ELC 495 Design Review 2

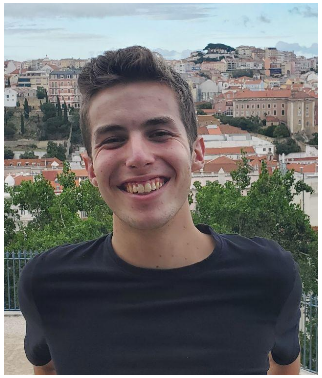
Autonomous Drone
with Thermal Imaging Capabilities

Fall Semester 2022

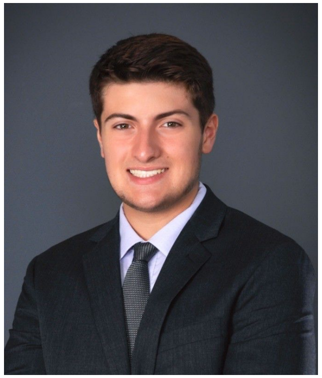
Advisor: Dr. Deese

Team Members

Sean Burtnett



Mike Bond



Jack Delvecchio

Darion Parks

Agenda

- Goals/Detail Specifications
- Project scalability
- Project Plan
  - Roles
  - Task Details
- Project Status
  - Schedule/Budget
  - Open AIs
- Summary

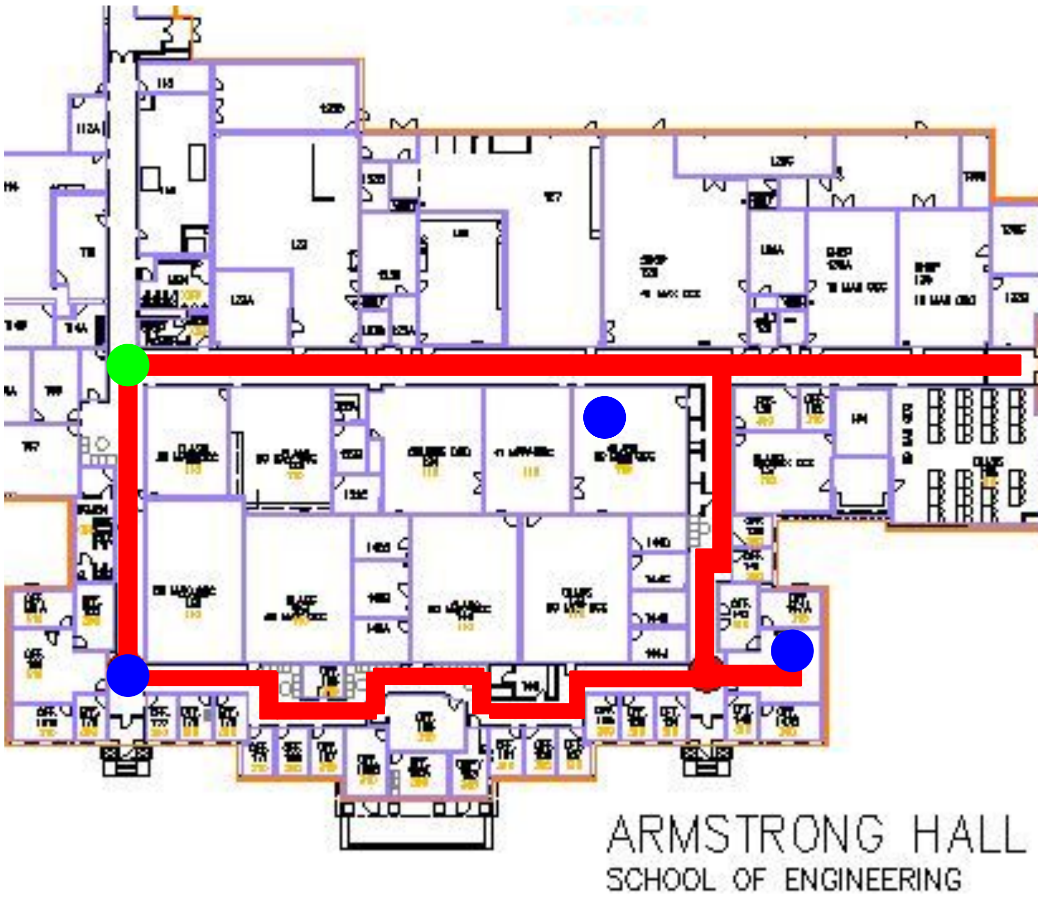
Goals/Detailed Specifications

- Goal
  - Build a quadcopter for the purpose of autonomously maneuvering in an indoor environment to relay data on thermal recognition to the user
  - Create highly documented guidelines on drone assembly for future senior project groups
- Detailed Specifications
  - A run will be deemed 'successful' if the drone can:
    - Maneuver through a doorway of size 30" x 80"
    - Export a thermal visual to a computer screen for human vision
    - Search an entire room with a minimum size of 100 sq. ft
    - Have zero collisions with objects along the route
  - Quadcopter approx dimensions
    - Height: 8in, length: 12in, width: 12in

Goals/Detailed Specifications

- Starting Point
- Human

**This is a potential test case



Project Scalability

1) Limited testing to indoor only
2) Thermal recognition will create a real-time thermal video (no human detection via drone required)
3) Scaled down specifications
4) Using Ardupilot (open source flight control)

**By adding these constraints, the drone assembly and thermal testing phase can be shorted, allowing more time for object detection

Project Plan: Roles

ALL

System architecture, part selection, drone construction

Sean (Software)

Raspberry Pi and Pixhawk interfacing, Flight Control

Mike (Software)

Indoor Traversal, Flight Control

Darion (Hardware)

Flight Control Hardware

Jack (Hardware)

Proximity and Thermal Sensor Design

Project Plan

First Semester (Fall ‘22)

Task 1: Define the System Architecture

Task 2: Develop Website

Task 3: Select/Order Components

Task 4: Drone Assembly

Task 5: Modify Flight Control for Autonomous Capability

Task 6: Implement the Thermal Sensor

Task 7: Simple flight and Thermal Recognition Testing

Task 8: Documentation

Project Plan

Second Semester (Spring '22)

Task 1: Implement the Proximity Sensors

Task 2: Develop Website

Task 3: Modify Flight Control for Obstacle Detection

Task 4: Indoor Testing and Proximity Sensor Testing

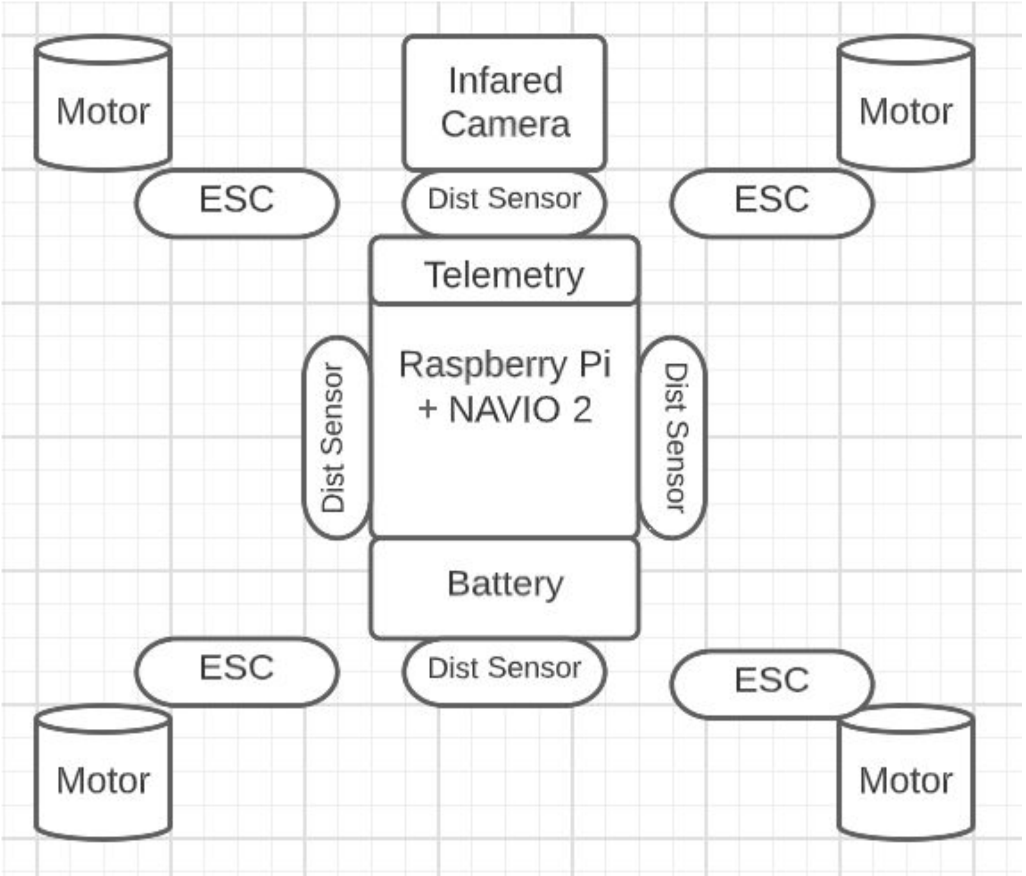
Task 5: Documentation

Project Plan: Schedule

Task	TASK TITLE	START	END	LENGTH OF TASK	PCT OF TASK DONE	Phase 1: Preliminary Design					Phase 2: System Integration					Phase 3: Testing/ Evaluation			
						1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	System Architecture	8/31/22	9/28/22	4	100%														
2	Develop Website	9/21/22	12/6/22	11	30%														
3	Select/Order Parts	9/7/22	10/5/22	4	100%														
4	Drone Assembly	10/5/22	10/26/22	2	0%														
5	Modify Flight Control	10/12/22	11/9/22	4	0%														
6	Thermal Sensor	10/12/22	11/9/22	4	0%														
7	Flight Testing	11/9/22	12/6/22	4	0%														
8	Documentation	8/31/22	12/6/22	14	40%														

Task 1: Define the System Architecture

- ESC = Electronic Speed Controller
- Telemetry = Receiver/Transmitter
- There will be 6 distance sensors
- There will also be a power module and a PPM encoder
  - PPM Encoder converts the flight control output into a signal for the ESC



Task 3: Define the System Architecture
- Compare Flight Controllers

	Navio2	Pixhawk
Price	$200	$100
Ease of use	Known to be buggy	Good documentation
Hardware level issues	Yes	No
Functionality	High	Low
Used by past groups	Yes	No
Uses Ardupilot	Yes	Yes (easier)

Task 3: Define the System Architecture
- Choosing Microcontrollers

- The Raspberry Pi 2 is commonly used with the flight controllers we are deciding between
- This was also readily available so we are borrowing it to reduce our budget
- The Raspberry Pi is easy to use, runs Linux, and has fast polling/switching (about 10ms)

Task 4: Drone Assembly

- We will order parts soon in order to start drone assembly as soon as the parts become available
- Assemble selected components
  - Test to ensure drone is capable of flight

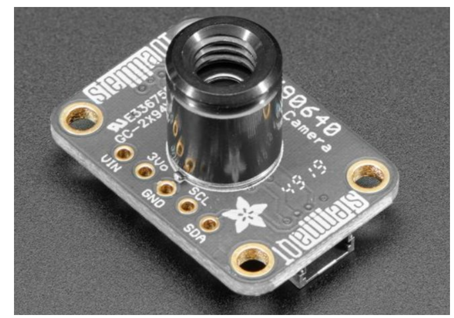
Task 5: Modify Flight Control
-Testing with the Raspberry Pi

- The flight controllers we are deciding between work with Ardupilot
- This is an open source software that has been in use for years and can be adapted to work with our project
- We’re currently familiarizing ourselves with the Raspberry Pi and Ardupilot

Task 6: Implement the Thermal Sensor

- The thermal sensor will be mounted with a fixed orientation
  - The sensor is stationary and the drone will move

Adafruit IR Thermal Camera



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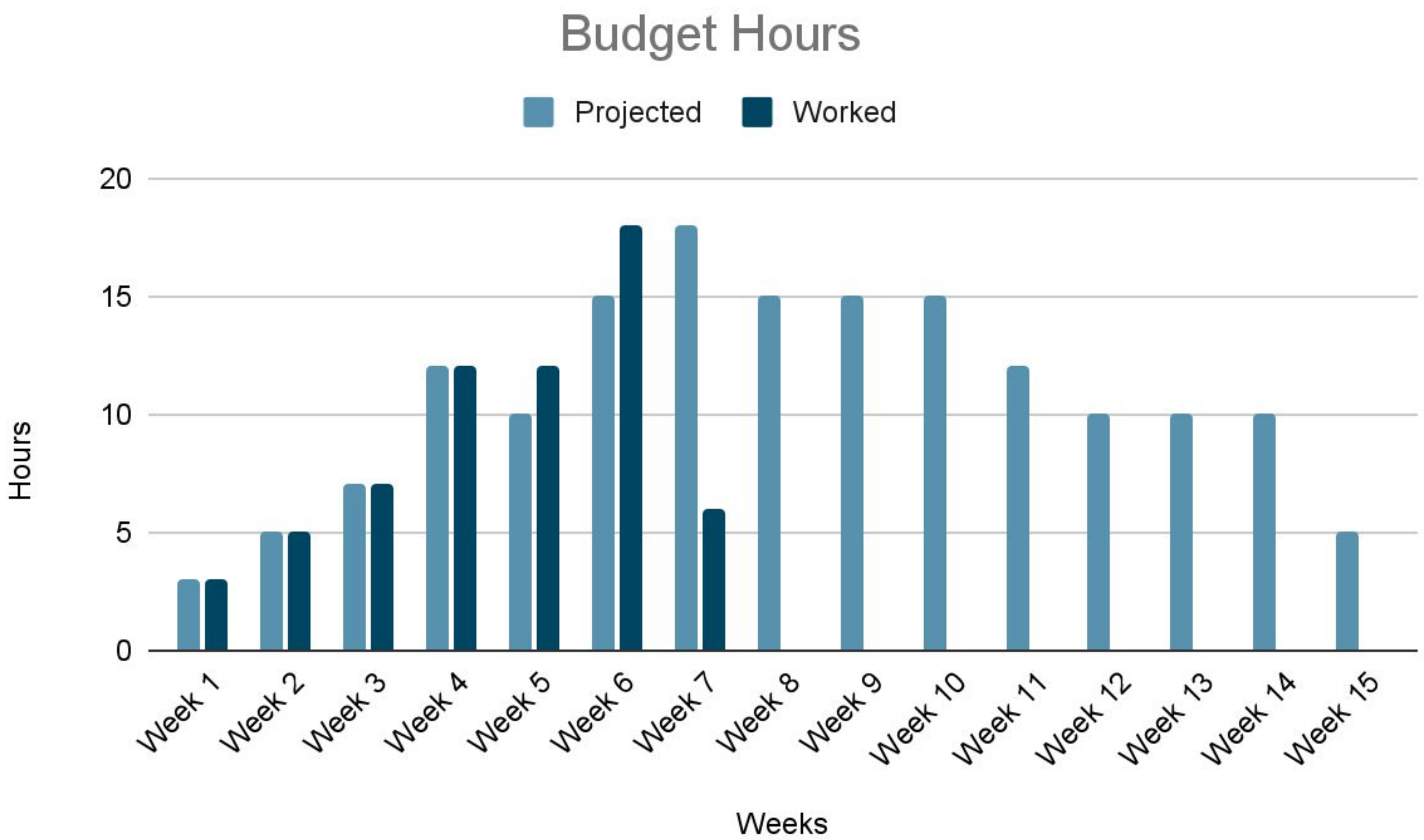
Task 8: Documentation

- Documentation will be done throughout the semester to ensure proper tracking of project progress
  - To be done both semesters

Project Status: Budget

Parts	Cost	Our Price
Raspberry Pi 4 Model B (4 GB RAM)	$134.95	$0.00
Navio2 Flight Controller	$200.00	$200.00
ESCs 4 PACK	$31.99	$31.99
Motors 4 PACK	$51.79	$51.79
Frame	$23.99	$23.99
Props	$14.49	$14.49
Battery	$25.99	$25.99
Battery Connector	$8.99	$8.99
Battery Charger	$41.99	$41.99
Micro SD Card	$5.99	$5.99
Micro SD to USB	$6.99	$6.99
Velcro Straps	$9.99	$9.99
Scotch Mounting Tape	$13.95	$13.95
Zip Tie	$5	$0.00
Telemetry	$97	$97
PPM Encoder	$18.99	$18.99
Vibration Plate	$8.00	$8.00
Ultrasonic Sensors x6	$122	$122
Sensor Adaptor Cables	$10	$10
Thermal Sensor	$150	$150
Total	$982.09	$842.14

Project Status: Budget



Project Status: Open AIs

- Decide between the Pixhawk and NAVIO2 for flight control
- Order Parts
- Add to our website

Summary/Conclusion

- We have scaled down the project goals
- We are deciding between parts to order and looking for ways to reduce our budget

Questions?