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Autonomous Lawn Mower

Introduction

We propose to implement a robotic system in Gazebo and ROS inspired by an autonomous lawn mower called “Automower” which is capable of mowing a desired lawn area, following a predefined pattern to cut the lawn and dynamically avoid obstacles. Assuming an environment map known beforehand, our robot uses the TurtleBot robot as its base platform as it follows its trajectory for mowing the lawn.

The robot starts and ends its mowing session at a home location or a charging dock. The system pre-plans a possible optimal trajectory for navigation. The deliverables will include but not be limited to, a ROS package for simulating the lawn mower in gazebo, a ROS node written in C++ to control a lawn mower running the ROS navigation stack autonomously; using high-quality software engineering practices, class and activity diagrams, an up-to-date GitHub repository with complete documentation and unit tests integrated with Travis CI and Coveralls.

Project Organization

Product development shall be done using the Agile Iterative Process where tasks will be tracked using a backlog table. All the tasks will be outlined and backlog tables for each iteration will also be maintained. The entire project will split into two sprints. Team members shall follow the pair programming method for development, where the roles of navigator & driver will be interchanged every sprint.
The release model will follow a rapid prototype development process and the testing model to be used will be unit testing where several unit tests will be designed for complete code coverage.

Technical overview

We will be using ROS and C++ for developing the entire project and Gazebo for the simulation of the module. Moreover, Rviz will be used for visualization of robot data. A turtlebot will act as a lawn mower which will navigate through the entire lawn covering all points autonomously. In this project, we are making an assumption that the lawn being mowed is known to the robot.

We will also be implementing the autonomous navigation capability of the robot and ensuring that the robot covers all the areas over the lawn. Waypoints for the navigation will be assigned for further trajectory planning of the robot. The motion commands according to the desired trajectory will be published to the turtlebot on a point by point basis and navigation to each waypoint will be checked for successful completion. The robot will be controlled via keyboard commands from the terminal interface for pausing, resuming and stopping the lawn mowing function. Additionally the node will also display the number of waypoints covered, out of the total number needed to traverse the trajectory.

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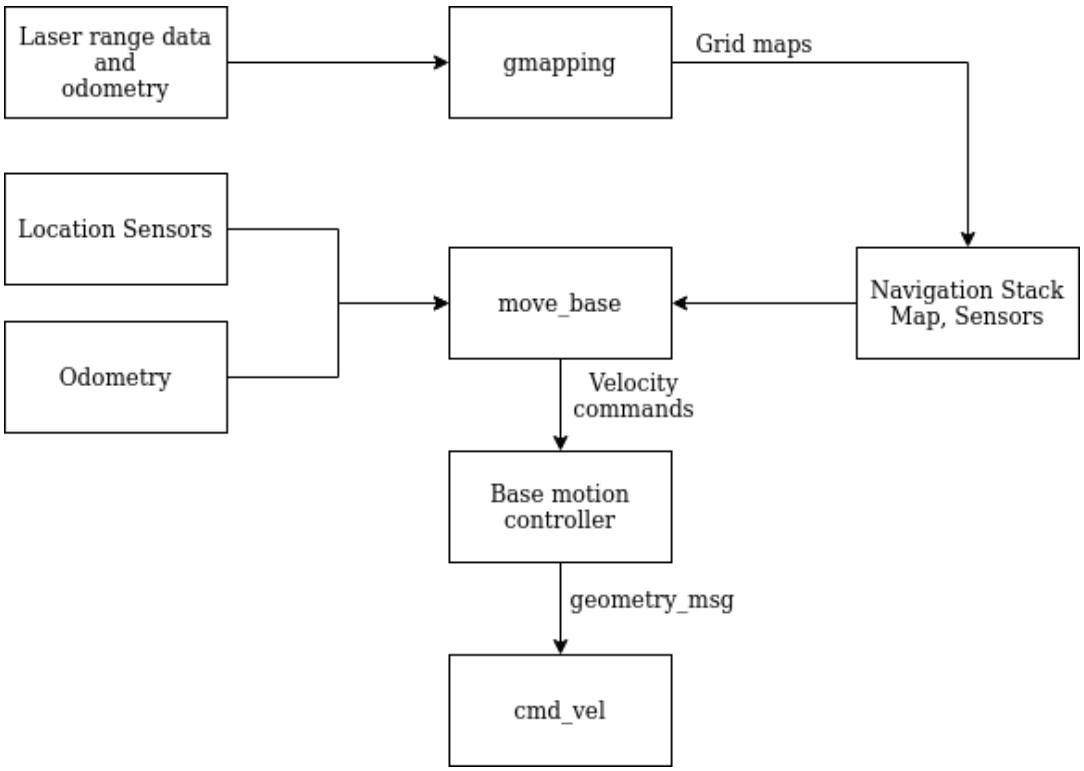
The architecture for the proposed idea is shown in the figure below,



Testing to check the waypoint navigation capability will be done by first providing a set goal and waiting for the robot to reach the said goal. We will then compare the distance between its current position from the odometry and the ground truth goal position.

Risk and Mitigation

The aim of the management is to create a quality deliverable with no bugs. Risk mitigation for the autonomous lawn mower will be performed by extensive unit testing of each module using gtest and rostest. Since the node will be operating in a real world robot which can be of potential physical risk to nearby humans in case of a failure, a mitigation plan of implementing a hardstop/killswitch is in place, if the robot were to ever become unresponsive to goal commands.