Emergency Rescue UAV Payload Development

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Background

In Alaska, around 500 Search and Rescue (SAR) operations are conducted each year, using approximately 30,000 man-hours. Alaska's unique environment including vast wilderness, dense forests, and harsh conditions makes SAR operations very challenging and significantly reduces survival time for missing persons.

Our project, the Field Integrated Navigation and Detection for Emergency Rescue (FINDER) sensor kit, is an unmanned aerial vehicle (UAV) payload that will assist and partially automate these SAR missions by detecting signs of individuals from above.

Imaging

As Alaska is dark most of the year, we are focusing on using low-cost thermal cameras for imaging. Our system utilizes the FLIR Lepton 3.5, a small thermal camera that can be found in some cellphones. This is combined with a FLIR Blackfly S optical camera provides good visual information in well-lit conditions.

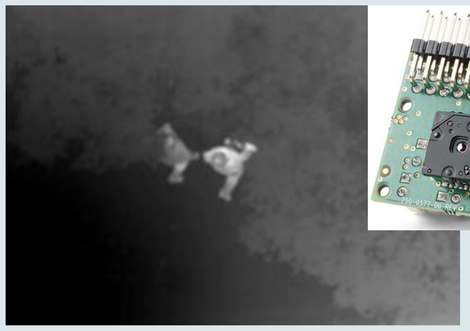

Figure 1: Two Individuals as seen from above with a thermal imaging camera. Photo credit: U. Ozyurt, (2023) International Informatics and Software Engineering Conference

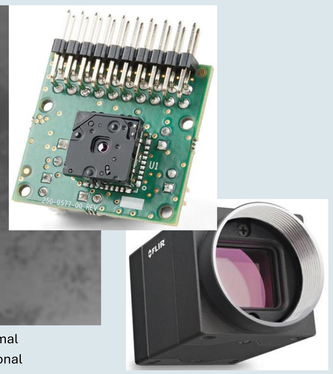

Figure 2: FLIR Lepton 3.5 Thermal Camera (Top) and the FLIR Blackfly S optical camera (bottom). Photo credit: flir.com

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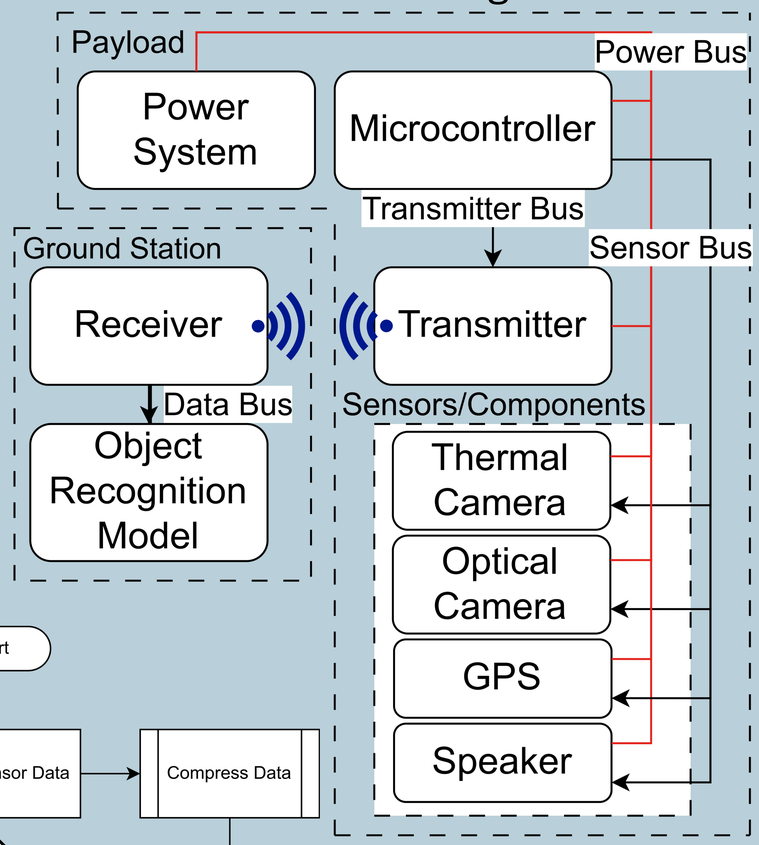
System Design

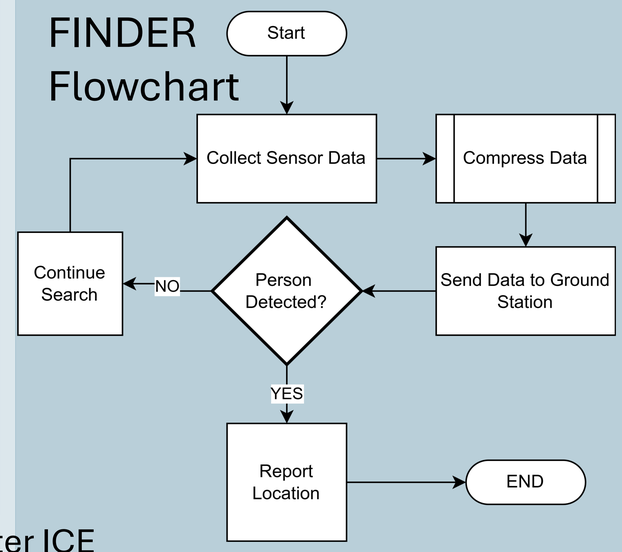
The project involves designing a payload for a UAV for SAR operations. The sensor kit combines thermal and optical cameras to detect people in various conditions. The thermal camera we are using is low quality, so we will combine the output of multiple with a method called Synthetic Aperture Imaging. We also plan to use an object recognition model to increase reliability and provide scalability to the system.

To the right is the block diagram of the system. This shows the physical components and connections of our system.

FINDER Block Diagram



FINDER Flowchart



To the left is the flowchart, which shows the process and decisions our system makes.

Object Recognition

On the ground station, FINDER utilizes a machine learning algorithm YOLO (You Only Look Once) to analyze the data sent in real time from the thermal and visual cameras onboard the UAV. This algorithm analyzes the frames only once so real-time detection of individuals is possible. This system will automatically notify the user when it detects a possible person eliminating the need for constant video surveillance allowing teams to focus on planning and coordinating other portions of the rescue operation.

Figure 5: YOLO detection as seen from above. Photo credit: Sergio Lo Caputo, (2022) Lecture Notes in Computer Science, 13196

Testing

To test the sensor kit, we are repairing a drone from the aerospace lab. This will allow us to test the FINDER sensor kit under actual flight conditions.

Conclusion

Our plan is to have a working and tested sensor kit by May for our Senior Design capstone project. Currently, we are working on integration of the sensors with the microcontroller and aim to start testing soon.