Outdoor State Estimation via Sensor Fusion Using a Four-Legged Robot Platform

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Introduction

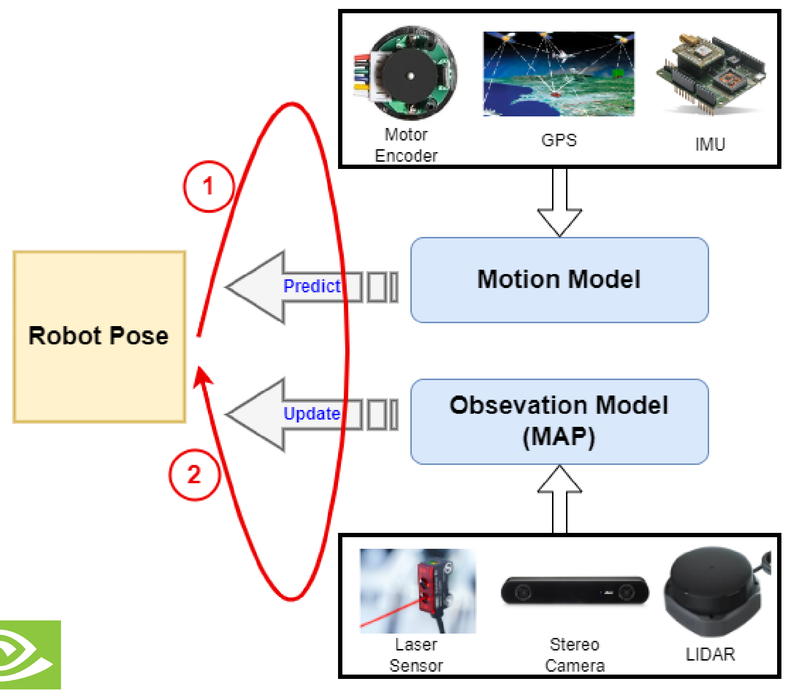
The project involves developing an autonomous shuttle to enhance campus transportation safety and punctuality. Utilizing a LiDAR sensor for mapping, an IMU for real-time location and speed data, and mecanum wheels for omnidirectional movement, the vehicle autonomously navigates to predetermined targets. Controlled via ROS2 Foxy and powered by a Jetson Xavier NX, the project integrates advanced sensors and control systems.

Specifications and Design Requirements

The autonomous shuttle platform includes a 2D RPLiDAR sensor with a 12m range., an XSens MTi-7 IMU sensor with ±0.1°/s accuracy and a 100Hz update rate, 100mm rubber mecanum wheels, 50W DC motors with 0.5Nm torque, motor drivers rated at 10A and 12V, ESP32 modules with 240MHz clock speed and 520KB memory, a Jetson Xavier NX featuring a 6-core ARM CPU, 384-core GPU, and 8GB RAM.

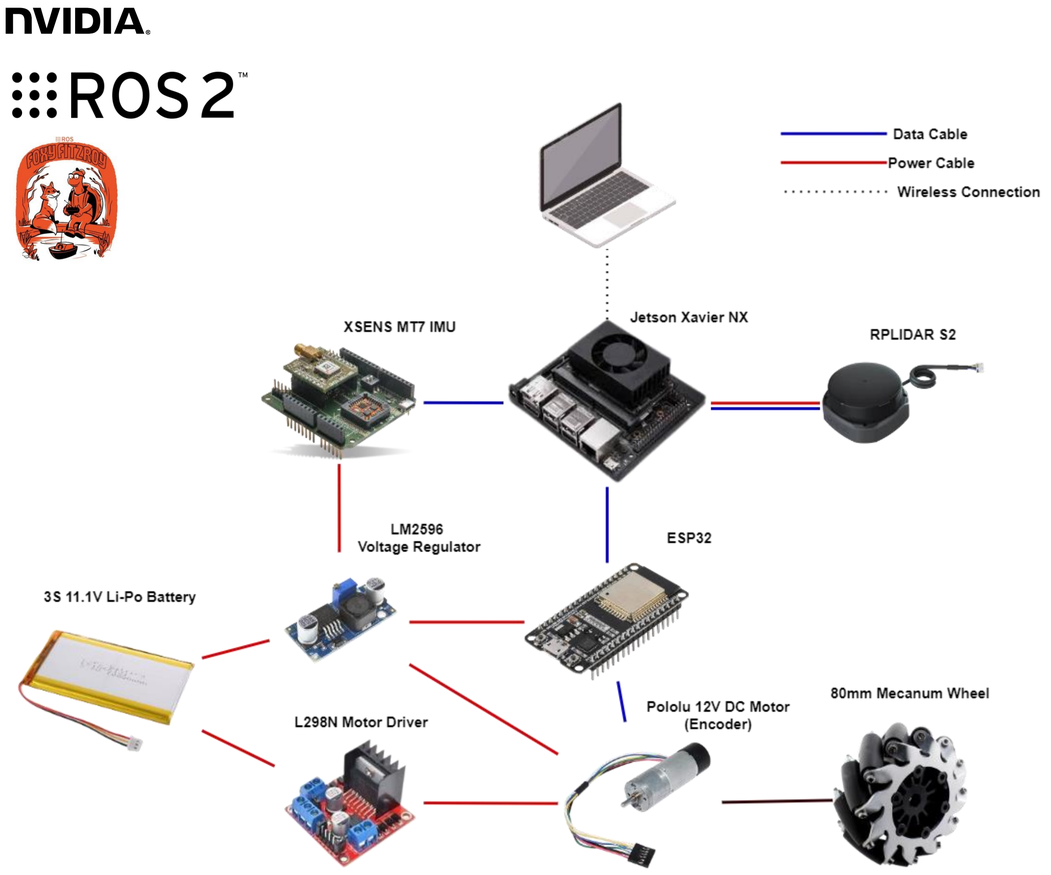
Requirements;
Autonomous Navigation: Target navigation, obstacle avoidance
Mapping: Real-time, accurate
Data Processing: IMU data for localization
Control: Reliable motor control
Integration: Seamless component interaction

Solution Methodology

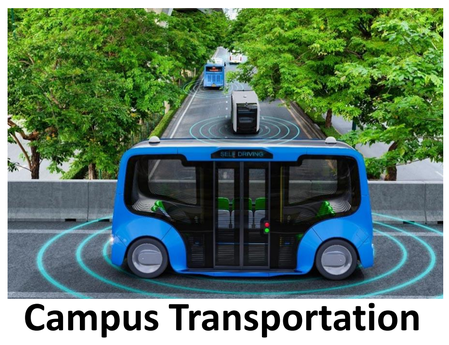


NVIDIA

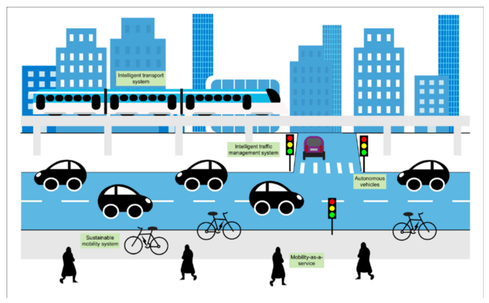
ROS 2



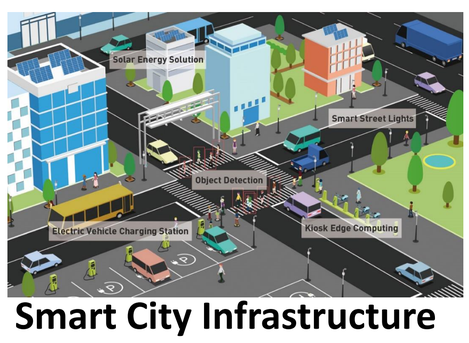
Application Areas



Campus Transportation



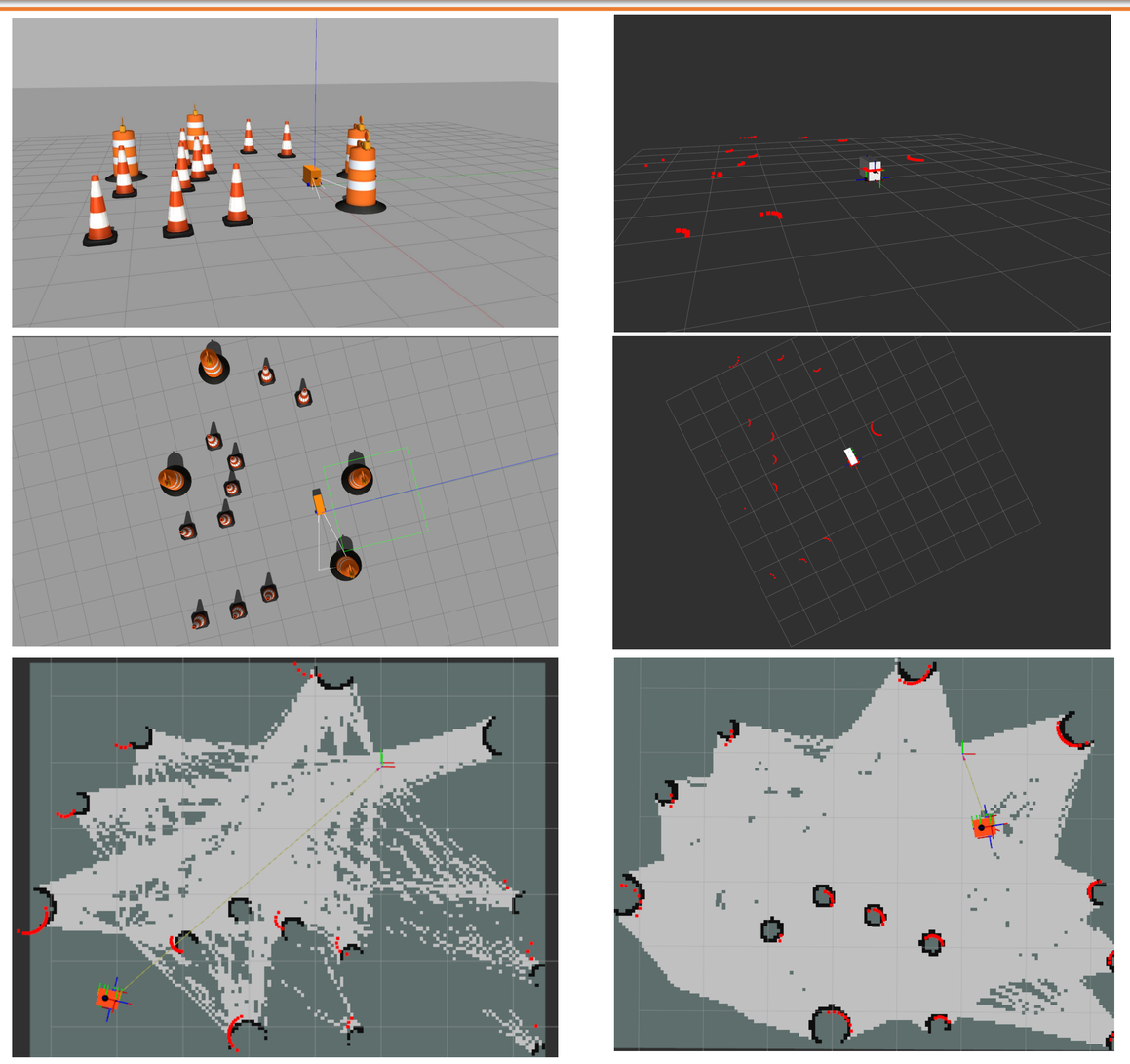
Urban Mobility Solutions



Smart City Infrastructure

Healthcare and Senior Living Communities

Results and Discussion



Future Works

-Enhanced Obstacle Detection
-User Interface Development
-Extended Testing
-Smart City Infrastructure

References

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- Hess, W., Kohler, D., Rapp, H. & Andor, D., 2016. Real-time loop closure in 2D LIDAR SLAM. 2016 IEEE International Conference on Robotics and Automation (ICRA), Stockholm, Sweden, pp. 1271-1278.

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