Unmanned Surface Vessel
Contents

• Mission

• Technology

• Progress
Mission

• Map and survey coastline using an easily deployable unmanned surface vehicle
  ◦ Erosion and coastal stability, disaster preparedness/response, maritime navigation and safety, military reconnaissance
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• Additional Challenge
  ◦ Enable safe autonomous navigation to tolerate unreliable communication
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  ◦ Radar based SLAM (Simultaneous Localization and Mapping)
  ◦ Relay telemetry (video/images/coastal topography)
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• Why radar?
  ○ Newer solid state radar provides short to long range detection with lower power consumption
  ○ Functions in poor weather and is cheaper and more reliable than other systems (LIDAR)
Block Diagram

Drone

- GPS
  - Ublox NEO-M8
- Radar
  - Quantum 2 Q24C
- SBC
  - Raspberry Pi
  - SC0195(9)
- Camera
  - Arducam IMX291 1080P
  - 120° wide angle
- Electronic Speed Controllers
- Thrusters
  - Blue Robotics T200
- Radio
  - Doodle Labs RM-2450-12M3

Control Station

- Laptop
- Radio
  - Doodle Labs RM-2450-12M3
Propulsion

- Blue Robotics T200 Thruster
  - 2x counter-rotating
  - 23.2 lb ft
  - Nominal power: 400W
    - 17A @ 12V
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- Blue Robotics Basic ESC
  - 30A limit
  - May need active cooling
Power

- Power elec. supply
  - 22.2 V, 22 Ah
  - Thrusters and radar
  - Expected 1 hr capacity
Power

- **Power elec. supply**
  - 22.2 V, 22 Ah
  - Thrusters and radar
  - Expected 1 hr capacity

- **Auxiliary supply**
  - 2x 12V, 3.8 Ah
  - Raspberry Pi, GPS, camera
Physical Design
Physical Design
Physical Design

• Control
  ○ Differential thrust
  ○ Targeting 3 knots
RASPBERRY PI 4B

Working Components

• Runs ROS2 on Ubuntu Linux
• ROS packages include:
  ◦ radar, radio, camera, and thruster
• Runs DHCP
  ◦ Used to assign radar IP, connected via RJ45
Working Components

- Simple USB Connection
  - Accuracy Issues
- 2.5m theoretical resolution
- 15m practical resolution
- Issues Requires Line of Sight (LOS)
Working Components

- Ethernet interface
  - UDP unicast
  - UDP multicast
- 250 spokes per scan
- ros2 run radar quantum
- Auto detect, keep alive
Working Components

- Connects via USB
- 120° Wide Angle
- IP67 Certified
- `ros2 run video_stream video_publisher`
Working Components

- USB-C / Ethernet Connection
- Duplex data stream
- 2.4 GHz Band
- Range ~10km @ 100 Mbps
- Successful at 2km, until loss of the LOS
ROS Graph
Progress Updates

Fall ‘23

- Hardware Acquisition
- Component Testing
- DevOps Setup
- Learning ROS
Progress Updates

Fall ‘23
- Hardware Acquisition
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Winter ‘24
- UDP Communication
- Boat Assembly
- ROS Package Structure
- Control Station Design
- Hardware Mounting
Progress Updates

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- Hardware Acquisition
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Winter ‘24
- UDP Communication
- Boat Assembly
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- Hardware Mounting

Spring ‘24
- Refine ROS Nodes
- Control Station GUI
- SLAM
- Testing
ACKNOWLEDGEMENTS

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