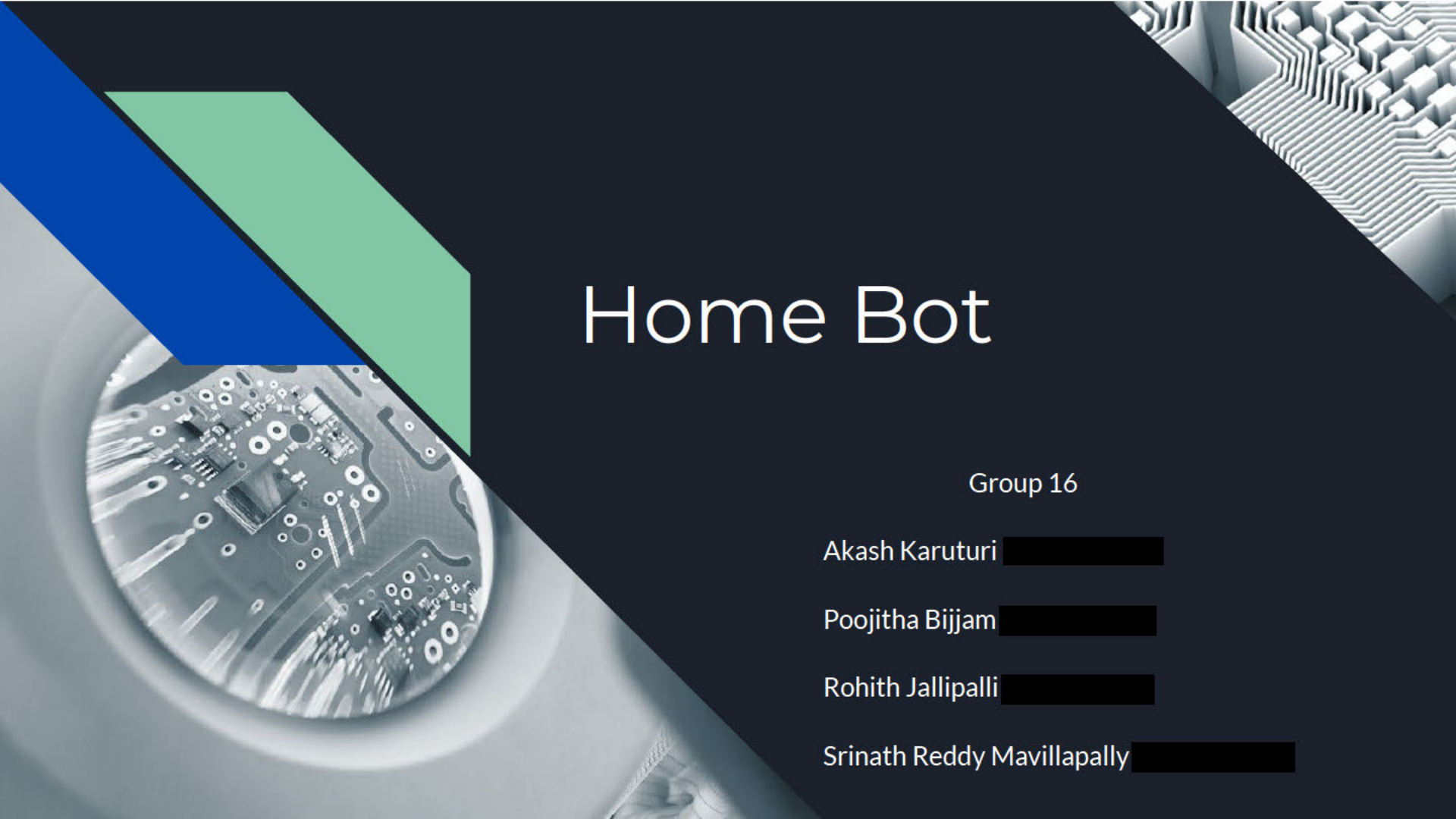


Home Bot

Group 16

Akash Karuturi [redacted]

Poojitha Bijjam [redacted]

Rohith Jallipalli [redacted]

Srinath Reddy Mavillapally [redacted]

Introduction

- This project's goal is to explicitly address robot navigation in static environments. Recently, autonomous navigation has become incredibly popular across the globe.
- In this experiment, we would work to solve the navigation problem by computing the robot pose and a map of its environment of operation at the same time.
- In order to increase the robot's awareness of its surroundings and help it recognize any impediments in its path, we integrated a LiDAR-based scanner with Gazebo.
- The project is practically completed over a gazebo.

Keywords

- ***SLAM*** - Simultaneous localization and mapping is a technique for autonomous robots that enables simultaneous map construction and vehicle localization. The bot is able to map out uncharted environments thanks to SLAM techniques. The map data is used by engineers to perform activities like path planning and obstacle avoidance.

- ***CARTOGRAPHER***- A system called Cartographer offers simultaneous localization and mapping (SLAM) in 2D and 3D in real time across numerous platforms and sensor configurations.

- ***RRT EXPLORATION***- A multi-robot map exploration algorithm is implemented by the ROS package RRT Exploration for moving robots. It is based on the method known as the Rapidly-Exploring Random Tree (RRT).

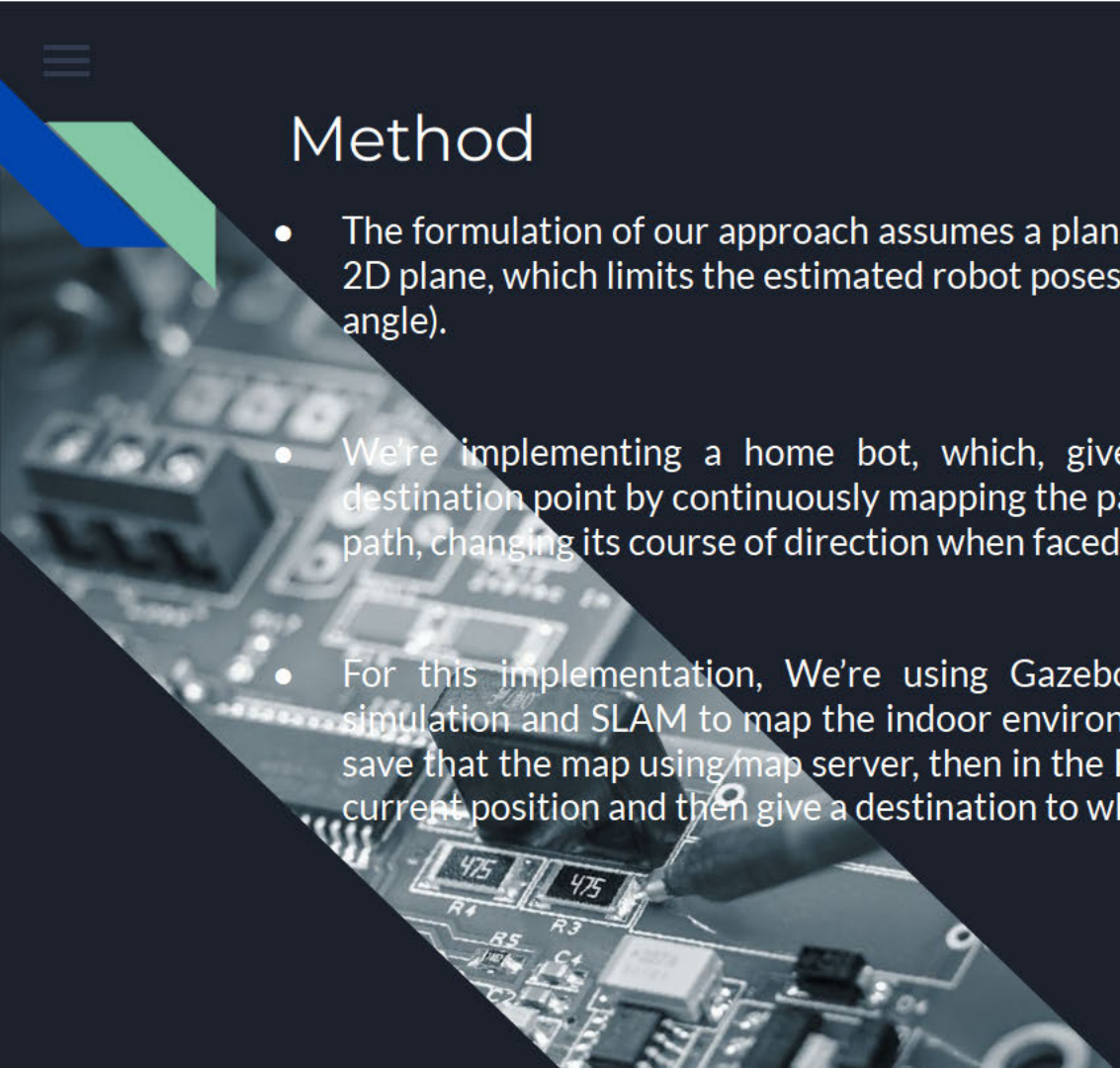
- ***LIDAR***- LiDar is a technique for measuring ranges (varying distance) that involves using a laser to target an item or surface and timing how long it takes the light to reflect back to the receiver.

Method

- The formulation of our approach assumes a planar Lidar mounted on a robot moving on a 2D plane, which limits the estimated robot poses to 3 DoF (2D position and an orientation angle).

- We're implementing a home bot, which, given a destination point, travels to the destination point by continuously mapping the path and detecting the any obstacles in it's path, changing its course of direction when faced an obstacle.

- For this implementation, We're using Gazebo for the environment and the robot simulation and SLAM to map the indoor environment, once the mapping is complete, we save that the map using map server, then in the Rviz terminal we estimate the home bots current position and then give a destination to which we intend the robot to travel.

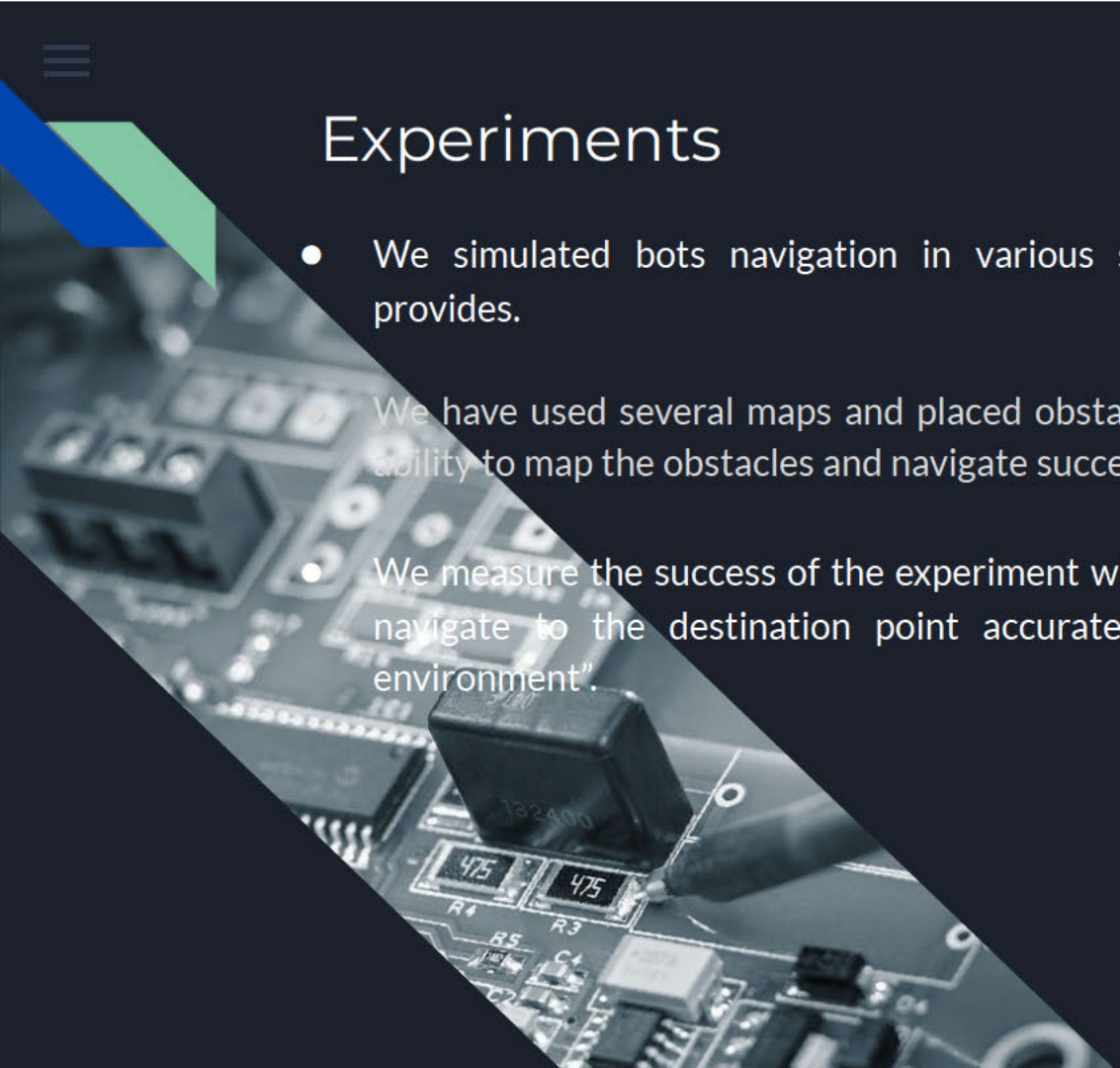


Experiments

- We simulated bots navigation in various simulator environments that GazeboSim provides.

  We have used several maps and placed obstacles and validated the accuracy of robot's ability to map the obstacles and navigate successfully to the destination by avoiding them.

- We measure the success of the experiment with the measurement of "can the home bot navigate to the destination point accurately, avoiding obstacles in a closed door environment".



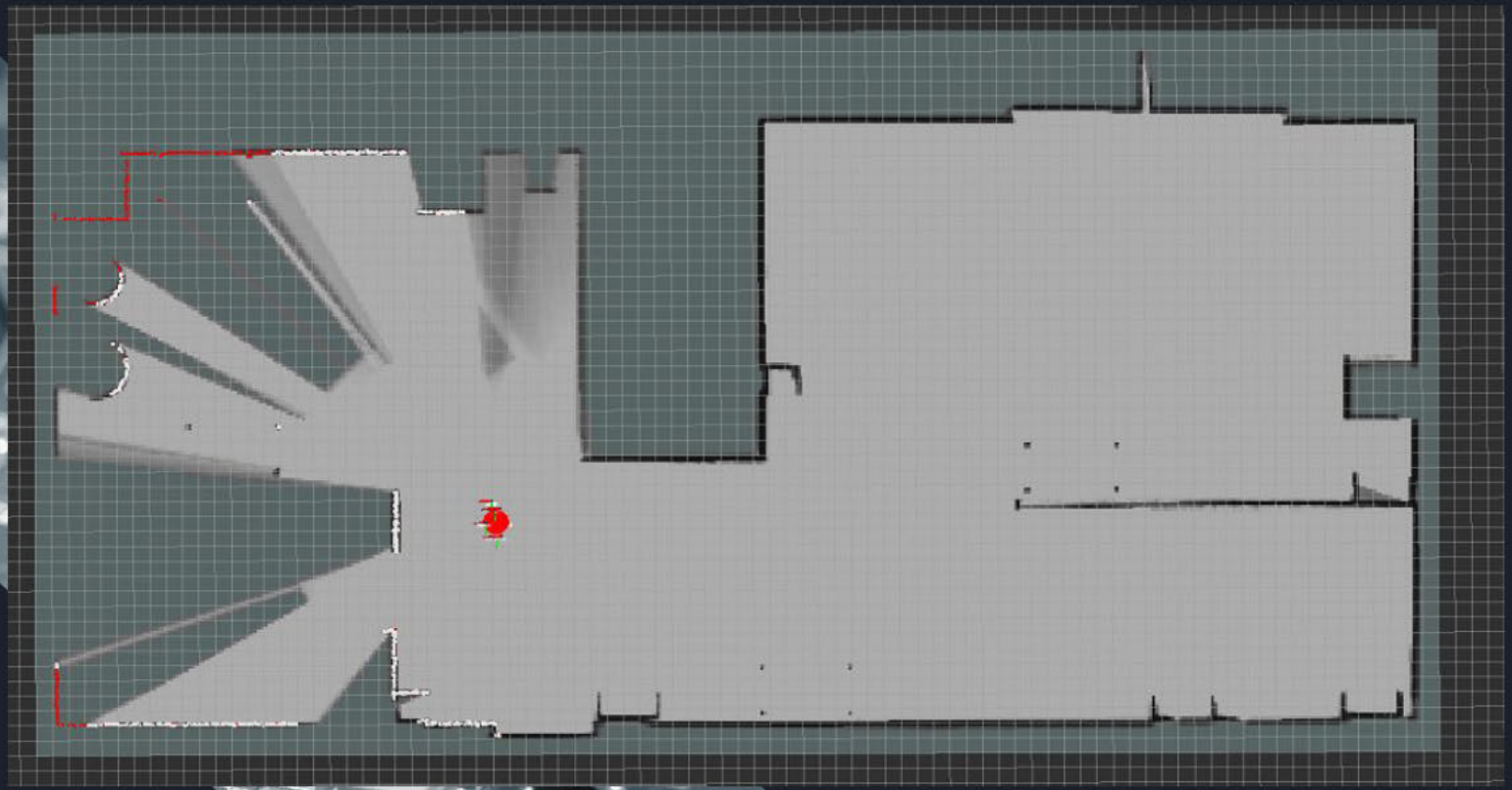
Exploration and Mapping

- For realizing obstacle avoidance, localization, motion planning, and navigation, it is necessary for the robot to obtain environment information beforehand.

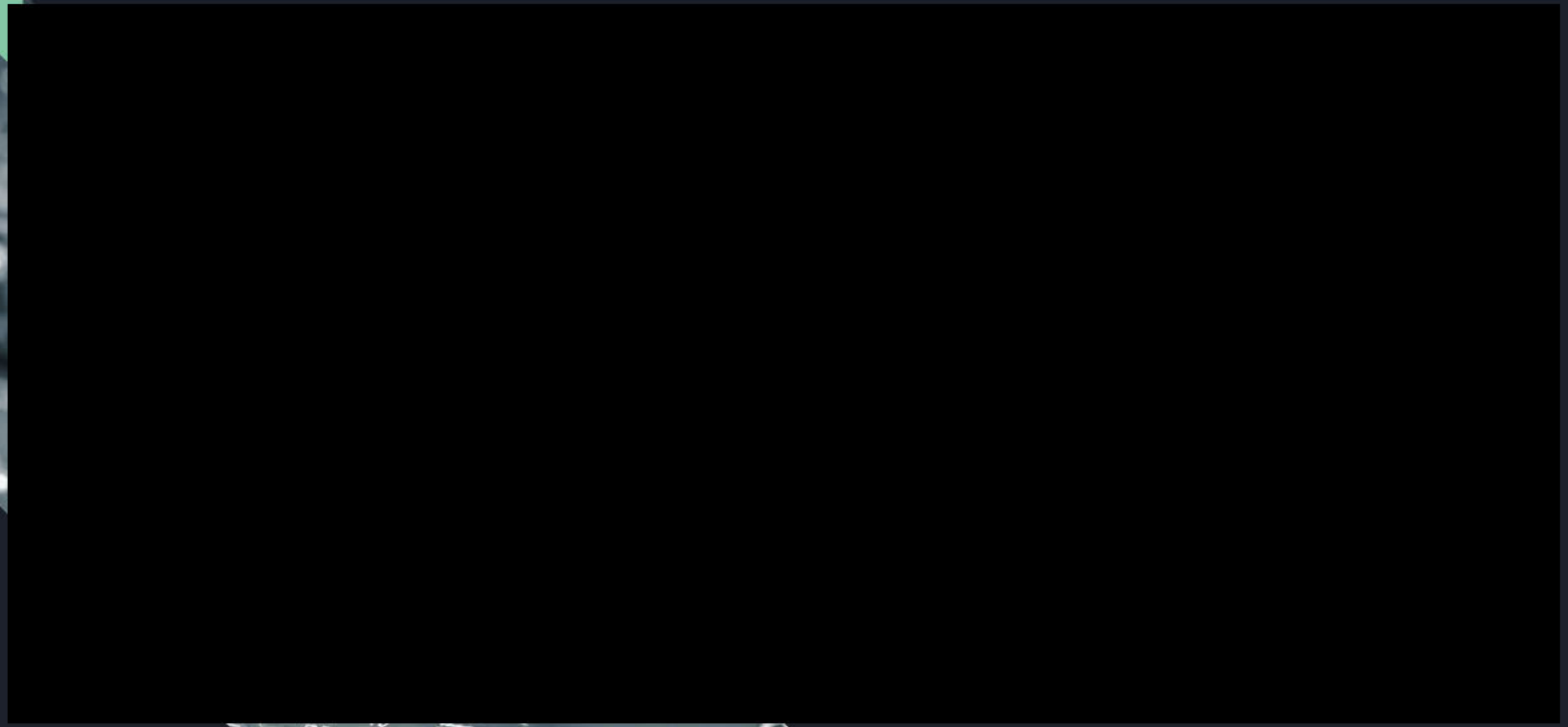
- We're using RRT exploration algorithm for the exploration and autonomous SLAM for mapping the surrounding environment and the robot is dynamically identifying the obstacles using LiDAR sensor.

Environment

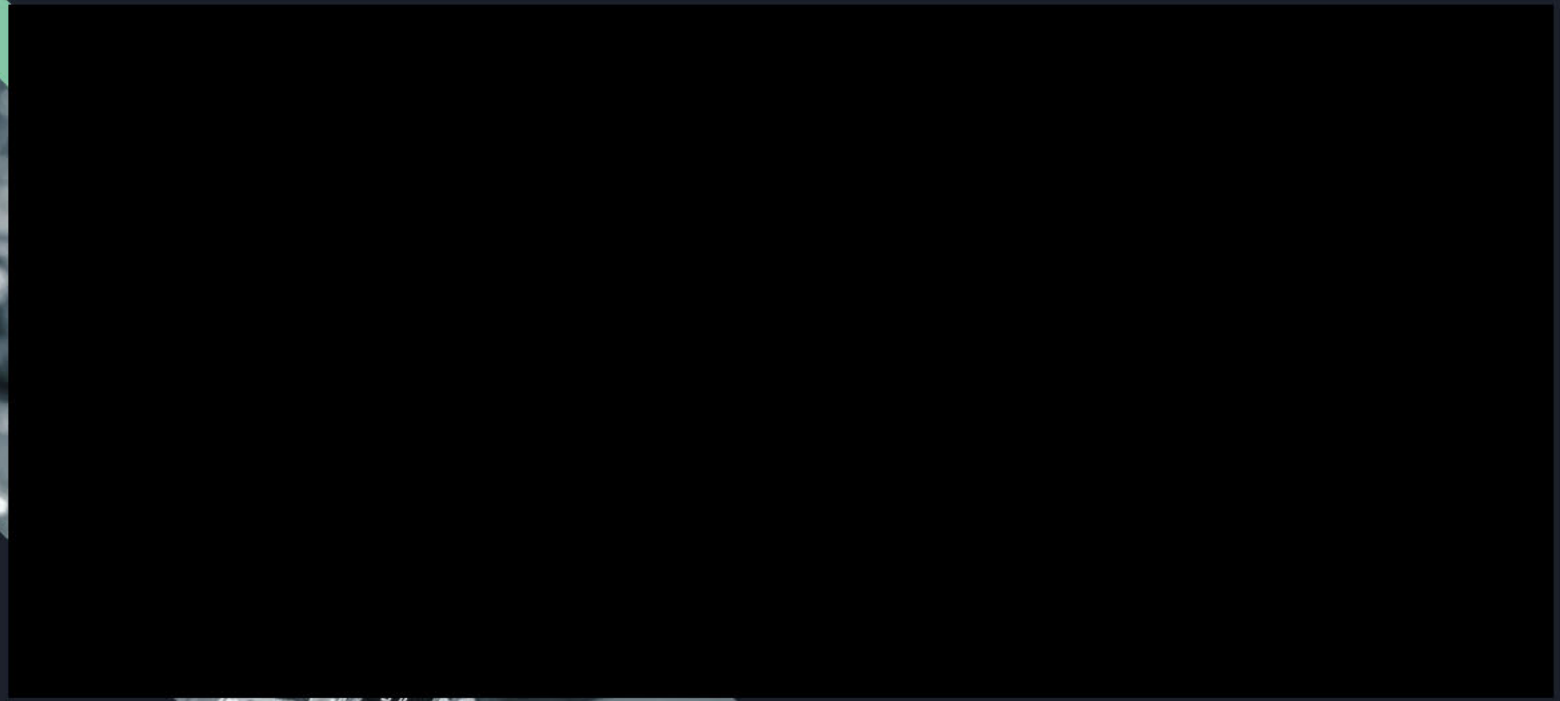
Map



Mapping Demo



Navigation Demo



Conclusion and Future Work

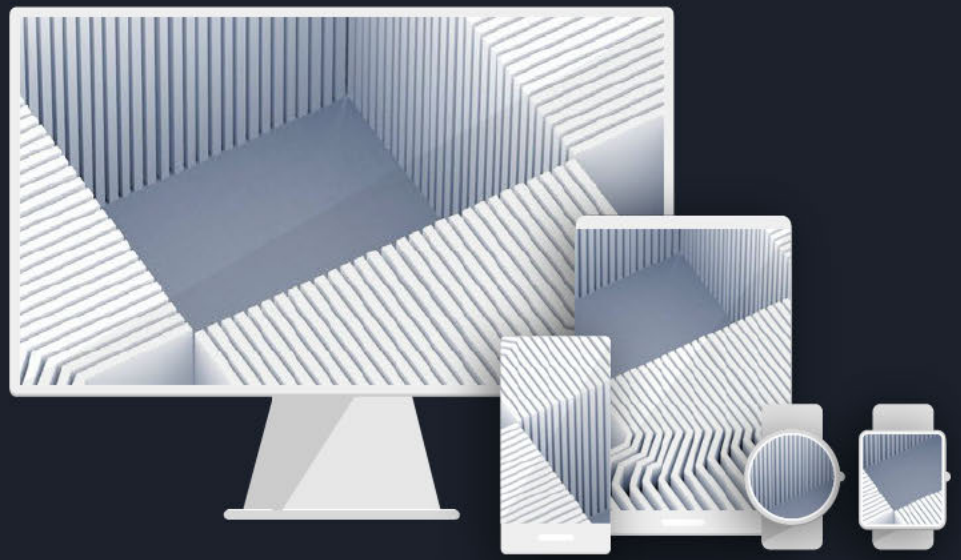
We have successfully created the environment map by using SLAM and implemented the localisation and navigation part as the bot moves from source to destination points autonomously. But during few tests conducted, we have noticed that bot is not stopping at correct destination. So we are working on improving the accuracy of bot navigation for better results.

- The future work for this project would be to run the robot in various indoor environments to validate if the robot is continuously mapping it's surrounding frontiers and detecting the obstacles.
- Generate more new environments and place a lot of obstacles surrounding the robot, varying object types(transparent to opaque) and sizes (large to small) to see if the robot would be able to detect all kinds of obstacles or not.
- Testing the accuracy of the localization to make sure the robot is highly efficient and effective in it's path planning to the destination.

References

- Exploring and Mapping Indoor Environment for Mobile Robots using Different Ways of Scanning
- https://ieeexplore.ieee.org/document/8202319

Thank you!



Questions?