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Room Reconstruction using LIDAR and Three Wheel Omni Drive

Advisor: Dr. Jafar Saniie (Chair Professor)
Department of Electrical and Computer Engineering, Illinois Institute of Technology
Embedded Computing and Signal Processing Research Laboratory

Shivankar (BE/10214/15)
Production Engineering

Arnav Swapnesh (BE/10427/15)
Production Engineering

ABSTRACT:

This project presents the design, validation and implementation of a three-wheeled holonomic motion system of a mobile robot designed to operate in homes or indoor spaces. The project analyses the kinematics of the motion system and validate the estimation of the trajectory comparing the displacement estimated with the internal odometry of the motors through encoders and the displacement estimated with a SLAM procedure based on LIDAR information.

The major components required in this project are:

Hardware:

1. Three-Wheel Omni Drive
2. YD LIDAR F4 PRO
3. Raspberry Pi 3
4. Arduino Atmega 2560
5. Adafruit L293D Motor Shield V 2.3
6. 12V DC Motors
7. AB Type Magnetic Encoders
8. Li-Po Battery 12V
9. Power Bank 5V
10. Power Distribution Board

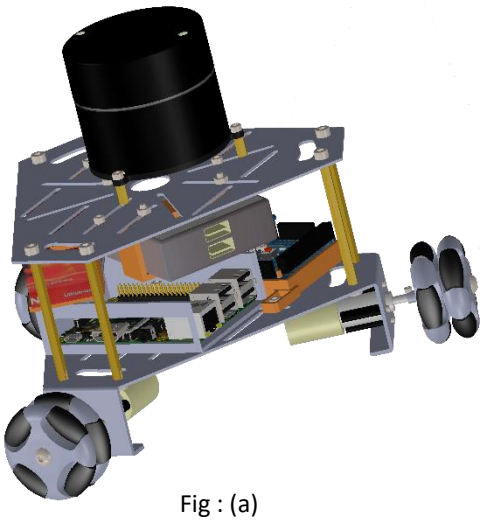


Fig : (a)

Software:

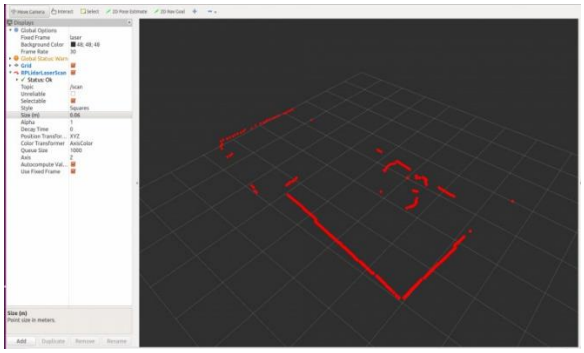
1. ROS- Kinetic (Robot Operating System) on Ubuntu Mate
2. Rosserial Arduino IDE
3. Solidworks 2017

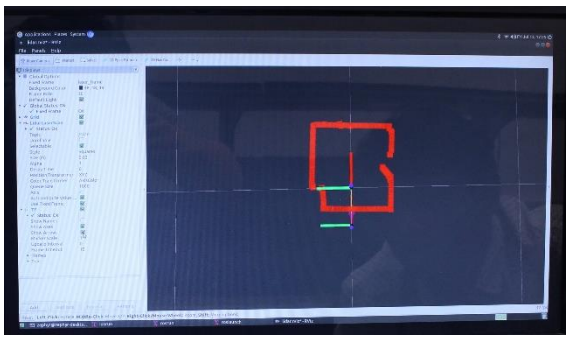
The majority of work was done on ROS- Kinetic Operating system which is a set of software libraries and tools that help us build robot applications from drivers to state-of-the-art algorithms and with powerful developer tools. ROS- Kinetic is a version of ROS.

For reconstruction purpose a LIDAR sensor was used which is a laser scanner and uses the process of Light Detection and Ranging (LIDAR) by measuring distance to a target by illuminating the target with pulsed laser light and measuring the reflected pulses with a sensor. Differences in laser return times and wavelengths can then be used to make digital 2D or 3D representations of the target.

METHODS:

The robot along with the fixtures required for components were designed in Solidworks 2017(CAD Software) and the robot was initially controlled using keyboard to generate a map of the surrounding. For precise movement of the robot encoder data was utilized and for mapping the surrounding the LIDAR data was assembled and converted to a point cloud form using certain packages in ROS. We tried to implement SLAM (Simultaneous Localization and Mapping) algorithms in our robot through navigation stack in ROS which contains a package called gmapping which uses the odometry data, LIDAR data, robot's current and desired location to give velocity commands to the robot to move autonomously and produce a map of the environment while avoiding any obstacles encountered along the way. The results were visualized on a visualization software in ROS called Rviz.





CONCLUSION:

Such types of robots have varied applications in numerous fields such as domestic, military or industrial depending upon the type of usage. Self-driving cars also utilize similar techniques for navigation. The project enabled us to utilize ROS platform for developing our robot and make it mobile using Arduino and Raspberry Pi.