Biomedical Wastes Handler Robot

By Group B
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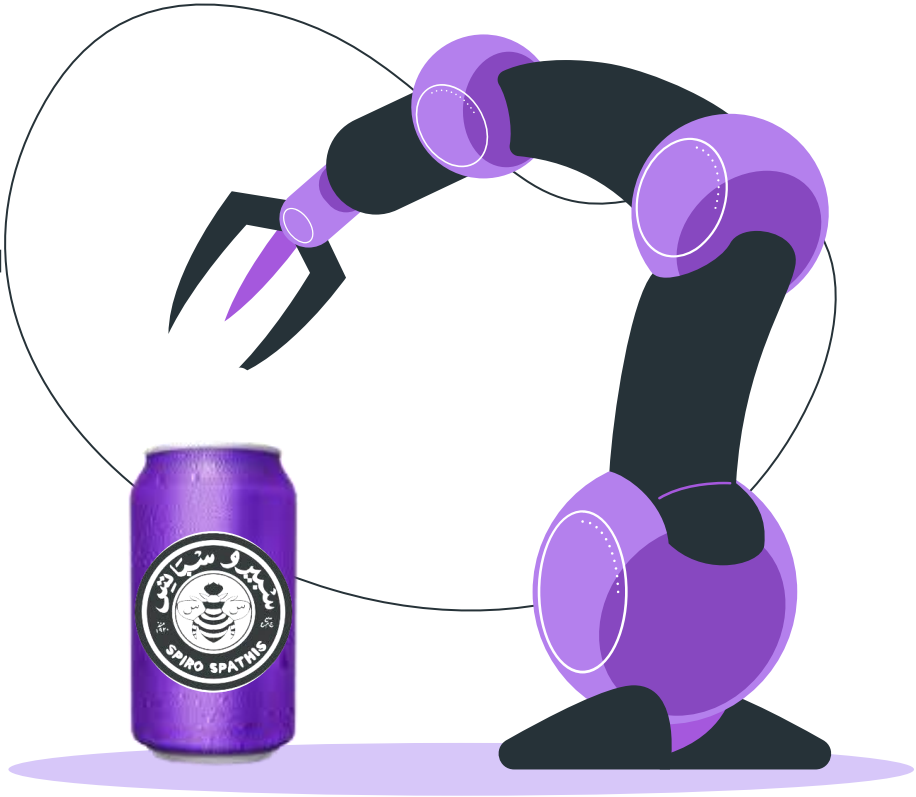


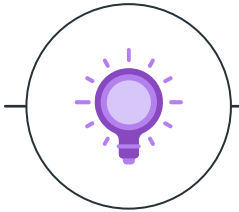
Agenda

Problem definition	Removing Hazardous materials Safely
Proposed Methodology	Automating the process through the proposed pipeline.
Simulation	Testing the implementation on a simulated environment
Challenges	Compatibility challenges
Real life implementation	Implementation using turtlebot3 as our testbed in scaled map
Results and Conclusion	What we found at the end of this journey

Project Timeline

Ideation

Plan the project and divide the tasks

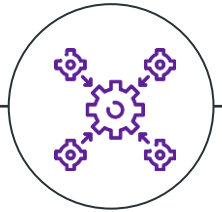


Simulation

Simulate each module

Integration

Integrate the environment



Real Life implementation

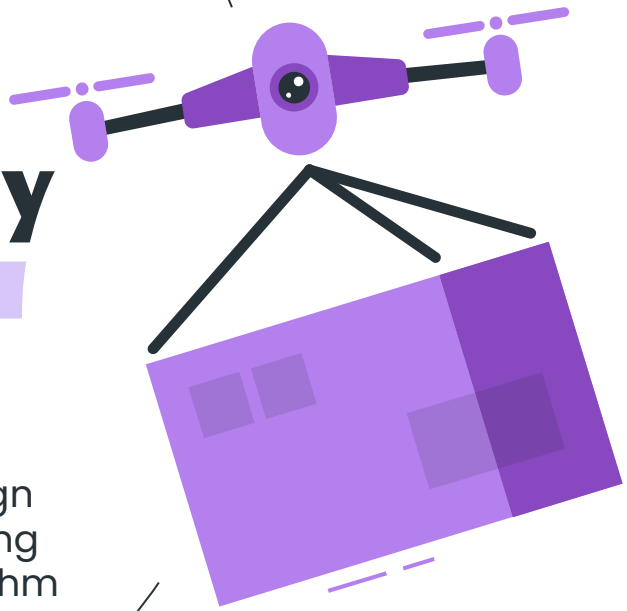
Using turtlebot3 as our testbed in scaled map

Problem definition

Moving Biomedical Wastes has:

- High risk to human health
- Emergency response time
- Unknown conditions
- Complex and confined spaces
- Efficiency and optimization

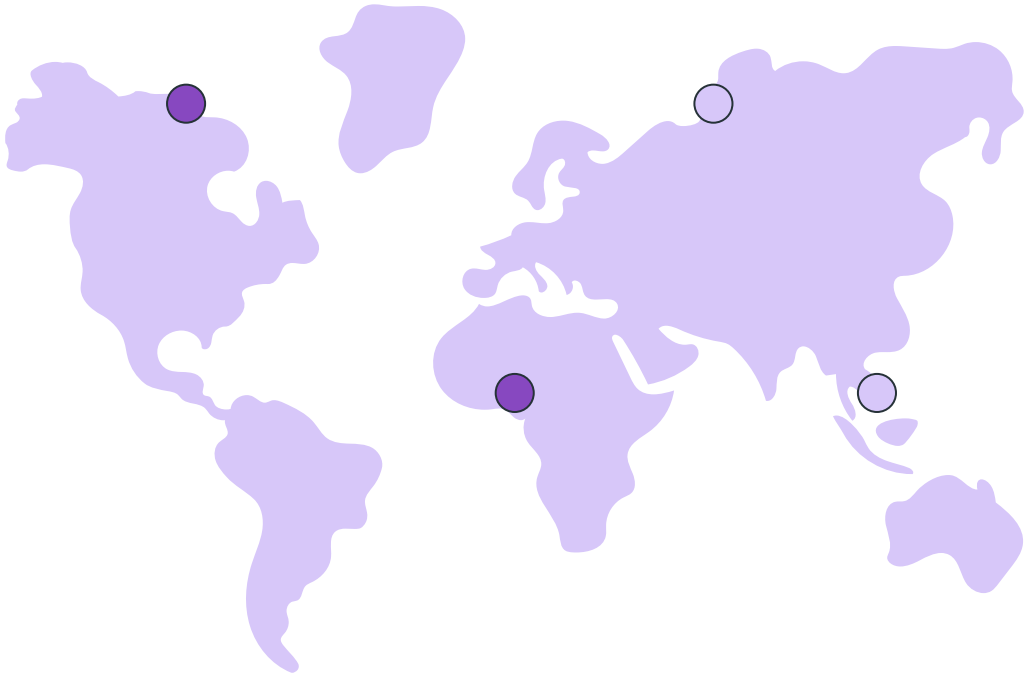
Proposed Methodology



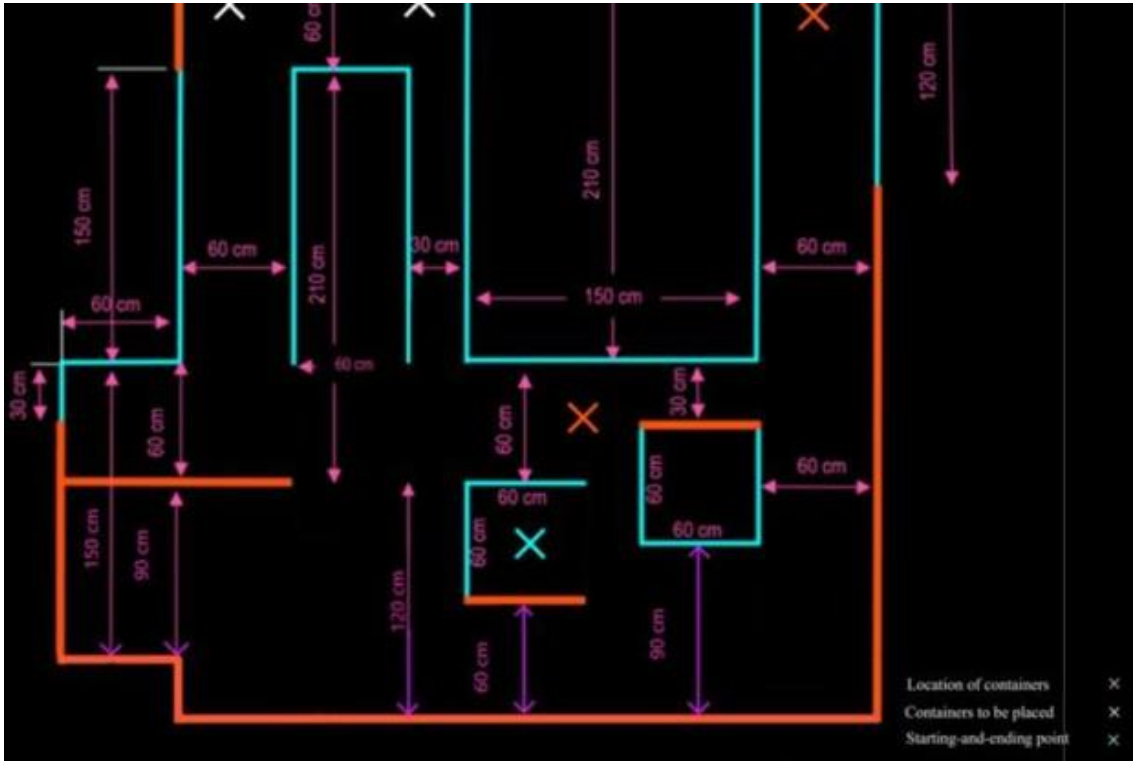
Develop a comprehensive map Implement SLAM for simultaneous localization and mapping to determine the robot's position. Use the A* algorithm for optimal path planning, considering obstacle avoidance. Design container detection using a camera and OpenCV using digital servoing algorithm Implement the DWA algorithm for dynamic obstacle avoidance. Test and evaluate the system's performance in a simulated environment before real-world deployment.

Workspace map

The robot should move from point to point on a map to pick some hazardous materials and place it in its designed place while avoiding dynamic obstacles and narrow paths. The map have keep out zones to be restricted areas that should be considered in the navigation system



MAP


150 cm
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60 cm
150 cm
90 cm
120 cm
60 cm
90 cm
Location of containers
Containers to be placed
Starting-and-ending point

Project Mile stones

1. Navigation
2. Keep out zones
3. Visual Servoing
4. Pick and Place
5. Nodes Integration

Navigation

Goal detection

Using A* algorithm to plan the way into the goal's points.

Obstacle avoidance

Using navigation 2 to do Slamming online while avoiding dynamic obstacles

Way points planning

Planning sub stations as a series of points to cover a path

Keep out zones

Red lines detection

Doing image processing to detect red lines or red rectangles and getting the dimensions and the positions of them.

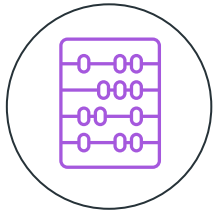
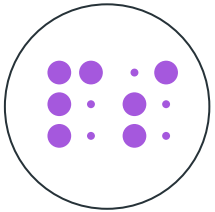


Image to map conversion

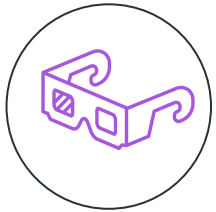
Converting the maps from image bird view into 2d maps.



Cost map update

Publishing the red lines as dynamic obstacles by updating the cost map using keep out zones filters.

Visual servoing

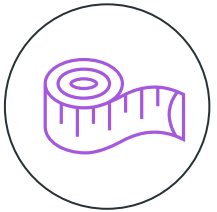


Detecting mask

Detecting Blue colored rectangles with specific aspect ratio. to initialize the servoing task. The mask focuses on a specified ROI.

Topic publishing

Publishing the info on a topic to handle the robots movement to maintain the can in the targeted area



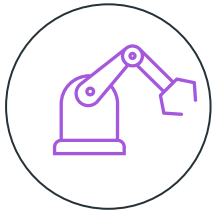
Stopping distance

Pooling on the aspect ration of the detected object as an indication of the distance to it to stop and pick it.

Pick and Place

Controlling the angles

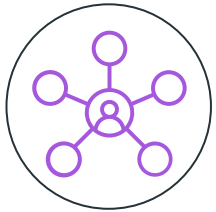
Controlling the angles of the robotic manipulator's by publishing the angles to the motors and the degree of how the gripper is opened.



Pick and place

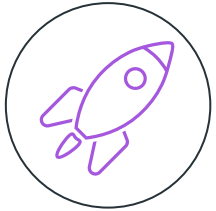
Planning the pick and place angle points to keep the gripper parallel to the object to pick and place it smoothly.

Nodes integration



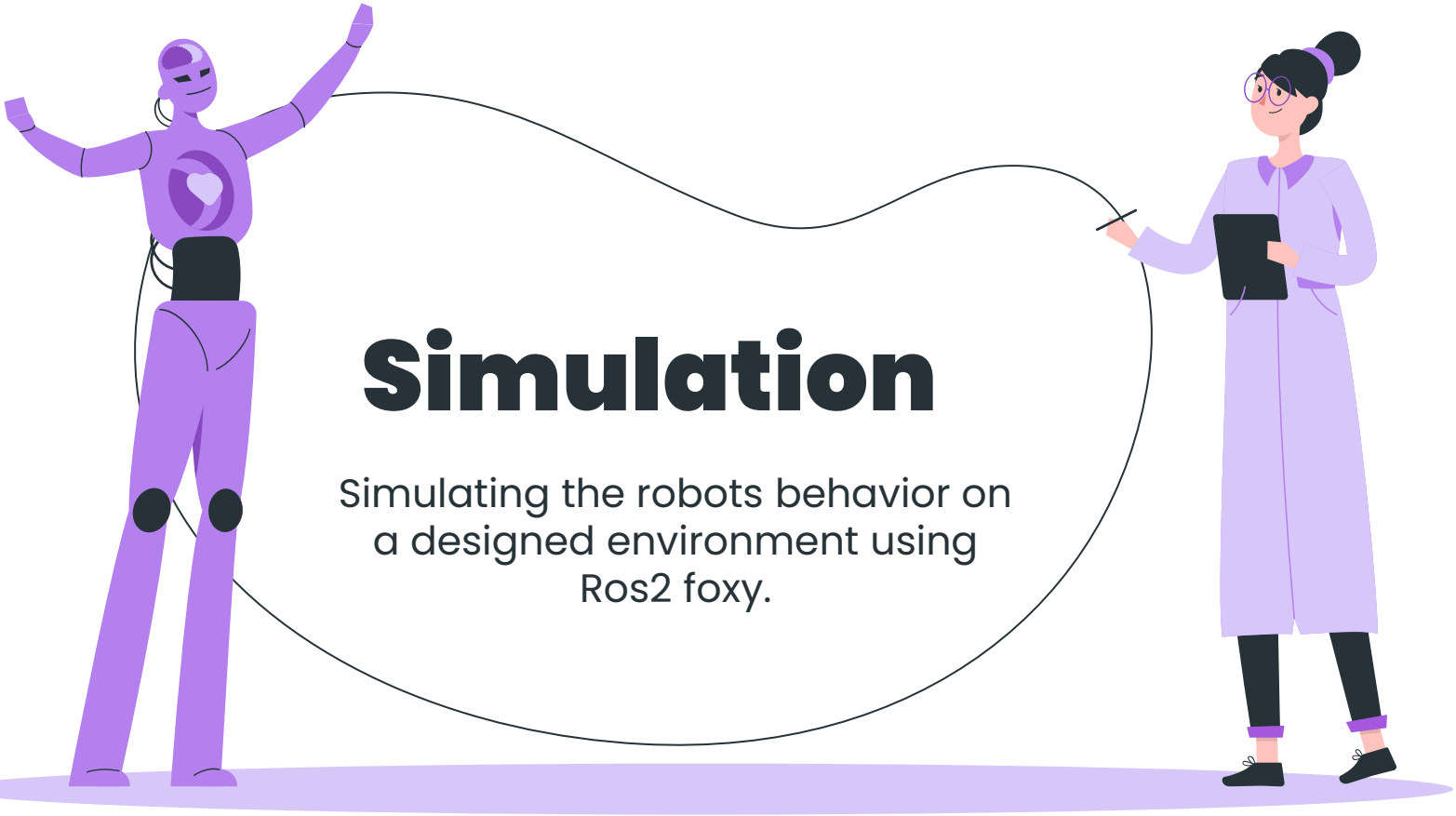
Handling topics

Using the integration between different modules through Ros2 topics and actions



Launch files

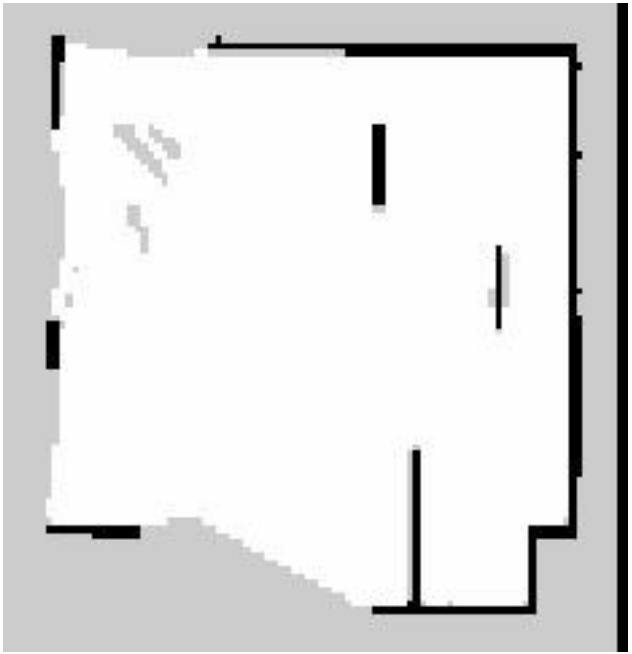
Using launch files to start different nodes and scripts

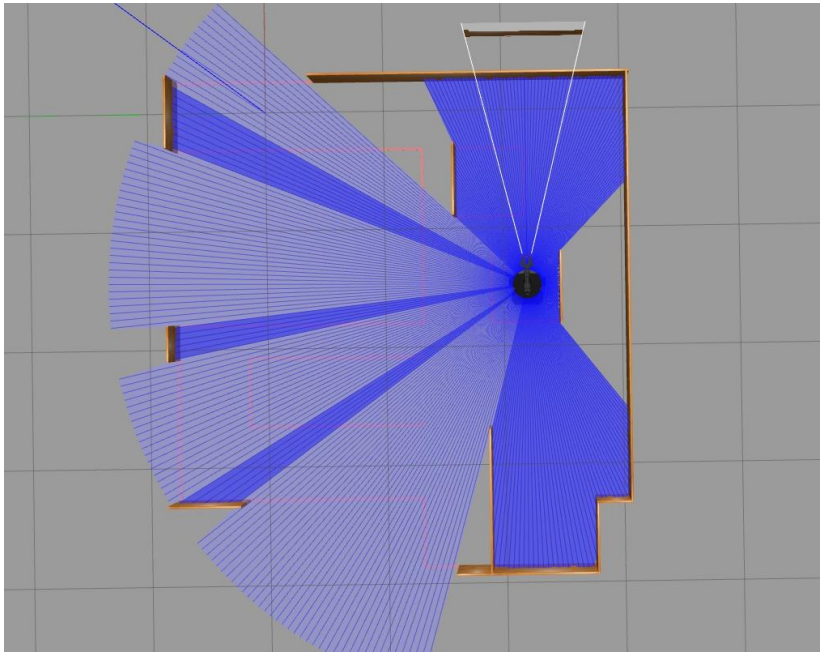


Simulation

Simulating the robots behavior on a designed environment using Ros2 foxy.

MAP





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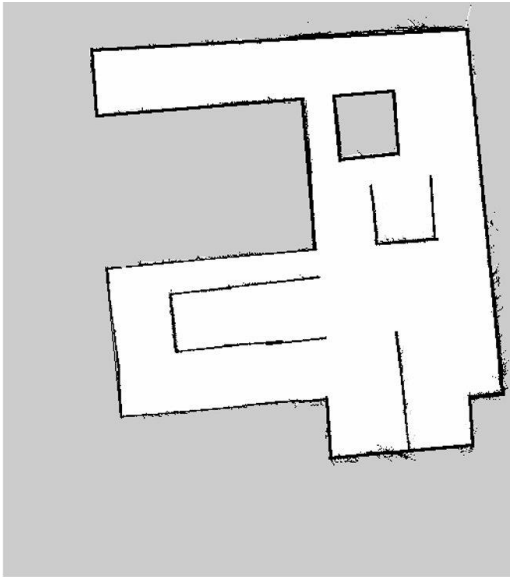
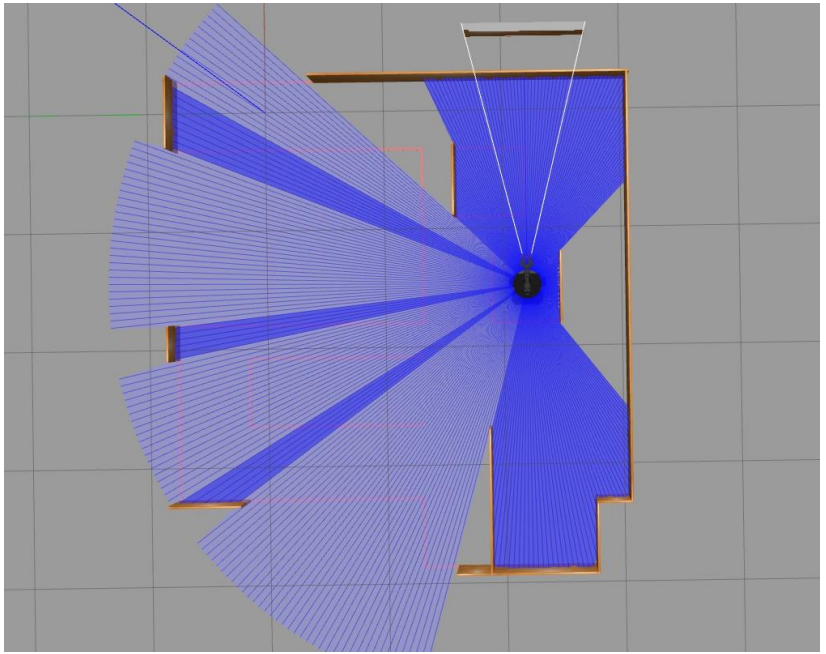
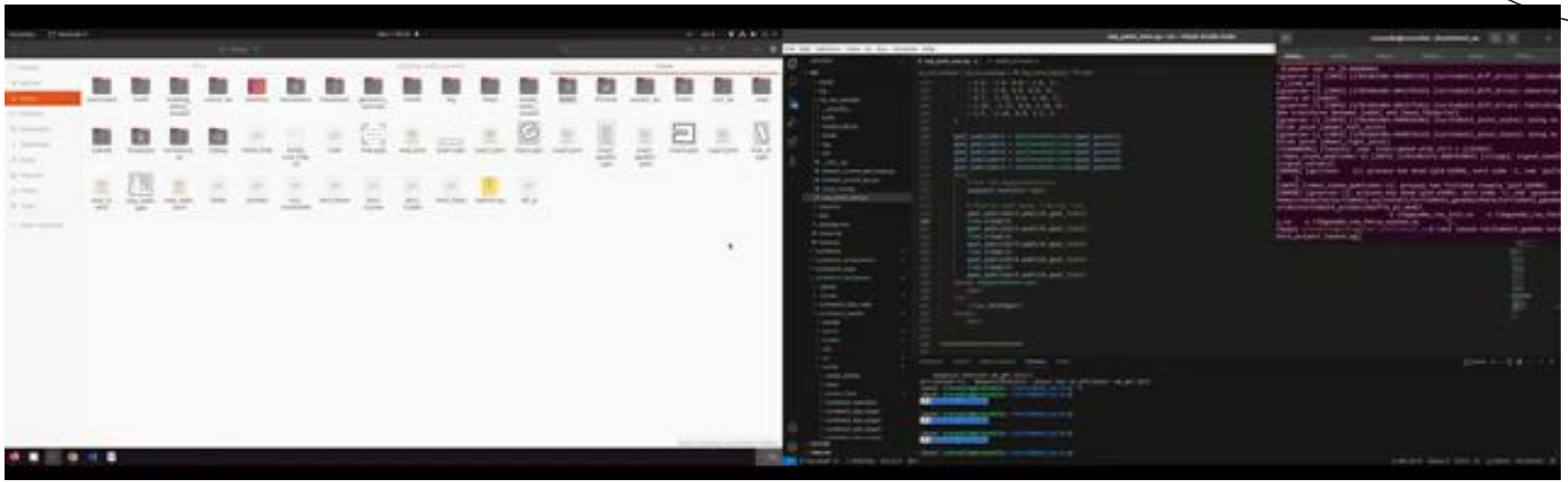
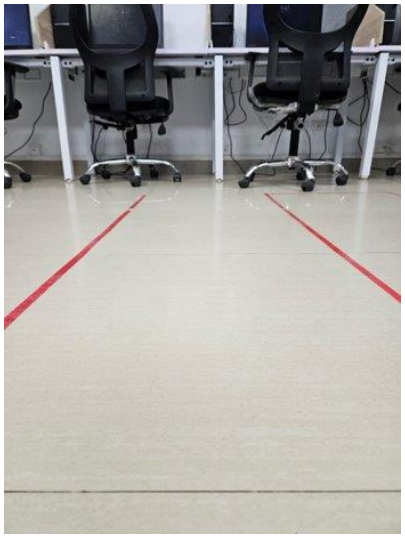


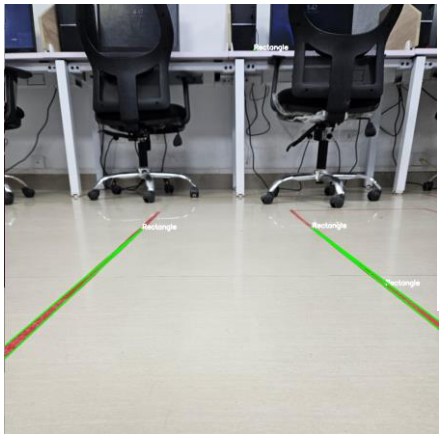


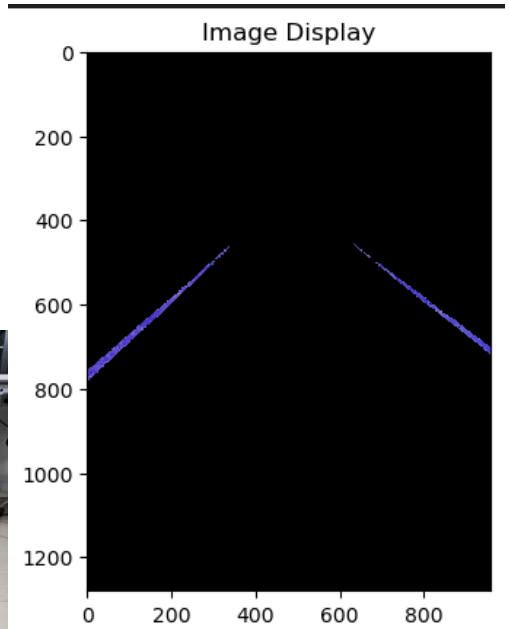
Way Point Executer



Red line detection





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...   [[[841 623]]

      [[842 623]]]
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    [[[303 499]]

      [[  0 757]]

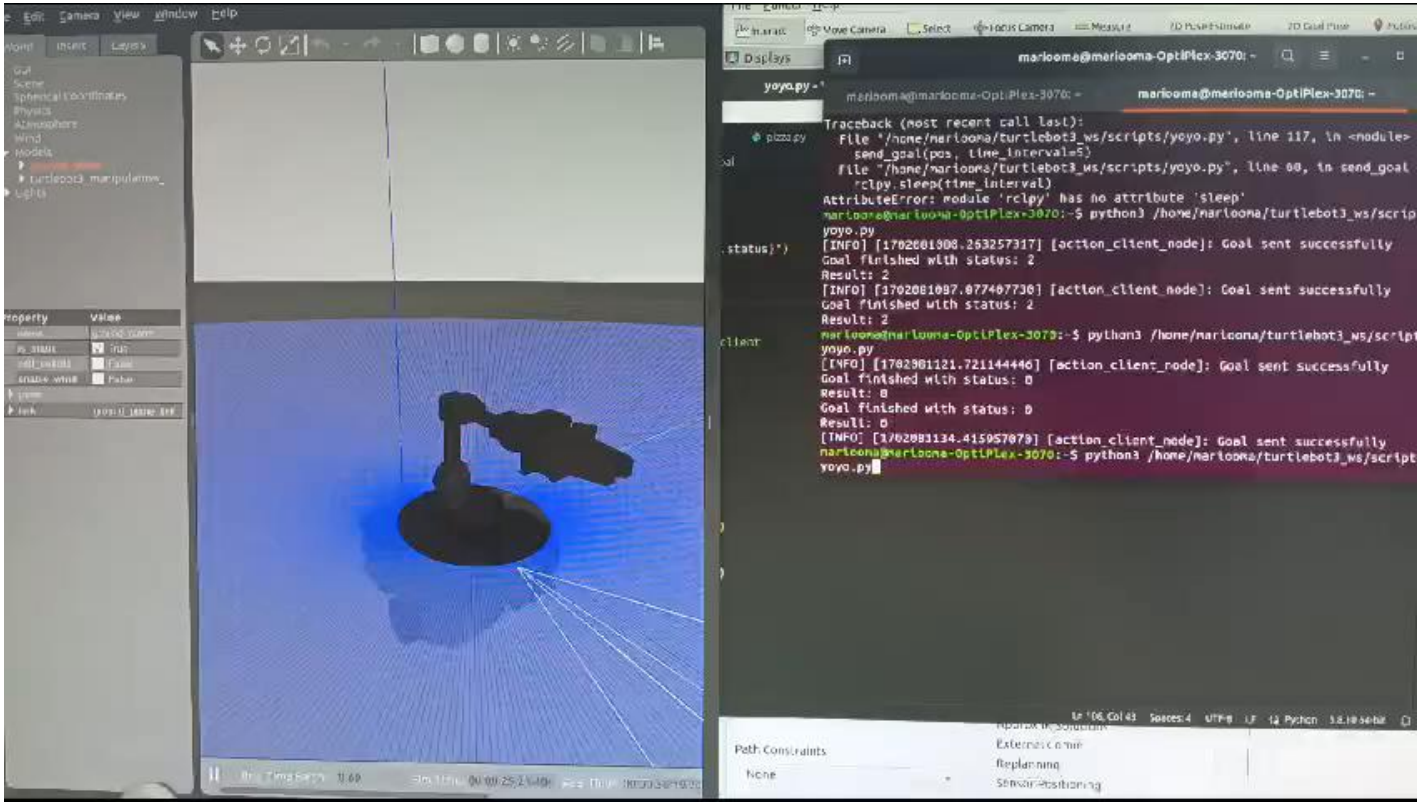
      [[303 500]]

      [[  0 785]]]
    rect
    [[[679 496]]

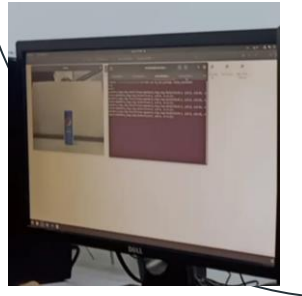
      [[959 720]]
    ...
      [[552 105]]

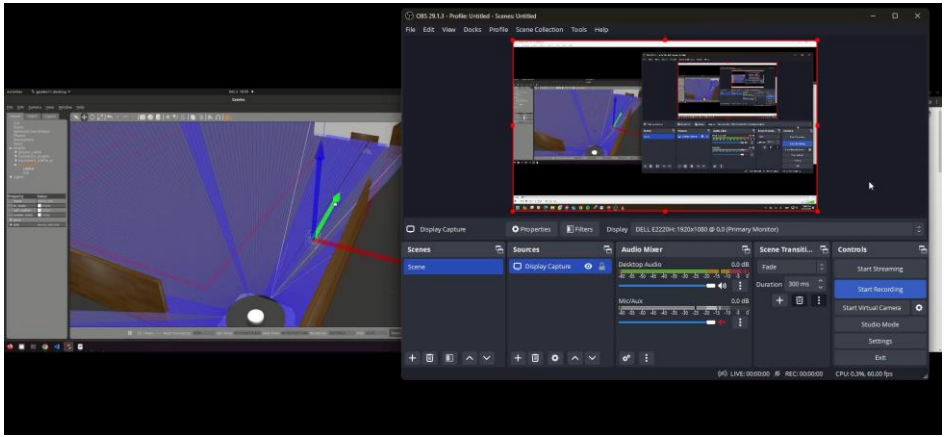
      [[552 102]]]
    rect
```

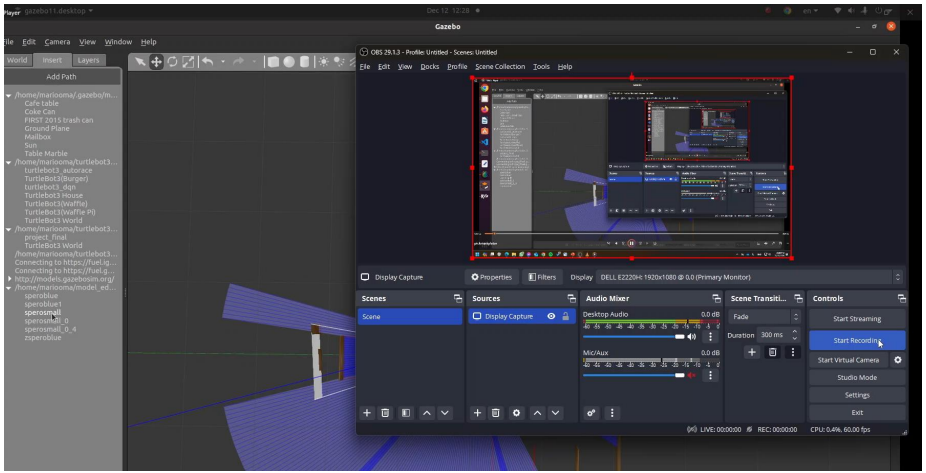
Pick and place



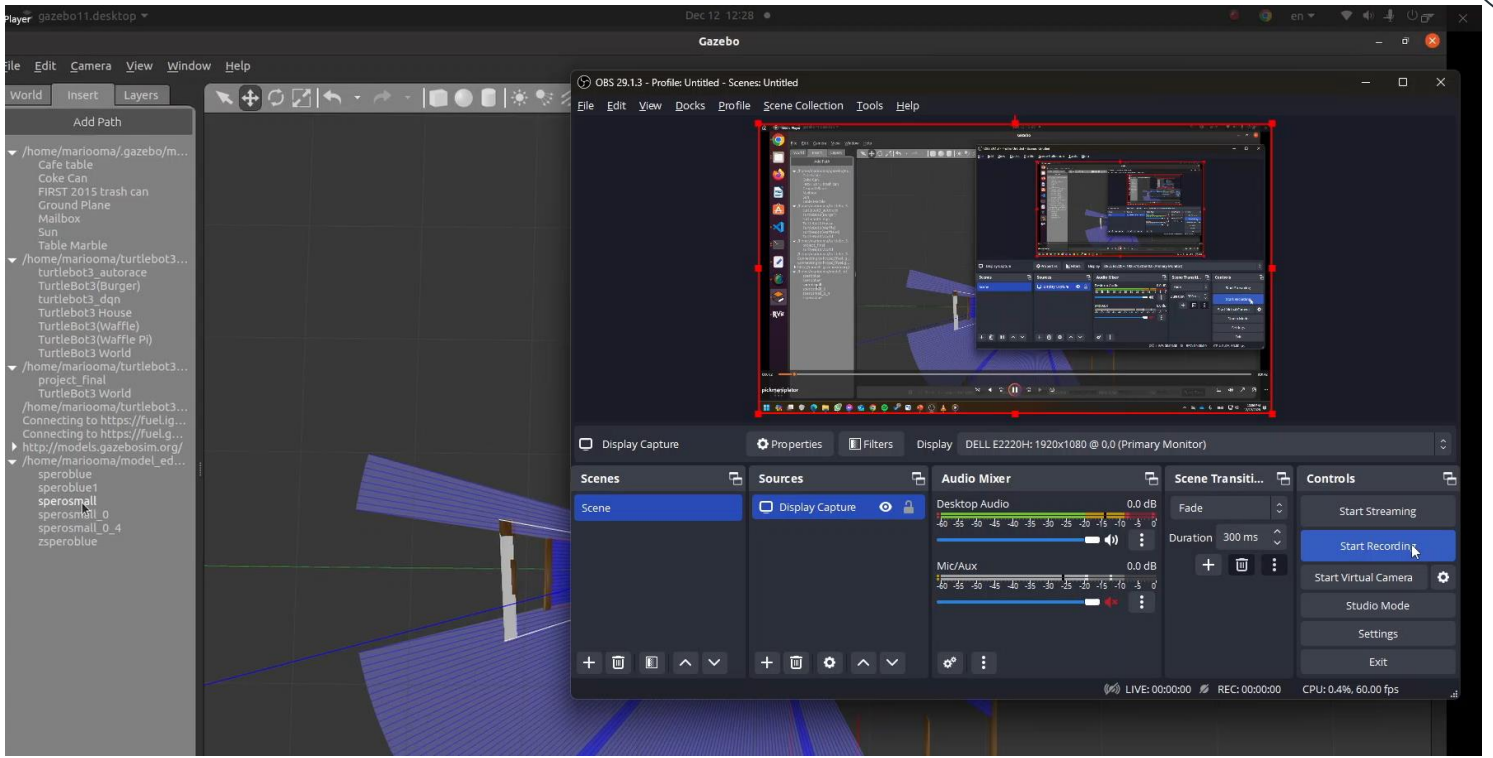
Visual Servoing







Pick the container



Challenges

- Ros foxy issues
- Cost map
- Time Management

General challenges

ROS Foxy Fitzroy is one of the ROS 2 distributions. Issues may arise due to bugs, compatibility problems, or conflicts with other software packages.

Real-time updates of cost maps.

Development timeline may get conflicts.

Navigation Challenges

Nav2 package simple commander not supported in foxy

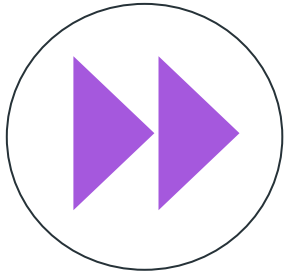
Waypoints not met in simulation requiring inflation radius

Waypoints topic in real life differs from simulation

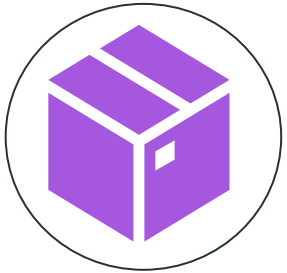
Tried SLAM toolbox but failed

Map rotating and not giving exact location

Pick and Place challenges

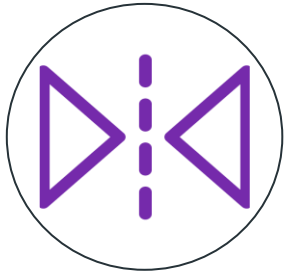


Moveit2 package not supported in Foxy

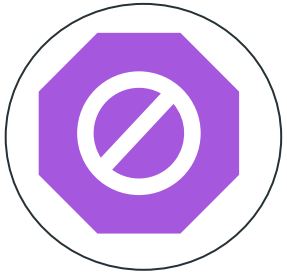


Packages/Dependencies errors

Visual Servoing Challenges

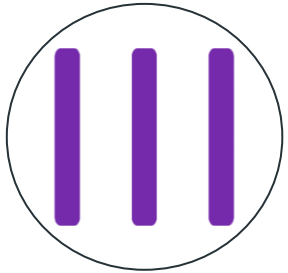


Reflections in can preventing color masking for visual servoing



Determining stop point for picking up the can

Redlines Challenges



Redlines detected but not published

Keepout zone not supported in foxy

Anatomy Of The Errors

Implementation

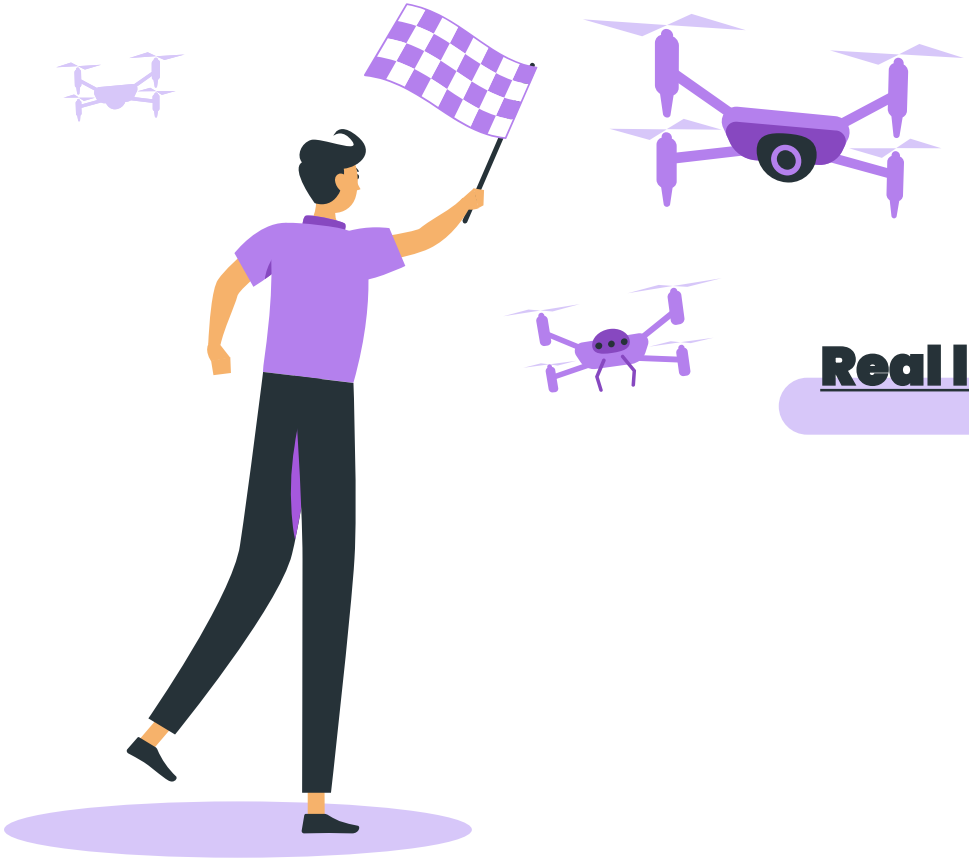
Ges and dependencies

Simulation

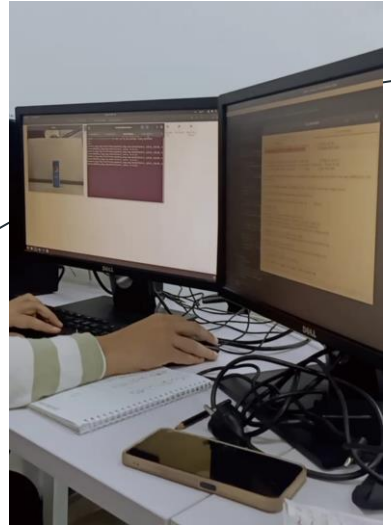
No movit package for foxy

Redlines

Keep out zone not supported in foxy, difficulties in topic publishing



Real life implementation



Enter RGB hex code (#): 89c1d0

or

Enter red color (R): 137

Enter green color (G): 193

Enter blue color (B): 208

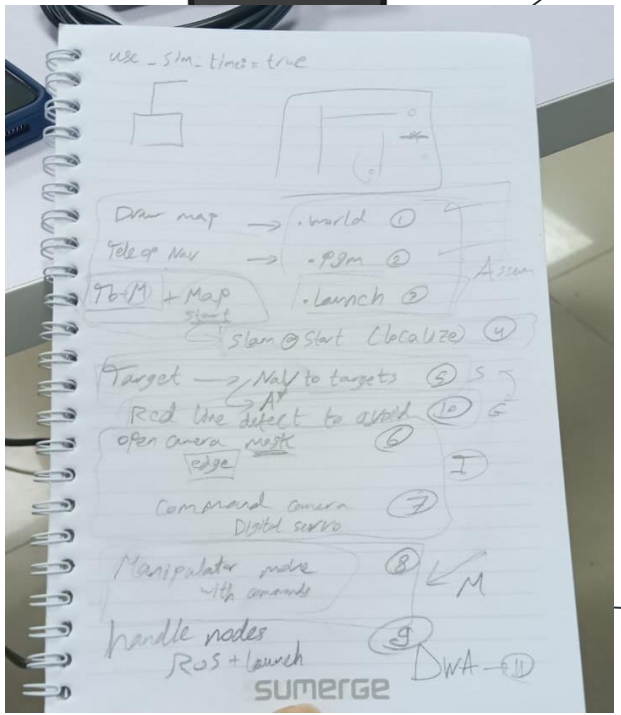
Convert Reset

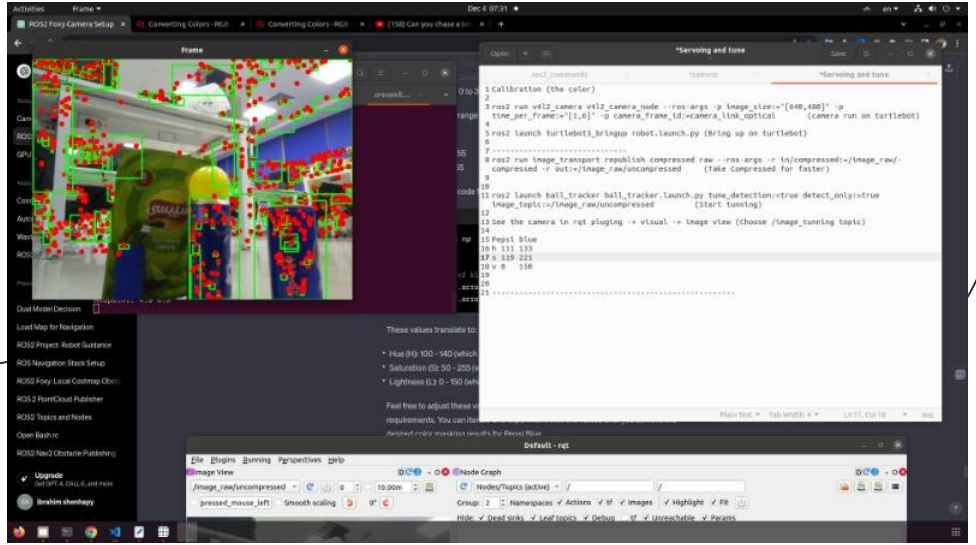
Hue (H): 193 °

Saturation (S): 34.1 %

Value (V): 81.6 %

Color preview:





Path Follow

Pick and place

References

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- https://emanual.robotis.com/docs/en/platform/turtlebot3/overview/
- A Concise Introduction to Robot Programming with ROS2 – Taylor and Francis group
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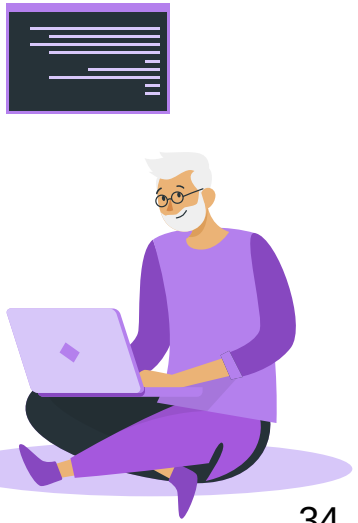
- A.-T. Nguyen and C.-T. Vu, "Obstacle Avoidance for Autonomous Mobile Robots Based on Mapping Method," in Faculty on Mechanical Engineering, Hanoi University of Industry, Hanoi, Vietnam, 2021.Faculty on Mechanical Engineer ing, Hanoi University of Industry, Hanoi, Vietnam, 2021. Available: https://tinyurl.com/5azymbw9



Thanks!

Thanks Again...