TEXAS A&M UNIVERSITY Engineering

Disaster Response Observation Network (DRON)

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Problem Definition

The Disaster Response Observation Network (DRON) is a proof-of-concept initiative that aims to leverage unmanned aerial vehicles (UAVs) to gather intelligence during structural fires to aide first responders in their scene assessment.

Methodology

Autonomous swarm functionality allows DRON to assist in emergency situations with minimal required human input. DRON is designed around ease of use, speed of deployment, and quality of data gathered and presented.

Functional Requirements

- A network where each individual node can function independently of each other for redundancy.
- Analysis and processing results sent back to a centralized ground control station (GCS) for interpretation and use by responders.
- Ability to display hotspots on structures by utilizing 3d point clouds to model surrounding hazardous areas.
- Ability to carry payload of over 500g while maintaining flight at 100.00 ft.

Mechanical

- Optimized the chassis design to include:
  - An updated design for a smaller battery, new telemetry modules, and sensors
  - More efficient spatial management for components and wires
  - An even distribution of weight to allow for stable flight

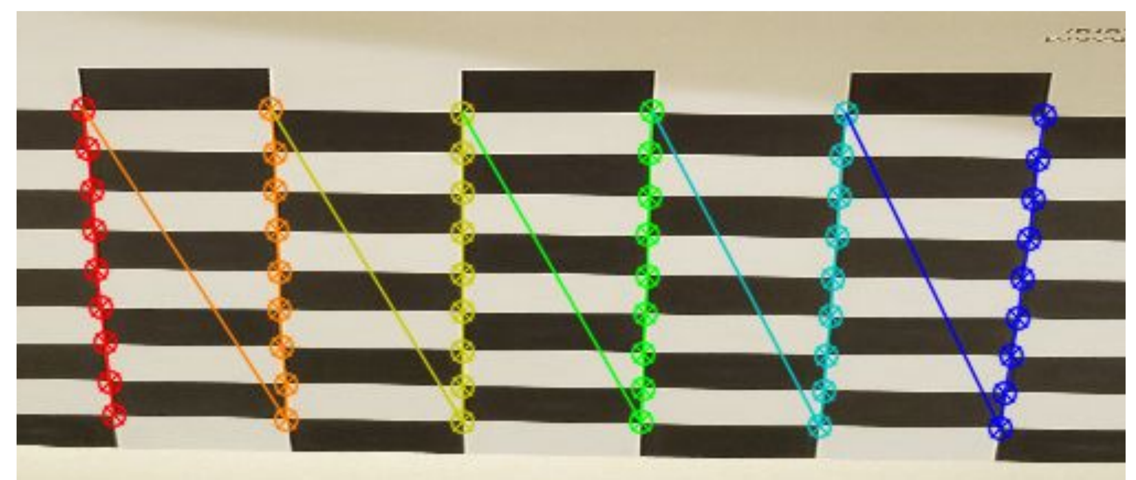

Figure 1. Camera calibration test

Thrust and Weight Distribution

Due to payload masses, each agent must be capable of generating a thrust to lift 500 grams.

Initial thrust tests determined each rotor produced ~750g of thrust, or approximately 3000g per UAV. Following these measurements, the layout of the components were chosen to carefully distribute the weight for safe flight.

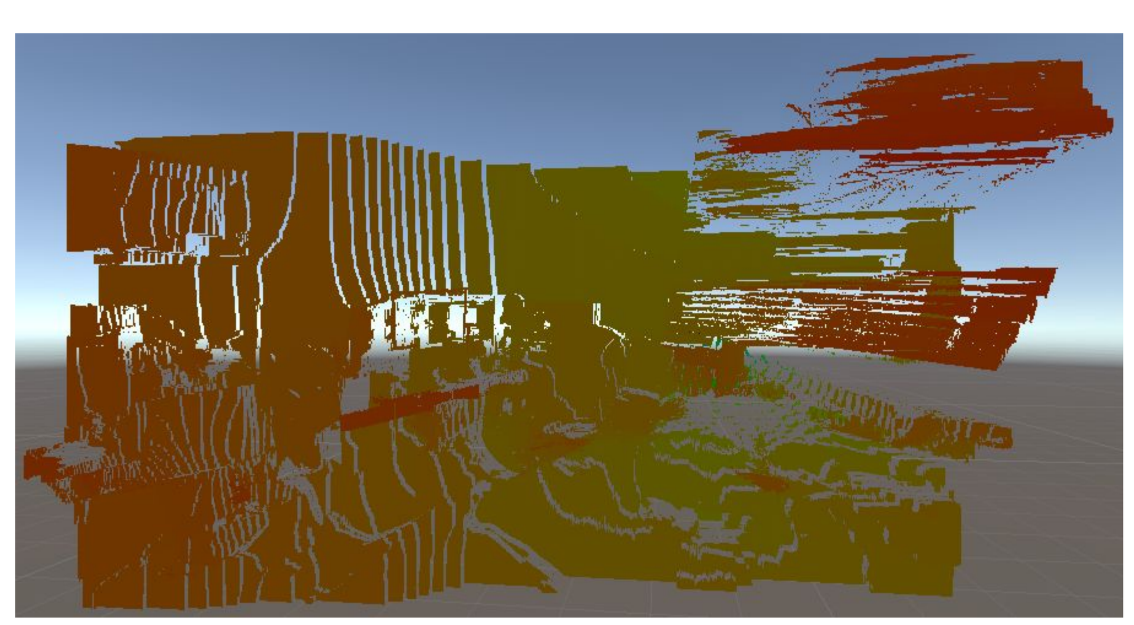

Figure 2. Point cloud projection in Unity

Software

In addition to managing coordination between components, two additional major tasks to approach included hotspot detection and 3d mapping.

The modules applied to tackle this included:

A. **ROS2 Humble:** Open-Source Framework to handle communication between nodes.
B. **Senxor:** Proprietary library to interface with the thermal camera to gather video feed.
C. **Open CV:** A common framework for a variety of Computer Vision applications. Here it was also used for creating Depth Maps from Stereo Images to generate the 3d point clouds.
D. **Unity**: On the graphical side, unity was chosen for its efficient and verbose 3D visualization functionality.

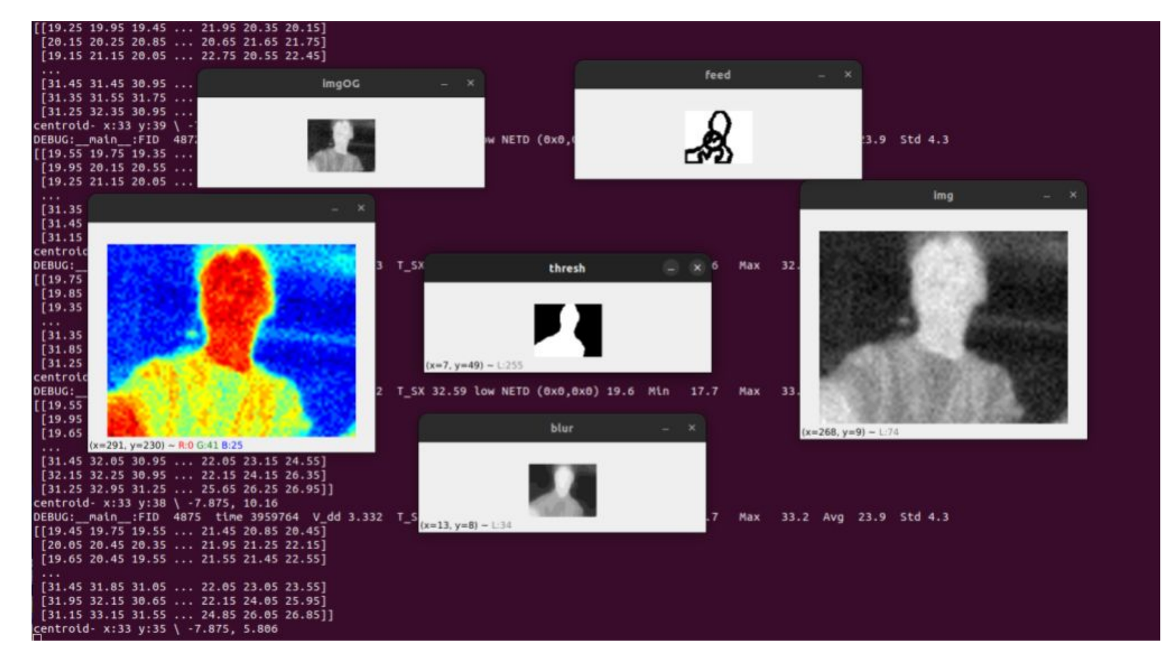

Figure 3. Thermal Camera heatmap output with OpenCV

Electrical

Configuring Mission Planner as the centralized GCS for use with the Pixhawk 4 flight controller, as well as the holybro 4-in-1 ESC to interface with the four propellers and the power distribution system.

The GPS is configured to map the UAV in real time, and the 3DR Telemetry module enables communication for flight commands.

The battery selected is rated for 720mAh, and while running all motors at full thrust would last ~3 minutes.

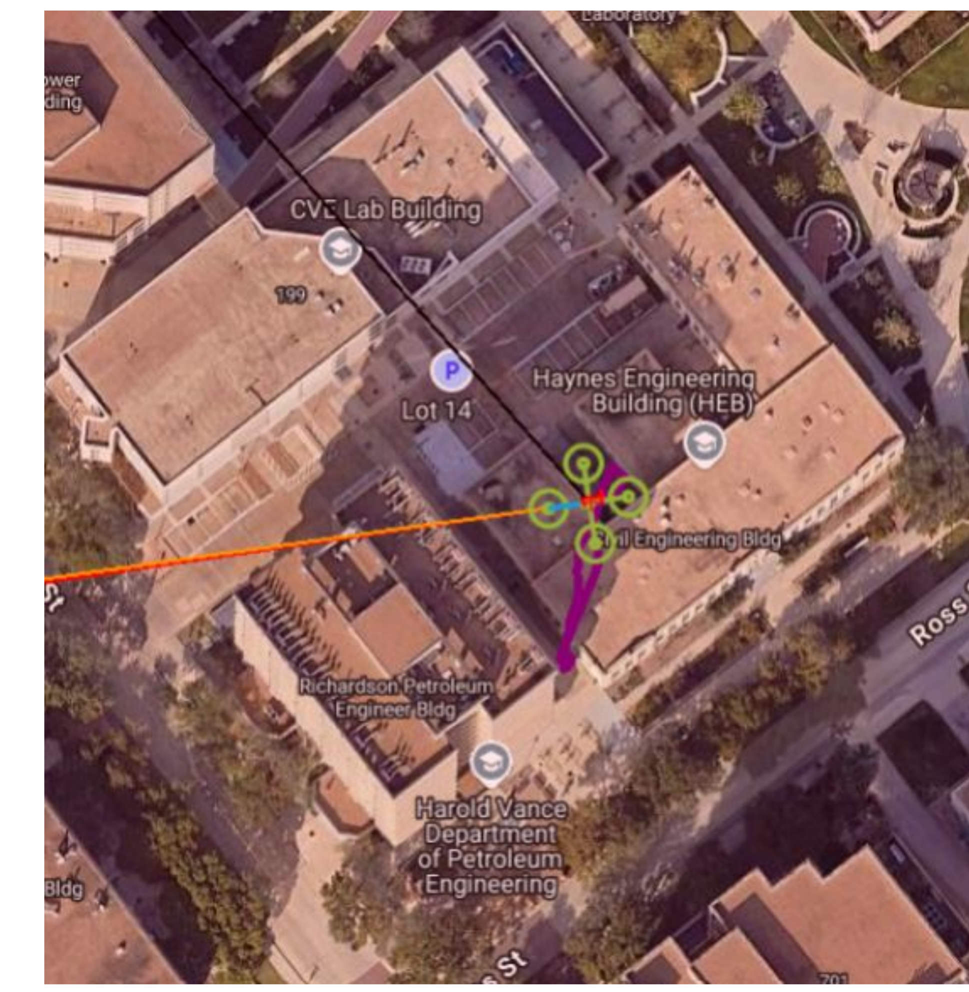

Figure 4. Mission Planner UI with GPS connection

Next Steps:

Our team plans to continue to refine and improve our project, augmenting and polishing current tools while introducing new technologies and functionality.

Mechanical: Finalize chassis design with capacity to carry full range of electrical components and achieve more aerodynamic efficiency.

Software: Implementation of dynamic path planning and swarm network intelligence.

Electrical: Handle autonomous flight control and pre-subscriber nodes of ROS2.

Scale: Lower the cost to enable larger swarms, testing ground station multi agent path planning.

Texas A&M University Robotics Team and Leadership Experience (TURTLE) Lab