

Objective

To capture thermal infra-red (TIR) images with accompanying geolocation data to produce temperature maps of large areas by integrating the high-precision Optris PI-640 thermal sensor with a drone.

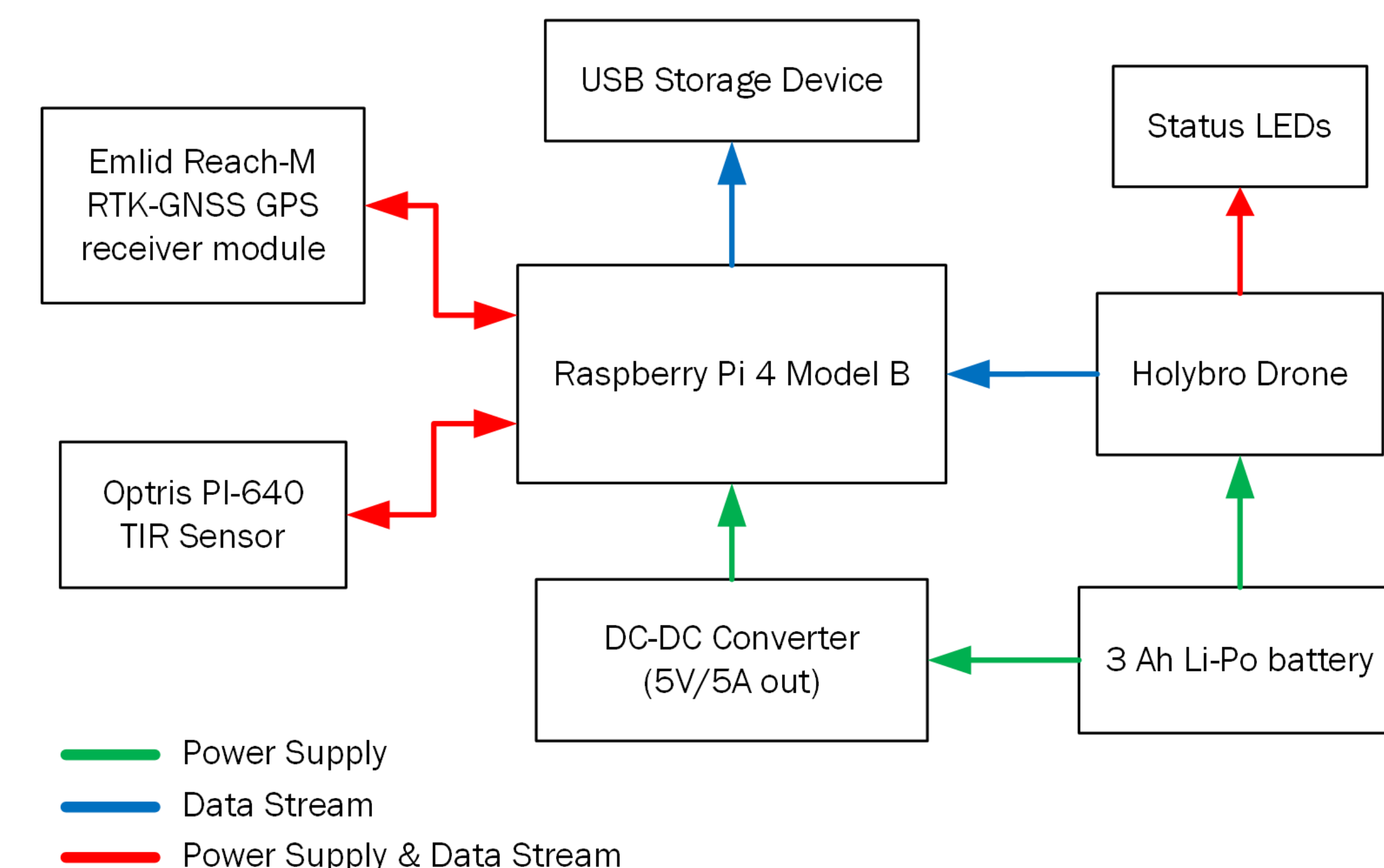


Background and Value Proposition

Our goal is to integrate the provided Optris PI-640 thermal sensor into a drone that will capture thermal infra-red (TIR) images with accompanying geolocation data, which is stored and processed to produce relevant temperature maps. These detailed maps will be analyzed to visualize temperature variations over large areas, which allow for estimations to be made regarding various environmental challenges and give scientists a favorable position to find solutions on several issues.

Key Requirements

- Added weight must not exceed 1500 g.
- Drone and camera must be operable for ~30 min (1 flight).
- Implemented software must be able to integrate relative GPS data into image headers to ensure a sufficient thermal map.
- Additional components must fit within usable space on drone without weight imbalance.



Connection diagram of all components.

Concept Development

- Requirement Gathering
 - The drone must be integrated with the thermal camera, a GPS module, and way to store the recorded data.
- Physical Integration
 - The 3D-printed camera mount connects to the rails of the main frame of the drone and points the camera in the correct direction. The other components attach to a 3D-printed plate that mounts to the top of the drone.
- Program Design
 - The program that coordinates the physical components and data flow is written in Python and runs on a Raspberry Pi 4B. The program records the temperature data from the infrared camera and the GPS coordinates for each image capture.

Final Design



Final configuration of drone with all components mounted.

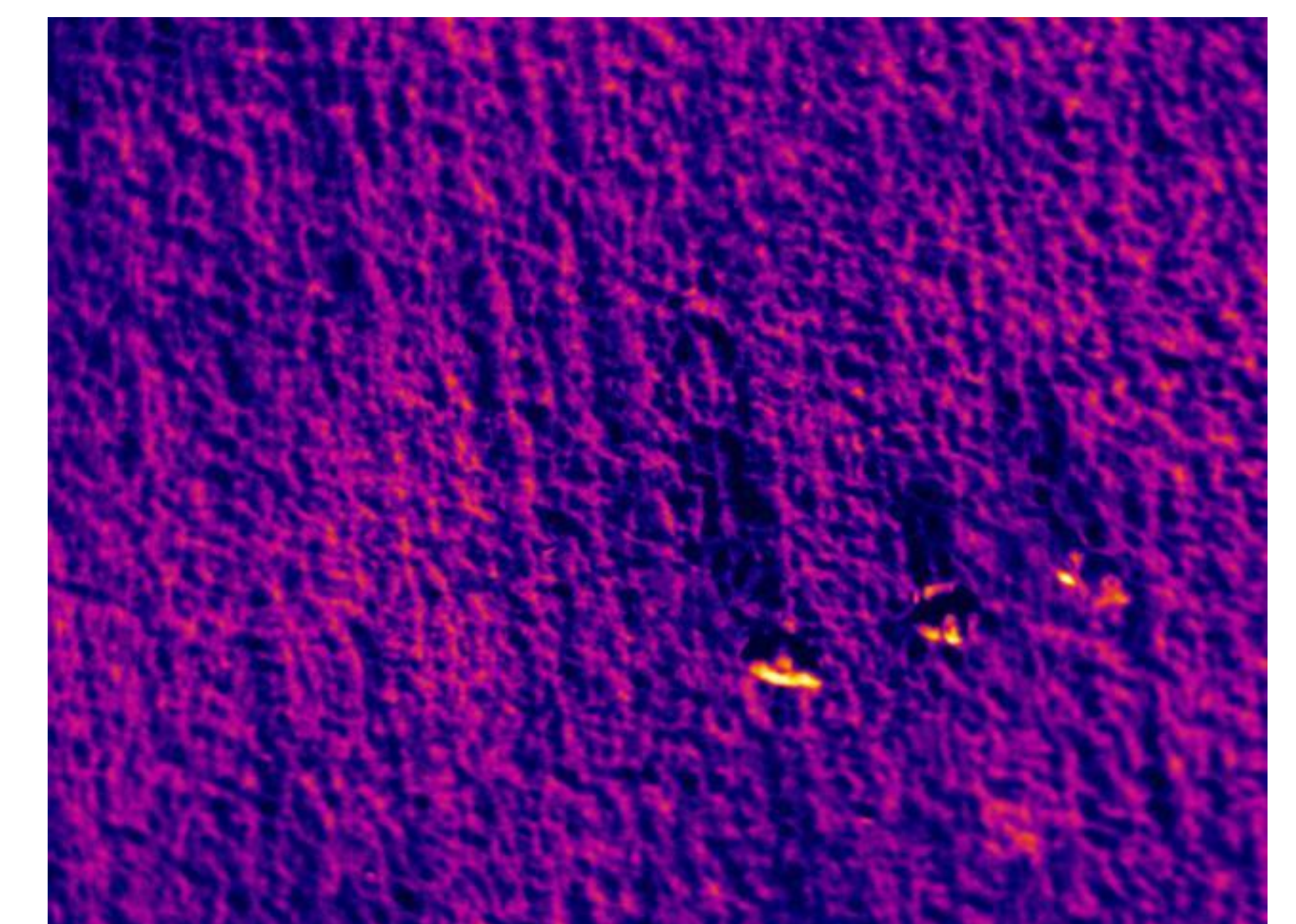
Acknowledgements

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 Lead Instructor: Bruce Bolden



Validation

- First Phase:
 - Test flights to check that the data is being recorded correctly.
- Intermediate Phase:
 - Verify that the post-processing application can generate normalized images from the data.
- Final Phase:
 - Ensure that the generated images can be combined into a coherent map of the imaged area.



Thermal image taken at Guy Wicks Field on campus.

Summary

We successfully integrated the Optris PI-640 thermal sensor with the Holybro drone kit, along with a Raspberry Pi 4B and an Emlid Reach GPS unit to create a prototype thermal imaging drone. Our concept development plan provided positive results, however further development is needed to optimize the GPS data from the Reach unit for generating accurate thermal maps.