International Conference on Big Data,Machine Learning, and Applications(BigDML 2021)

#79
Implementing Autonomous Navigation on an Omni Wheeled Robot Using 2D LiDAR, Tracking Camera and ROS

Atharva Bhorpe, Pratik Padalkar, Pawan Kadam

TABLE OF CONTENTS

MOTIVATION

- Robotics is the multidisciplinary branch of engineering of building devices that physically interact with their environment, and are used in automobile industries, medical institutes, food processing companies.
- We are entering a new era of Industry 4.0. Robotics and automation are important aspects of it.
- Almost every industry is adopting intelligent robots which perform their tasks on their own. These autonomous robots are helping industries to revolutionize faster.
- This paper shows the different softwares and algorithms used to implement holonomic natural navigation.

LITERATURE

	Name of Author	Proposed methodology	Publication year
Holonomic Implementation of Three Wheels Omnidirectional Mobile Robot using DC Motors	Riky Tri Yunardi, Deny Arifianto, Farhan Bachtiar, Jihan Intan Prananingrum	The inverse kinematics of 3-wheeled omnidirectional robot's movement is studied.	Journal of Robotics and Control(JRC) (2021)
Global and Local Path Planning Study in a ROS-Based Research Platform for Autonomous Vehicles	Pablo Marin-Plaza , Ahmed Hussein , David Martin, Arturo de la Escalera	The concepts of Global and Local Planner are explained and the Dijkstra and TEB planner algorithms are studied.	Journal of Advanced Transportation (2018)
Navigation and Control System of Mobile Robot Based on ROS	Li Zhi, Mei Xuesong	This paper discusses the different parameters of Navigation Stack of ROS and how to tune these parameters.	IEEE (IAEAC 2018)
A Quantitative Study of Tuning ROS GMapping Parameters and Their Effect on Performing Indoor 2D SLAM	Yassin Abdelrasoul, Abu Bakar Sayuti HM Saman, Patrick Sebastian	In this paper, 2D Mapping is carried using GMapping algorithm. The paper explains the different parameters of the algorithm in ROS and how to tune those parameters.	IEEE (ROMA 2017)
A Study of Monte Carlo Localization on Robot Operating System	Fitria Romadhona Quratul Aini, Agung Nugroho Jati, Unang Sunarya	In this paper, SLAM implementation using Monte Carlo algorithm on a mobile robot is studied. This localization algorithm is implemented using Robot Operating System (ROS).	ICITSI (2017)
SLAM Algorithm Analysis of Mobile Robot Based on Lidar	Zhang Xuexi, Lu Guokun, Fu Genping, Xu Dongliang, Liang Shiliu	In this paper, SLAM implementation on a mobile robot is studied.	Chinese Control Conference (CCC) (2019)

METHODOLOGY

1. Hardware:

   - Computer – Laptop (Ubuntu 20.04)
   - Microcontroller – Arduino Mega 2560
   - Wheels – Omni wheels of radius 50mm
   - Motors – RS775 DC motors
   - Battery – LiPo 4 cell of 8000mAh
   - Motor Drivers – BTS motor drivers
   - Tracking Camera – Intel RealSense T265
   - Laser Sensor – RPLIDAR A1M8

METHODOLOGY

2. Software:

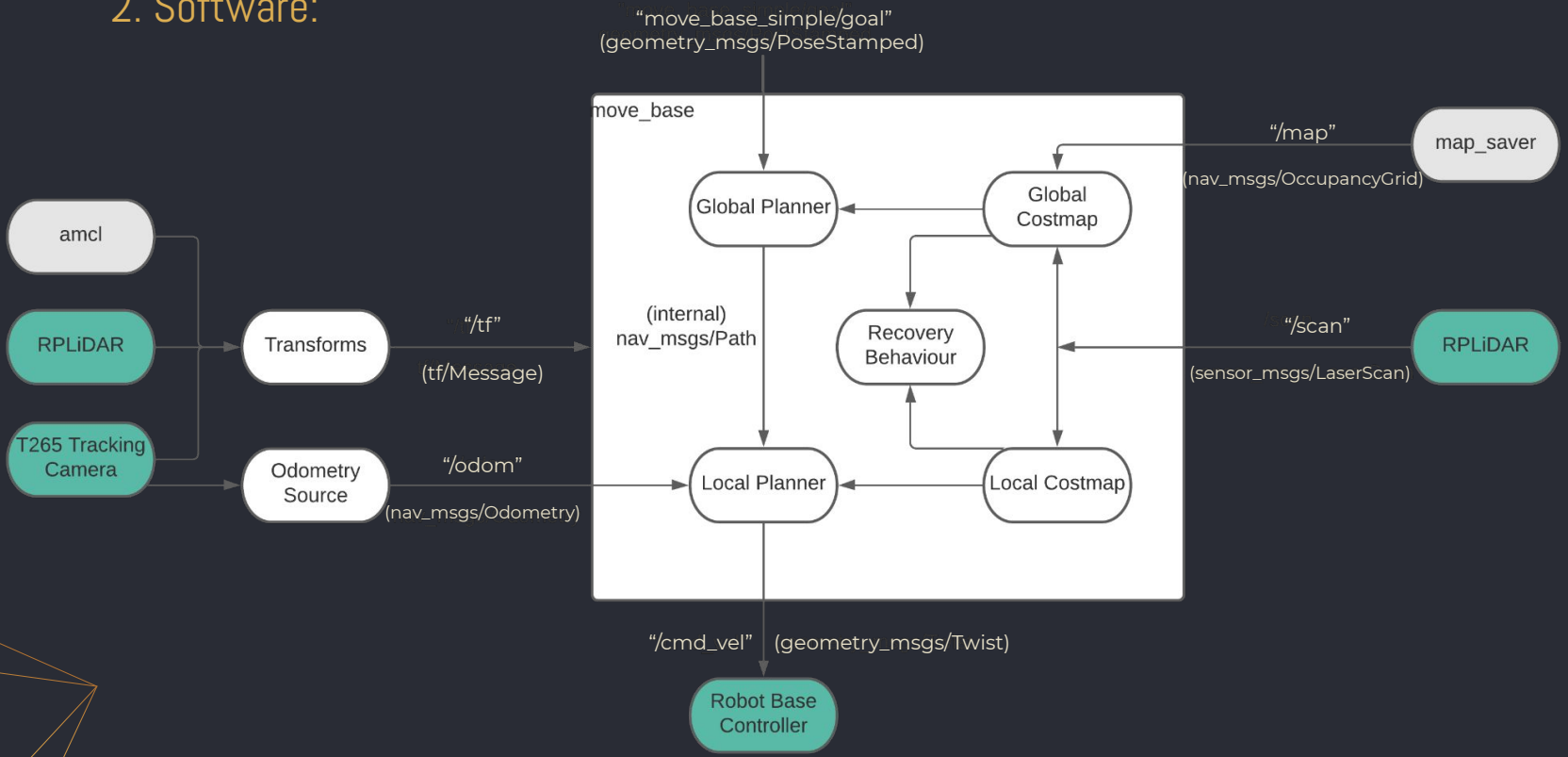
1. ROS Navigation Stack:

- Set of packages of mapping and path planning algorithms. The ROS Navigation Stack consists of different stages of working as

a. Mapping
b. Localization
c. Path Planning
d. Global Planner (Dijkstra)
e. Local Planner (Timed Elastic Band (TEB))
f. Move Base

METHODOLOGY

2. Software:

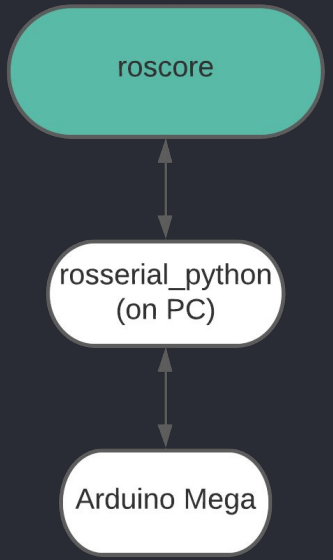


METHODOLOGY

2. Software:

2. Microcontroller:

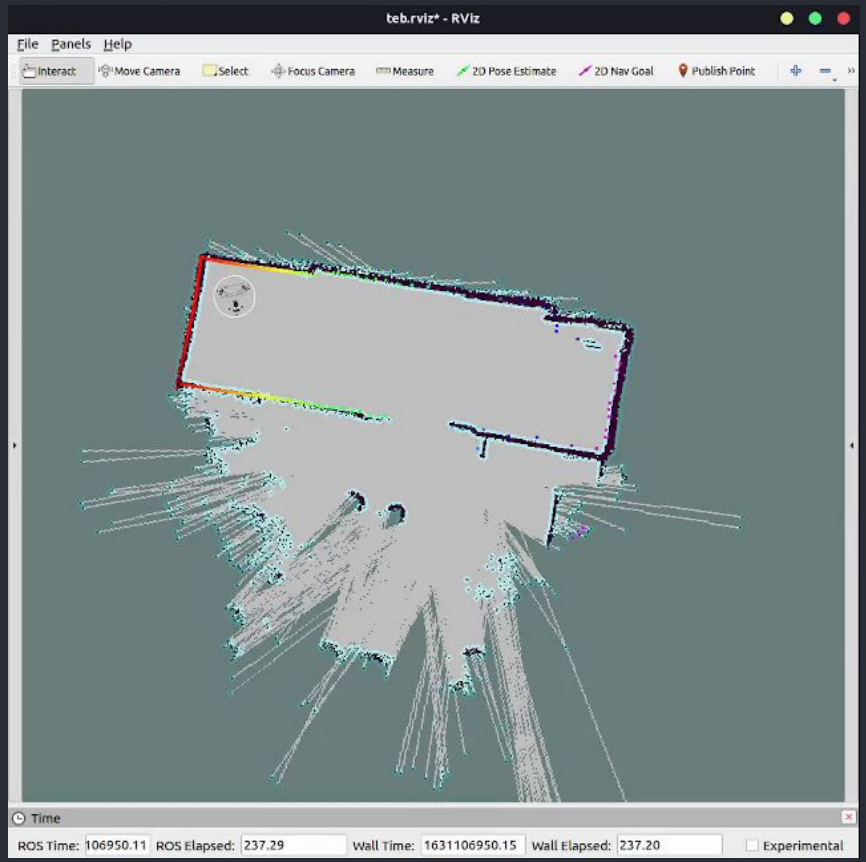
- We have used an Arduino microcontroller to control our robot and pass the commands from the ROS server to an Arduino using *rosserial* to the robot wheel.
- ROS has official support to connect an Arduino to ROS and has its official package called rosserial.
- We have used the rosserial python package on PC side. This package creates a ROS node called *serial_node* that publishes the linear and angular speed data through the "*/cmd_vel* " topic and an Arduino subscribe to this topic and sends commands to the motors connected to the wheels accordingly.



METHODOLOGY

3. Execution:

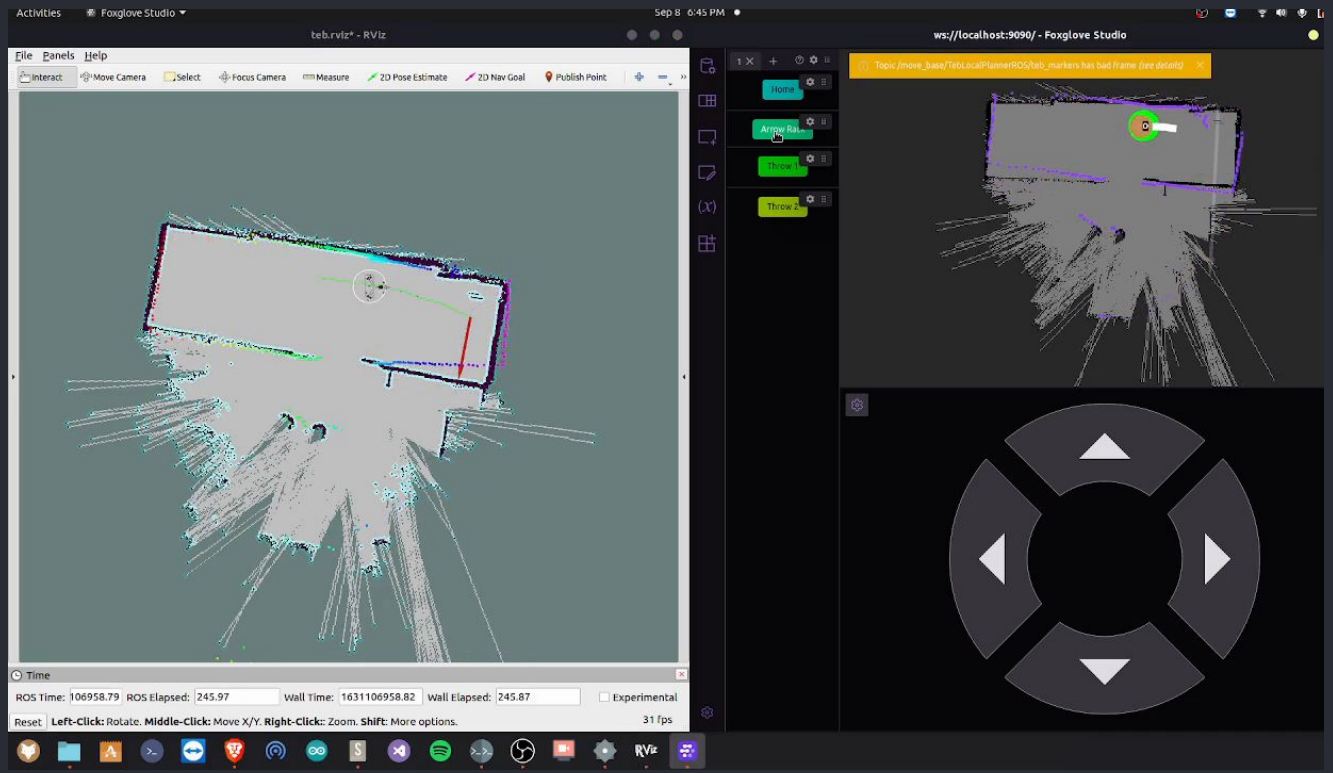
1. ROS Rviz:



METHODOLOGY

3. Execution:

2. Goal:
Foxglove Studio



RESULTS

- A comparison of the total time taken to travel between two fixed points using the different navigation methods is shown in the Table

Navigation Method	Approx. Time Taken (in sec.)
Manual Non-Holonomic	15
Autonomous Non-Holonomic	11
Manual Holonomic	10
Autonomous Holonomic	9

CONCLUSION

- Using autonomous navigation is faster than manual navigation in both holonomic and non-holonomic movement.
- Using Tracking Camera for Odometry is more accurate than using encoder sensors on motor.
- GMapping SLAM procedure is used to build an incremental map using a laser sensor.
- Quality of localization and navigation of the robot depends a lot on the motors and LiDAR sensor.
- Used move base to configure global and local planner parameters specific for this robot for optimum path planning and locomotion.

THANK YOU!