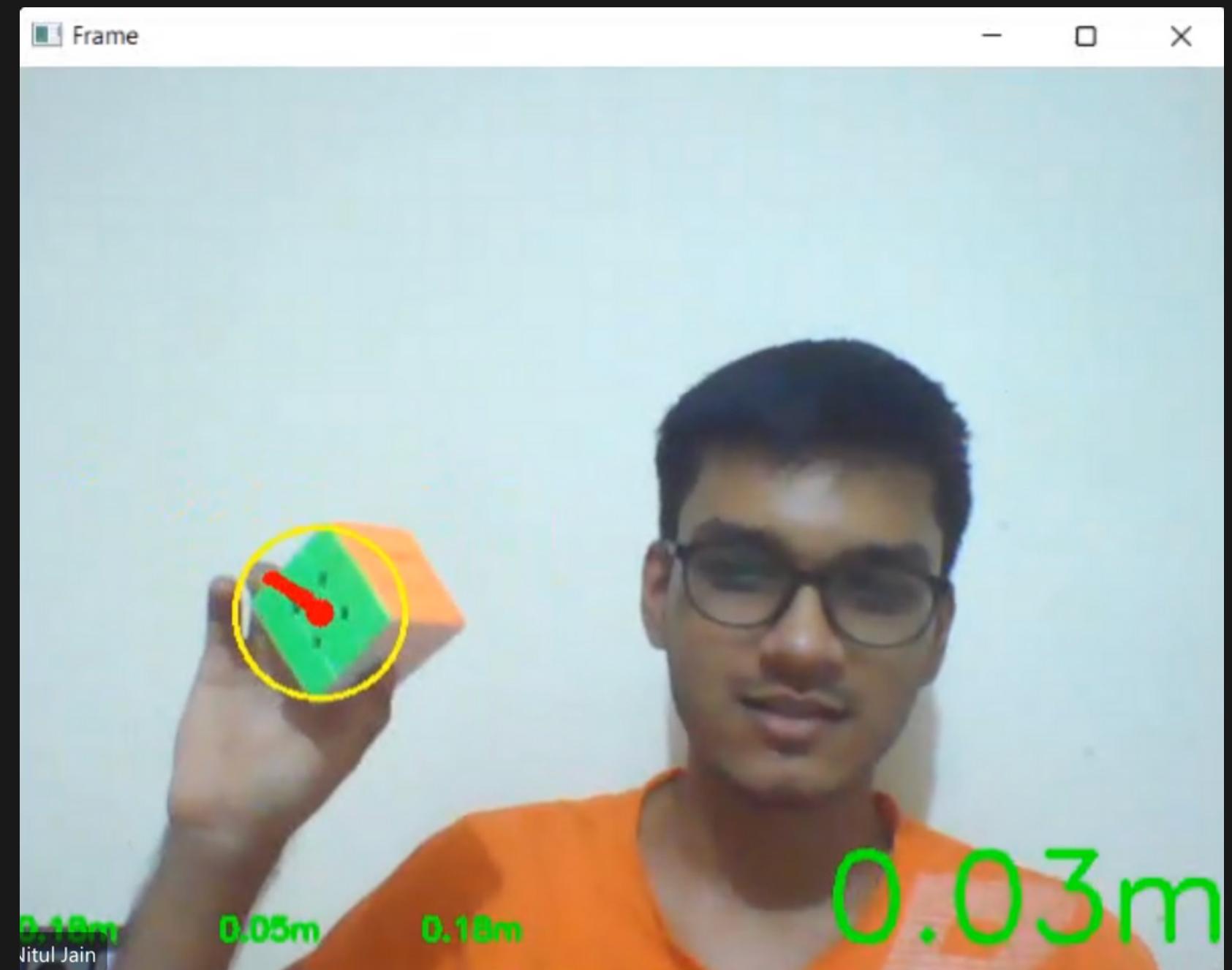
# Computer Vision



# OpenCV Detection

Using the **OpenCV library**, we created a script that utilised the following methods -

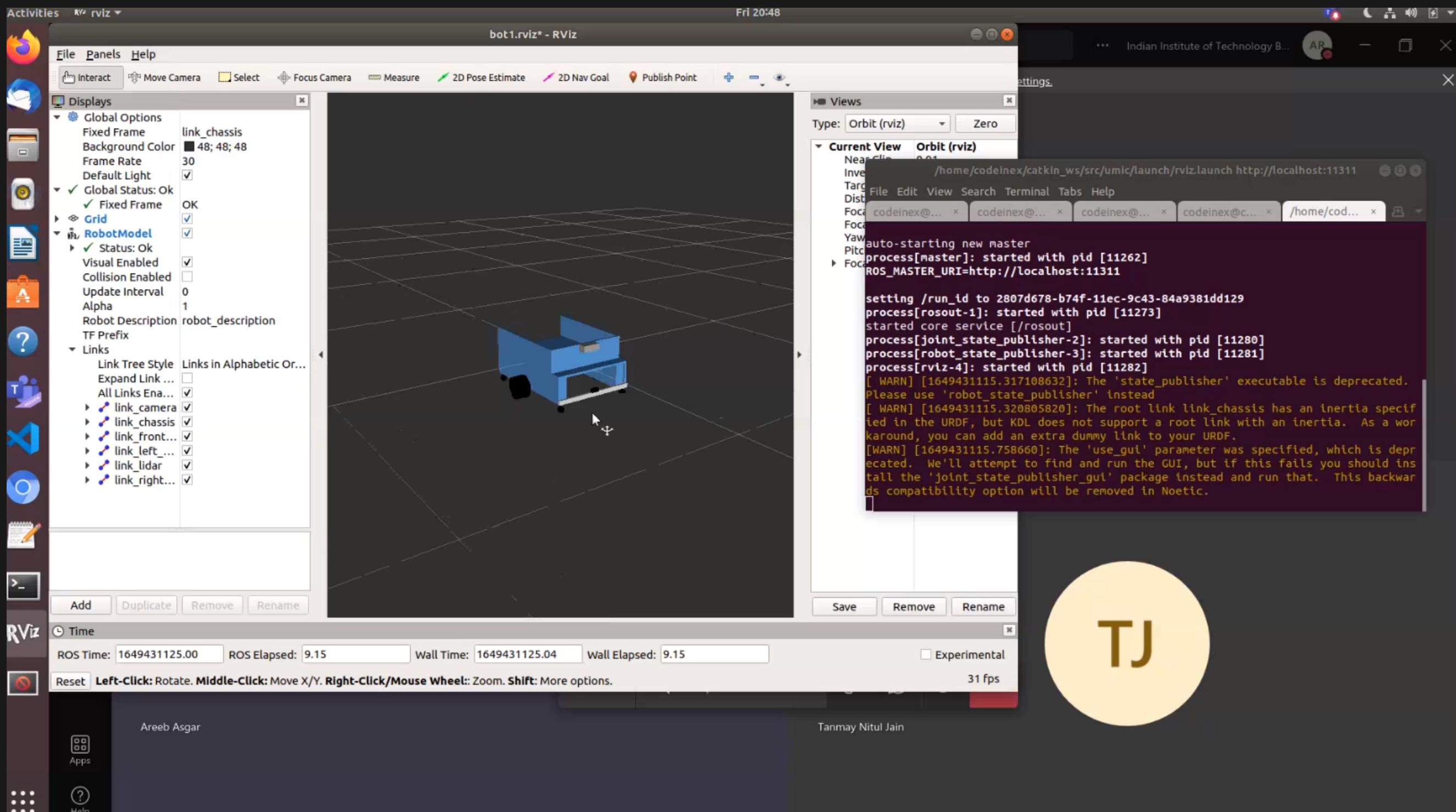
1. Contouring and Thresholding
2. Using CV.Moments to identify the centre and radius of the contour
3. Using ROS-Numpy conversion script to identify the pixel coordinates



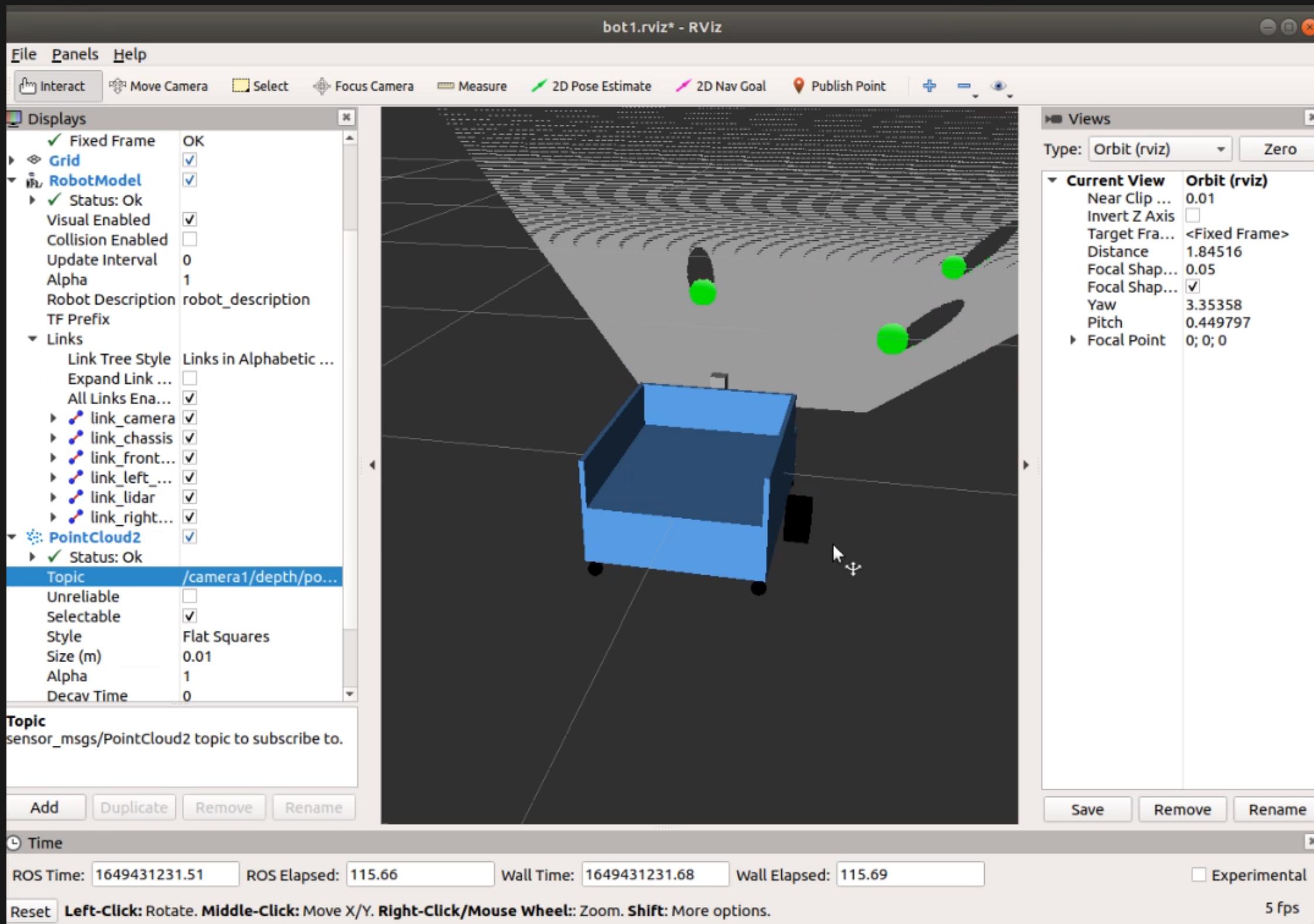
# Mission Simulation



# RVIZ Simulations of URDF Model



# Point Cloud Data Visualization



# ROS Middleware Setup



# Modularity in Code

## Solution Approach

### Obstacle Avoidance

LIDAR divides 180-degree views into 5 regions equally. The robot traverses into the region where there are no obstacles within a range of 50 cm.

### Green Ball Detection

Using OpenCV scripts and the NumPy library, we locate the centre of the green ball.

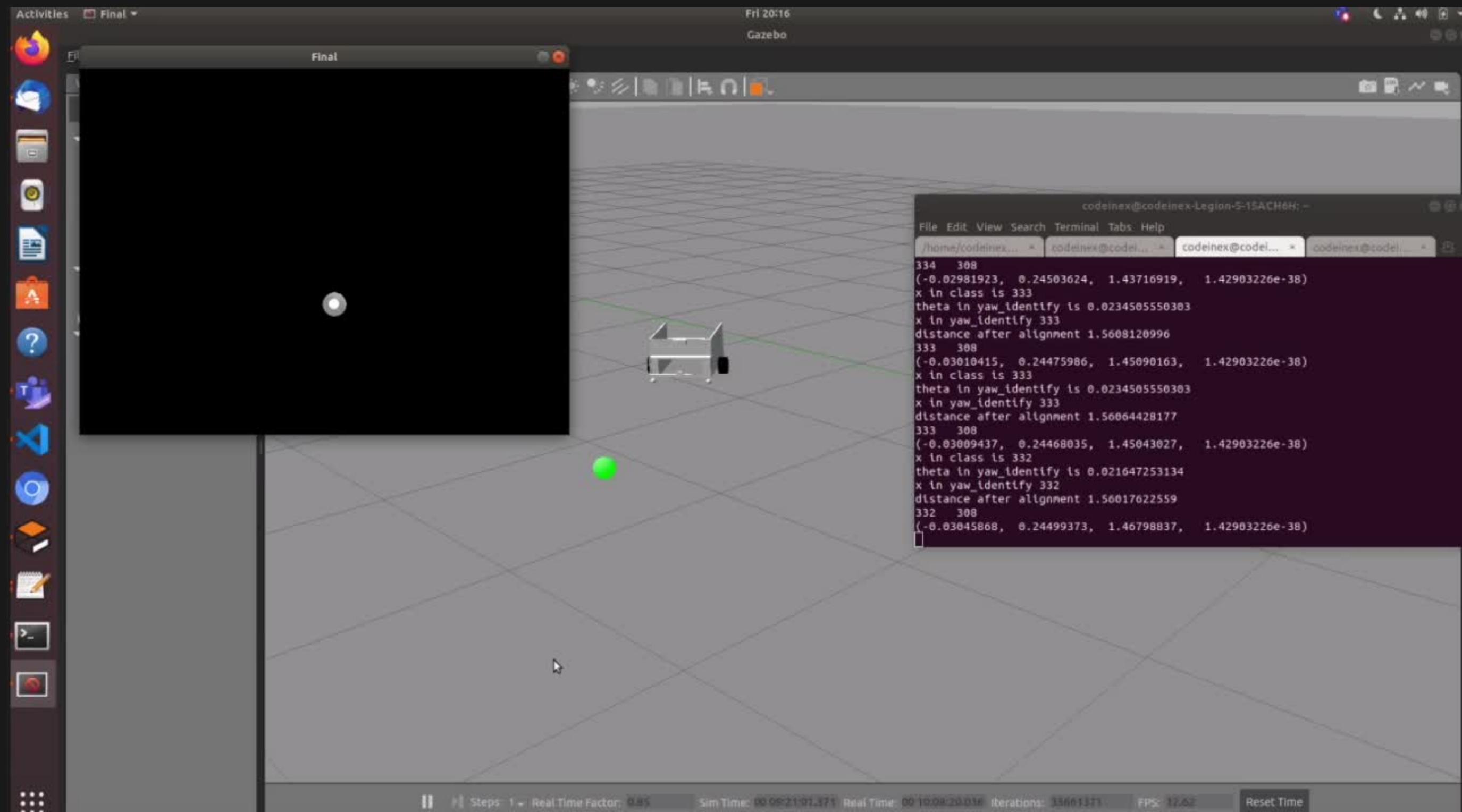
### Angle Calculation

**Yaw Angle calculation to find the angle of turn required to align the field of view of the robot with the ball's center.**

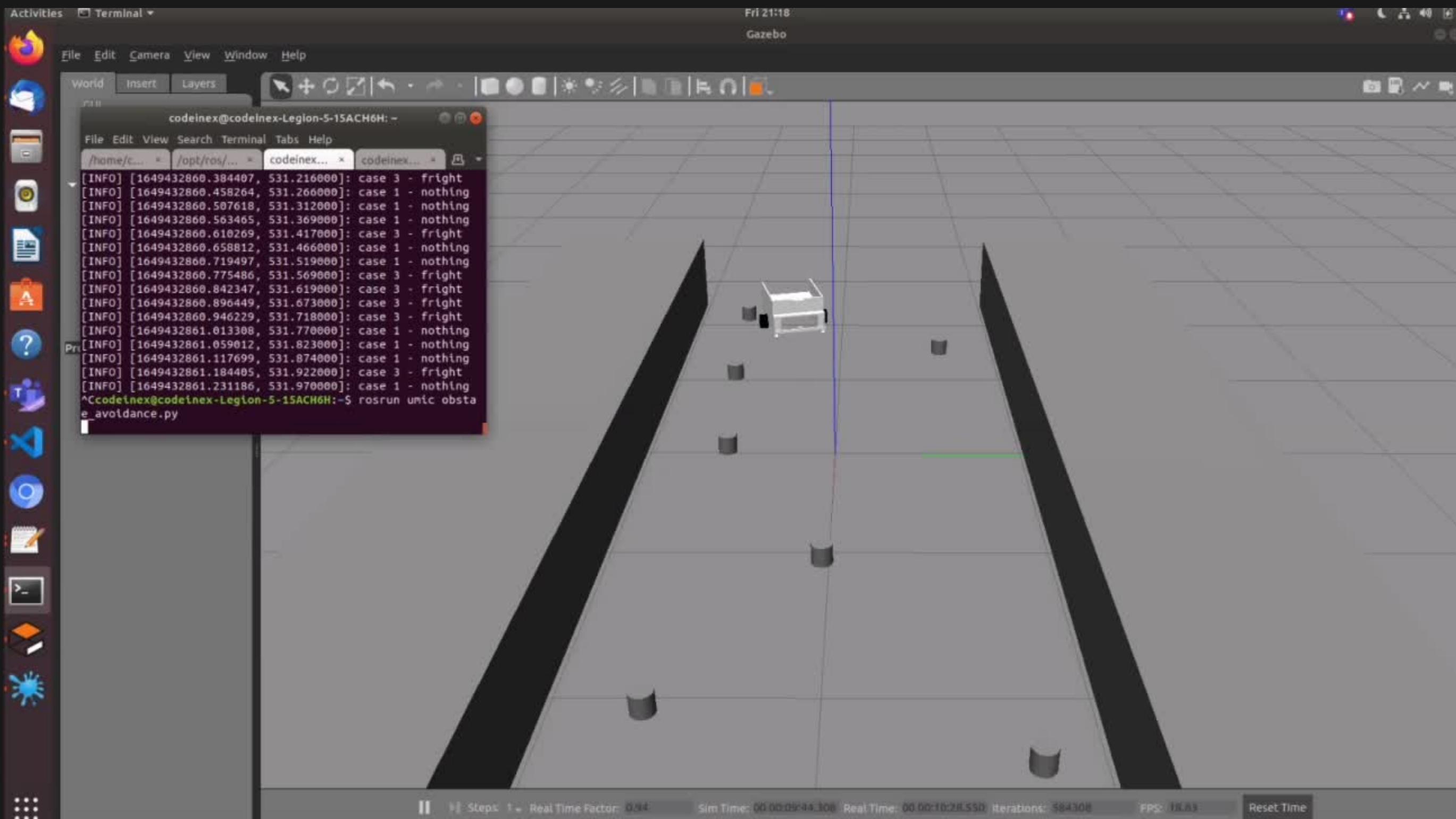
### Distance Calculation

Find the relative distance to move towards this green ball and collect it in the robot's storage chamber.

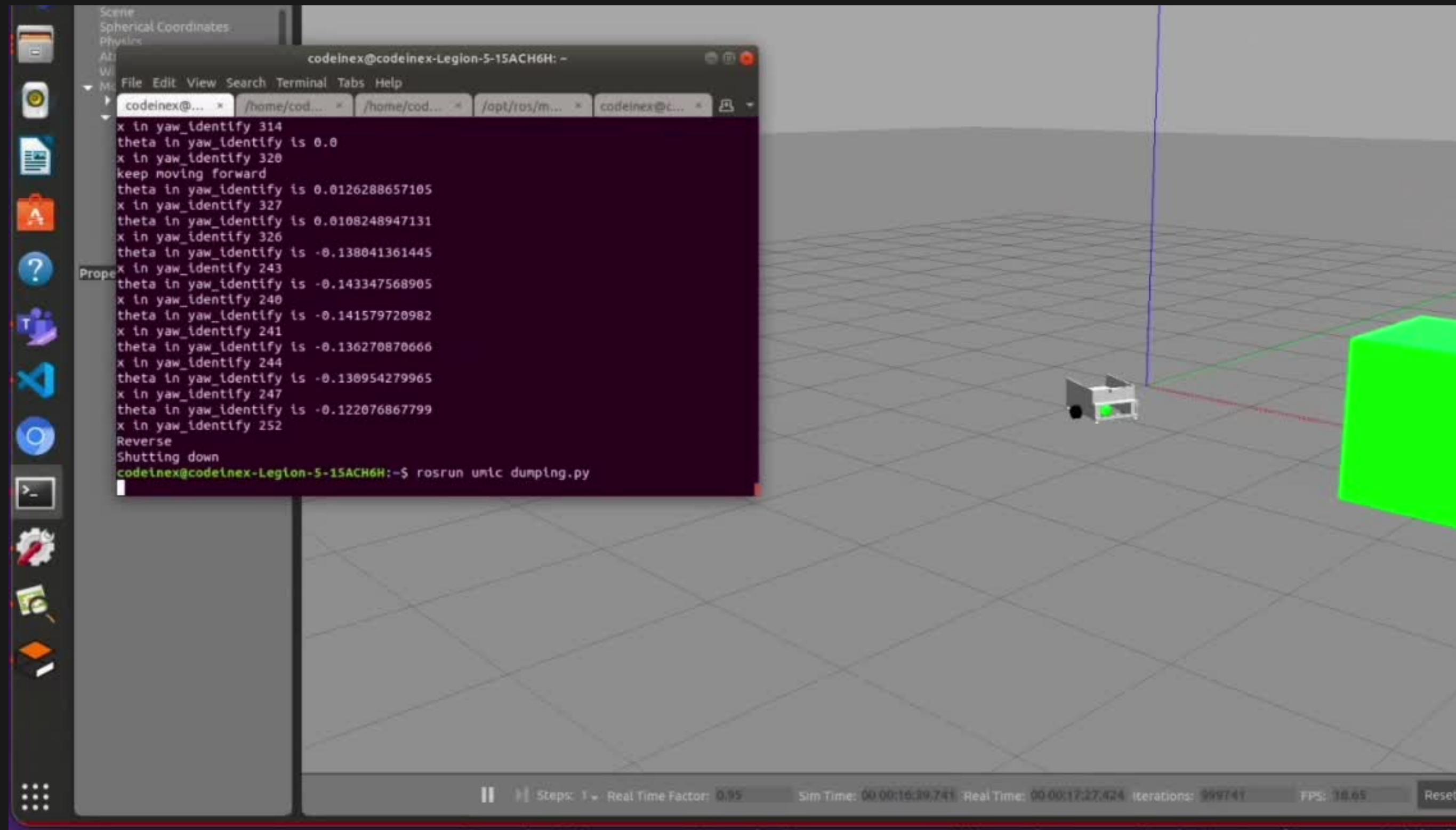
# Ball detection and intake



# Obstacle Avoidance Demonstration



# Ball Dumping



# The Team - Mentees



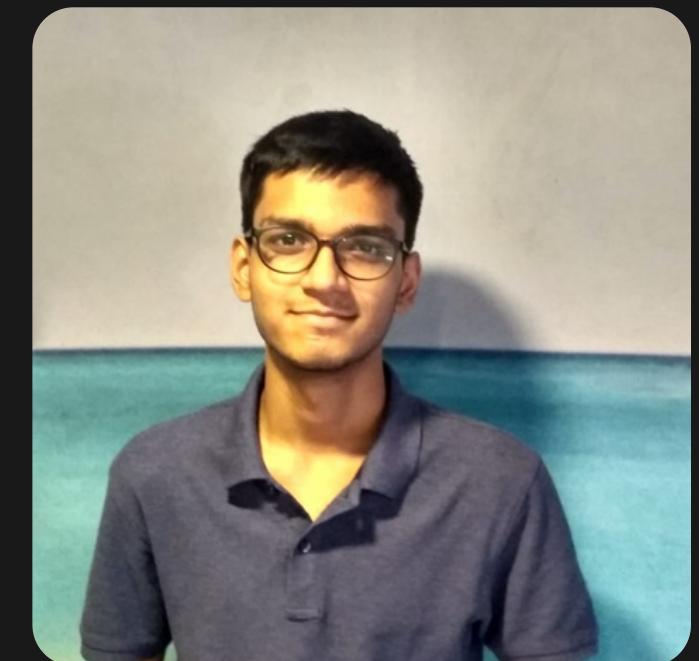
**Ayush Ramteke**



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# The Team - Mentors



**Akshat Gupta**



**Rudraksh Kuchiya**



**Harshil Naik**

# Questions?

