Disaster Response Observation Network (DRON)

TEXAS A&M UNIVERSITY Engineering

Project Lead: Ian Wilhite

Members: Aidan Briggs*, Jacob Fuerst*, Elizabeth Hannsz*, Alan Alvarado, Quinn Belmar, Malcolm Ferguson, Jason Lev, Brian Russell, Swayam Sakpal, Nahum Tadesse

TEXAS A&M UNIVERSITY ROBOTICS TEAM & LEADERSHIP EXPERIENCE

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 and emergency response.

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.
- Data transmitted to a centralized Ground Control Station (GCS) for interpretation and use by responders without a technical background.
- Ability to display hotspots on interactive 3d structures to model surrounding hazardous areas.
- Ability to carry payload of instrumentation (~500g) while maintaining flight at ~100 ft long enough to appropriately gather critical data.

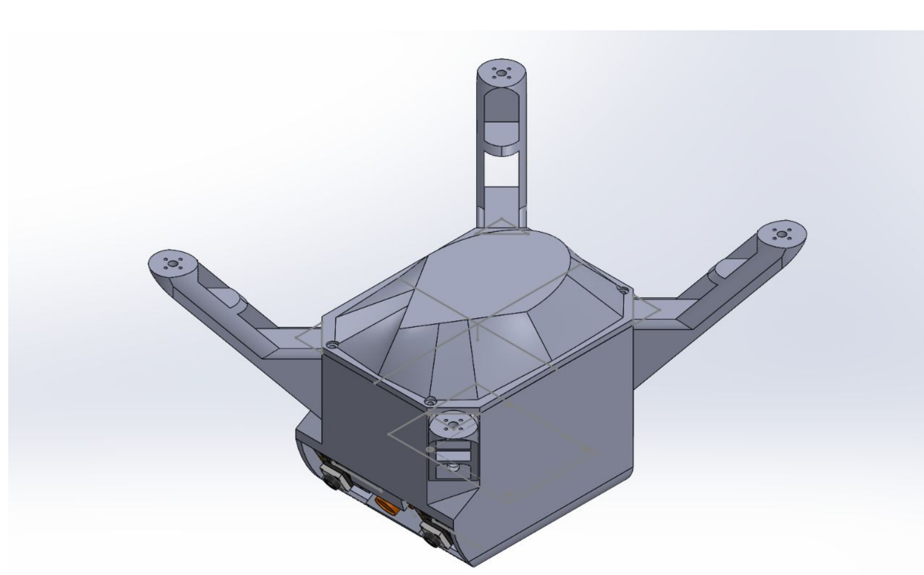

Figure 1. Updated Chassis

Mechanical

Optimized the chassis design to include:

- An updated design for a smaller battery, new telemetry modules, and additional cameras.
- A larger internal volume and more efficient spatial management for components and wires.
- Proper positioning of cameras to support stereo vision while maximizing internal volume.
- An even distribution of weight with a low center of mass to allow for stable flight.

Thrust and Weight Distribution

Due to payload masses, each agent must be capable of lifting 500 grams and maintaining an altitude of 100ft for 3 minutes.

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.

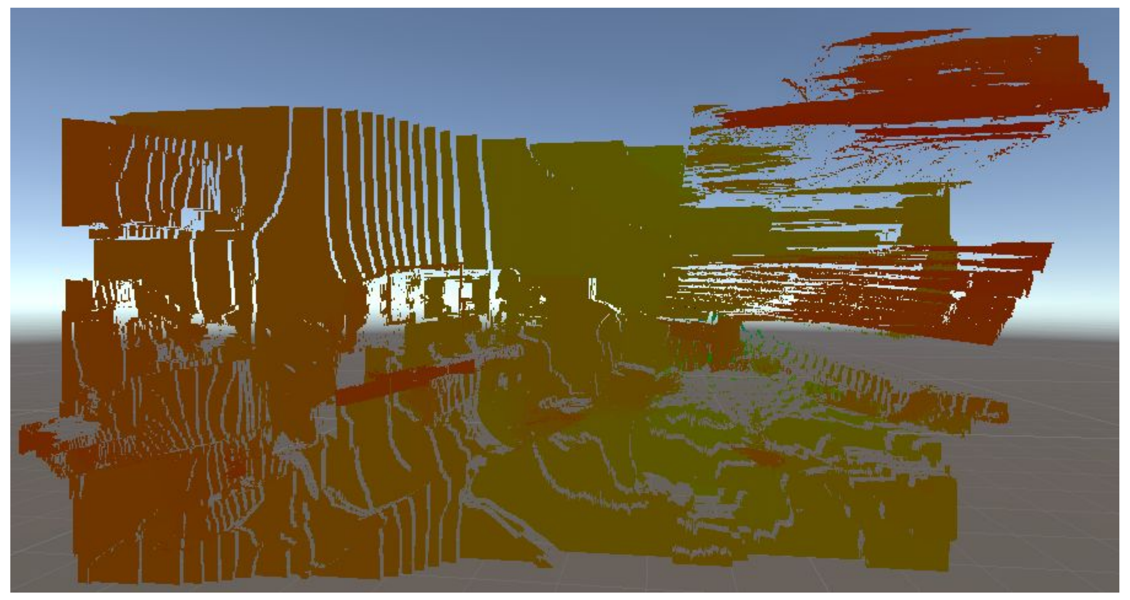

Figure 2. Point cloud projection in Unity

Software

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

The modules and libraries applied in the task of gathering, processing, and visualizing the

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.

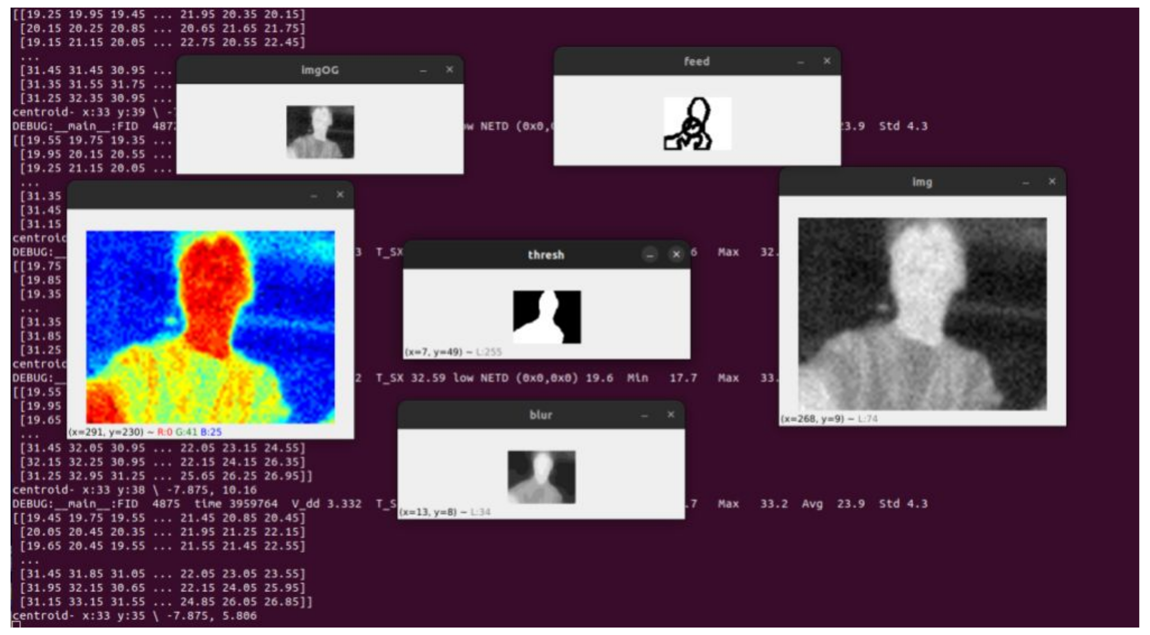

Figure 3. Thermal Camera heat map output with OpenCV

Electrical

Configuring Mission Planner as the centralized Ground Control Station (GCS) for use with the Pixhawk flight controller, Electric Speed Controller (ESC) to interface with the propellers and 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.

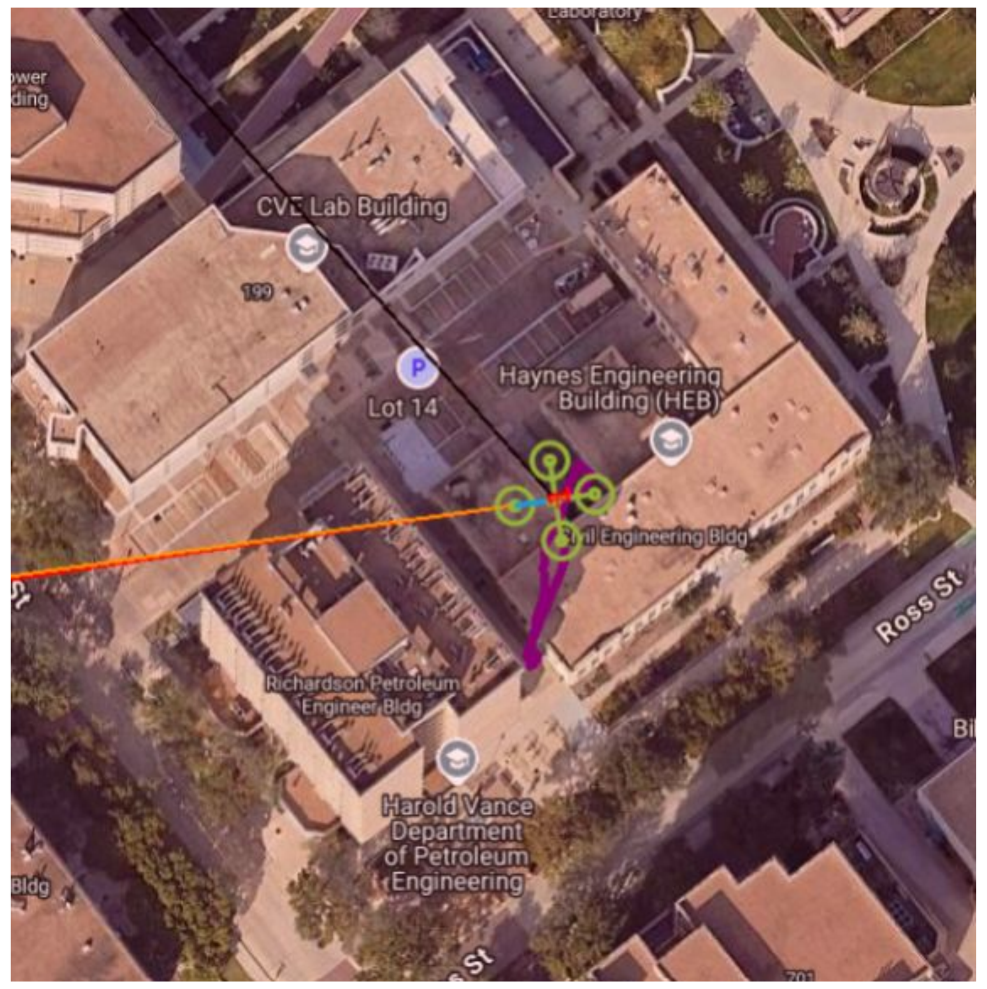

Figure 4. Mission Planner UI with GPS connection

Next Steps:

The next steps for the project involve streamlining flight controls for multiple UAVs at once,

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. Visualization of temperature data in real time on a 3d object

Electrical: Handle autonomous flight control through Mission Planner through Ardupilot, establish onboard computer publisher nodes.

Scale: Lower costs to enable larger swarms, test ground station multi agent path planning, networking limitations.

Testing: Obtaining FAA licenses for an autonomous systems test with a reasonable structural fire analog.