ROVERSIM

PROJECT REPORT

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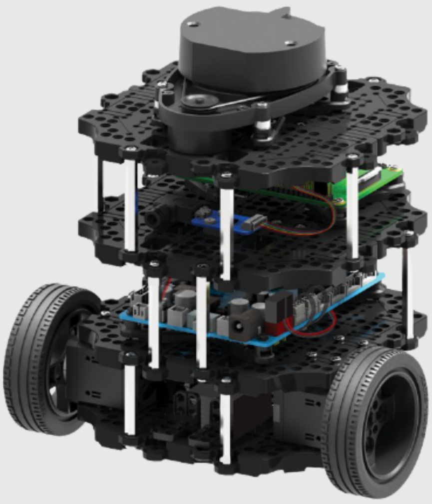
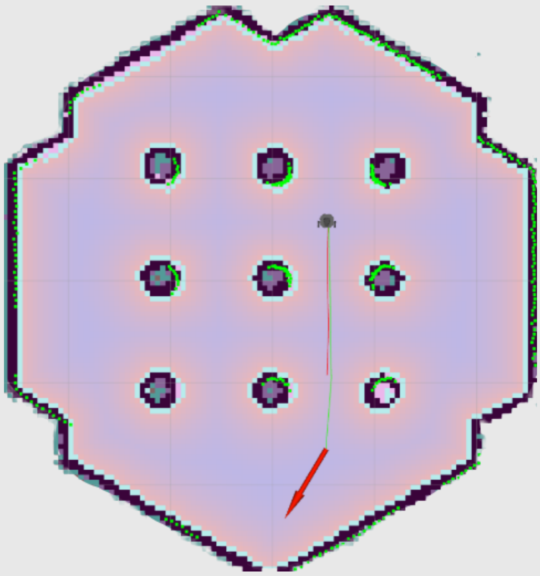
Abstract

The project aims to introduce the Path-Planning phase to a wireless rover to make it capable to navigate autonomously in an environment with the help of path planning algorithms (Dijkstra and SLAM) parsed by a python script. It aims to reach the endpoint through the shortest path and shortest time. This was done using ROS navigation stack by performing a simulation of a rover model in Gazebo environment, by running ROS (Melodic Morenia) in Ubuntu 18.04. The robot used in this project is Turtlebot 3.





Motivation

Watching a robot move on its own without any human input is always fascinating. So, our team of 5 freshers decided to take on the challenge to learn how a robot maps the environment, find its position in the map of the environment and move from one position to another on its own.

The future will be fully automated with the help of robots and for that automated navigation will be extremely important. So making a small robot move automatically is the first step.

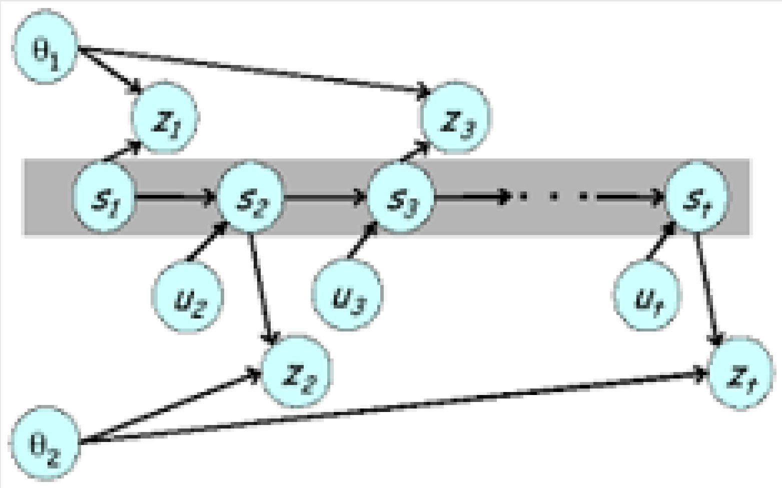
Applications

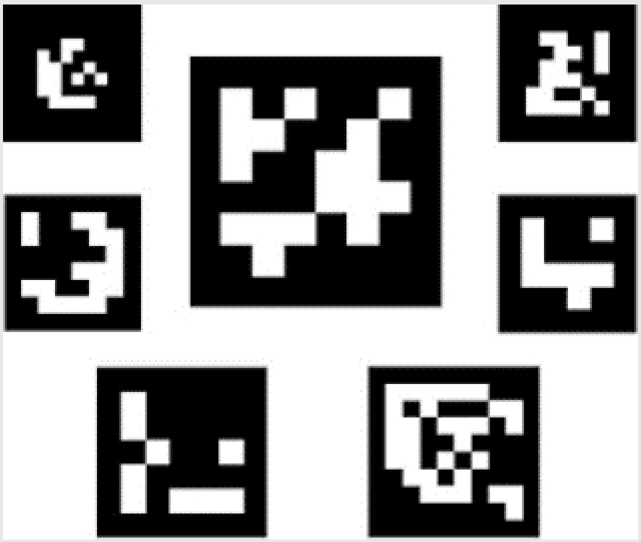
- Autonomous Vehicles
- Navigating a fleet of mobile robots to arrange shelves in a warehouse automated cleaner at home
- Finding Shortest path for a robot to serve in restaurant/other services
- Terrain mapping on different planets
- Exploration of mines

Limitations

- While navigating to its destination, the robot tends to go too close to an obstacle and get stuck in a loop that makes it rotate constantly.
- EKF Slam has some limitations as listed below:
- For larger inputs, the application crashes because the time complexity of the algorithm is O(n^2)
- Featured(point) landmarks can only be detected
- All densities involved in the algorithm are modelled as Gaussian. Hence the model is assumed to have a normal distribution which introduces some noise.
- The environment has to be a static environment.

Future Improvements





- Implementation of fast slam in ROS
- Adding ArUco marker detection capability for pose estimation

References

- ROS Wiki: http://wiki.ros.org/
- Path Planning: https://www.youtube.com/watch?v=ZmQIkBws4LA
- EKF Slam: https://www.youtube.com/watch?v=X30sEgIws0g&t=1632s&ab_channel=CyrillStachniss
- Slam basics: https://www.youtube.com/watch?v=B2qzYCeT9oQ&list=PLpUPoM7Rgzi_7YWn14Va2FODh7LzADBSm&ab_channel=ClausBrenner
- Chapter 10 in Probabilistic Robotics by Dieter Fox, Sebastian Thrun, and Wolfram Burgard
- Slam for dummies: https://dspace.mit.edu/bitstream/handle/1721.1/119149/16-412j-spring-2005/contents/projects/1aslam_blas_repo.pdf