Propbot: Autonomous Wireless Data Collection Robot

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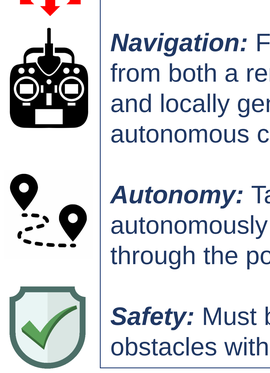
Capstone Team 50

Introduction/Motivation

Applications such as smart cities, autonomous vehicles, and remote work rely on a fast and resilient communications networks. The task of collecting data for research on the propagation of radio signals has never been more essential.



Current methods for collection of wireless propagation data rely on backpacks or carts to carry around heavy equipment which prove to be:

- ***Time consuming***
- ***Difficult***
- ***Inaccurate***

Our Solution

Propbot is a fully autonomous robot designed to automate the collection of wireless propagation data making the process quicker, easier, and more reliable for researchers

Requirements

Motion: Execute longitudinal and rotational movements

Navigation: Facilitate motion commands from both a remote operator through RC and locally generated commands from the autonomous computer

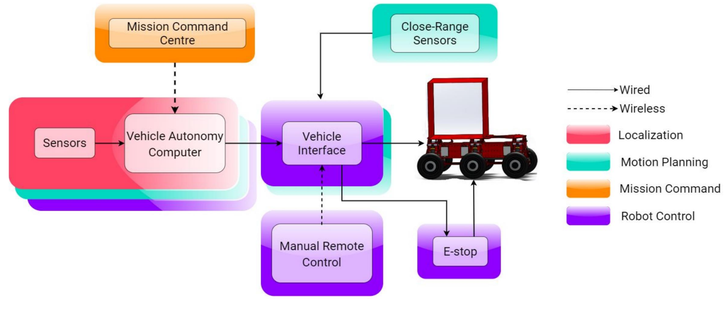
Autonomy: Take a set of way points and autonomously generate a path of motion through the points that avoids obstacles

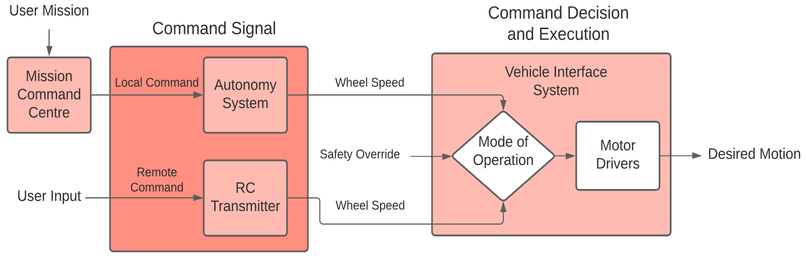
Safety: Must be safe and avoid/prevent obstacles with objects and pedestrians

System Architecture

Autonomy System
Serves to safely guide Propbot towards its intended destination(s) with minimal aid from a fallback user.

Vehicle Interface System
Serves to perform transmission of wheel speeds from the autonomy system, RC controller, and E-Stop depending on the mode of operation of Propbot

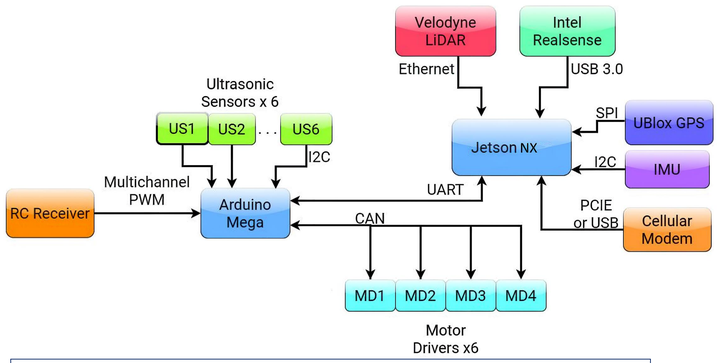




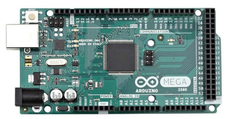
Command arbitration is performed depending on Propbot's ***mode of operation***

- RC Mode
- Autonomy Mode
- E-Stop Mode

Design Features



Inter-component communications rely on a range of wired and wireless protocols including I2C, CAN, UART, PWM, Ethernet, and RC Pulse



Vehicle Autonomy Computer (NVIDIA Jetson NX) is responsible for running the autonomy system

Vehicle interface Board (Arduino Mega 2560) performs command arbitration and sends speed commands to the motor controllers

Propbot relies on a suite of sensors and electronics to perform autonomy and obstacle avoidance

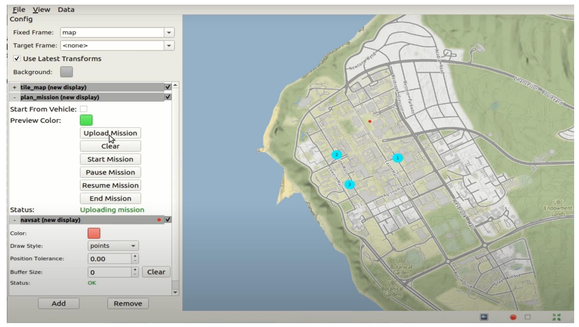
LiDAR

IMU

Depth Camera

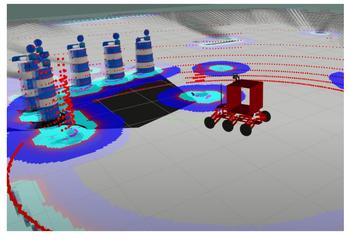
GPS

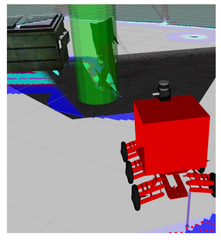
Sonar



Custom Mission Command software allows researchers to upload waypoints and monitor the status of Propbot

Simulation





ROS Gazebo is a simulator configured to communicate raw, mocked sensor data to the Autonomy System. The system responds with the desired velocity of Propbot and its movement is viewed through Rviz, a ROS visualizer.

Achievements

Safe and reliable teleoperation

Integration of Autonomy System with Nvidia Jetson NX

Robust power distribution system

Future Work/Acknowledgements

- Implementation of LiDAR
- Implementation of Roboteq SBL1360A Motor Controllers
- Overall system validation
- Extensive data collection

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