Unmanned Surface Vessel

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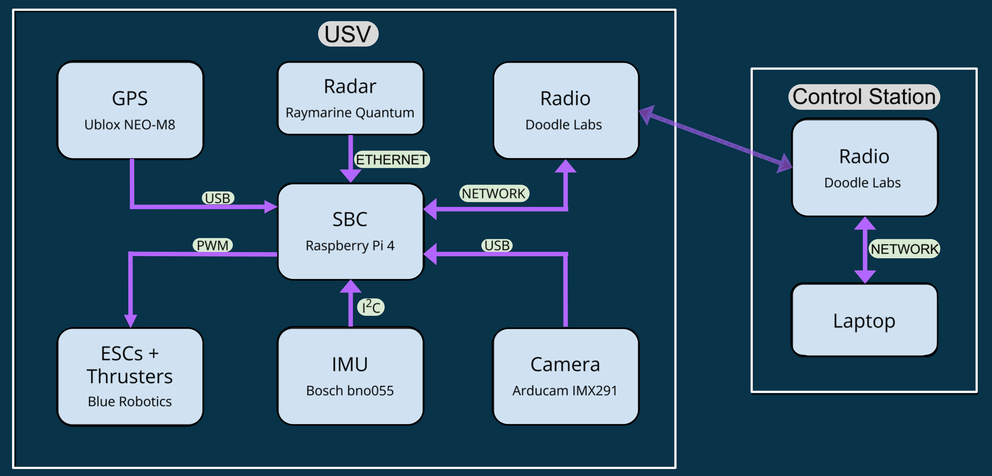
Background

Developments in climate science and geopolitical conflict have increased the demand for coastal reconnaissance. Modern applications call for robotics to improve safety and efficiency. We present a radar-navigating unmanned surface vessel (USV) as a platform to perform intelligence gathering missions.

Capabilities

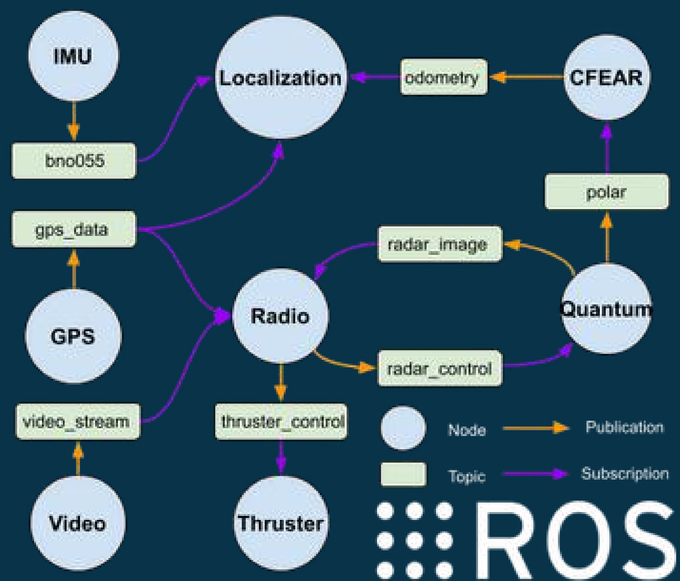
Signal jamming and sparse cellular coverage in remote areas mandate robotic self-reliance. Equipped with a mesh radio, the USV can be teleoperated from a control station. With more than 5 hours of battery life, it can map surroundings with radar and stream live video of operations, while navigating at 10 mph.

Block Diagram



Software

USV control software utilizes a system of nodes defined under Robot Operating System (ROS) to control peripheral, process data, and communicate with the control station. ROS nodes communicate by publishing and subscribing to user defined topics. Nodes written with Python and C++.



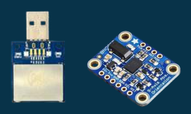
Hardware

Quantum Q24C Radar
Gathers 360 degree point cloud (250 spokes) of the environment ranging from 1/16 to 24 NM

Raspberry Pi 4B
USV's onboard computer that runs ROS nodes for hardware drivers, socket communication, navigation, and signal processing

mini Mesh Rider Radio
Streams video, telemetry, and radar data to the control station from 2+ km

Blue Robotics T200
Two powerful thrusters propel the USV at 10 mph and enable zero radius turning

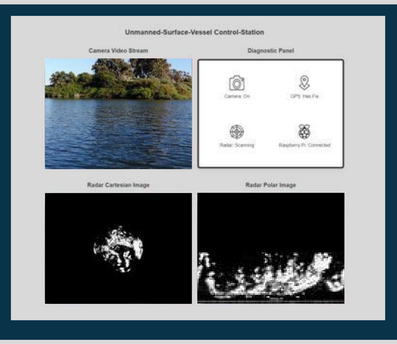


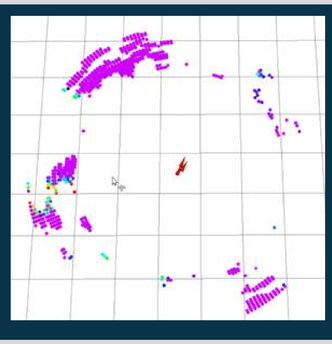
NEOM8 GPS and Adafruit IMU
Sensor fusion of acceleration data and GPS position provides localization of the USV for map-making

Mapping

Radar point clouds are collected from different positions and composed to form larger maps.

Control Station / SLAM Simulation





Acknowledgements

Dr. Yogananda Isukapalli, Dr. Phil Tokumaru, Eric Hsieh, Ryan Friedman, Matthew Fehl

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