



INFRASONIC WILDFIRE DETECTION AND REPORTING



A FIRE FINDERS AND STANLEY SOLUTIONS COLLABORATION

2023 CAPSTONE PROJECT



OBJECTIVE

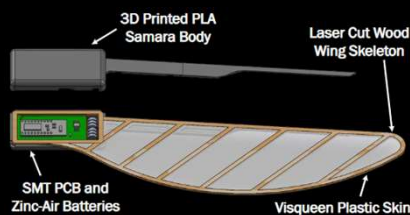
- Create a system of Low-Cost, Low-Power Devices that can Detect and Report the Occurrence and Location of a Wildfire Event from the field.

VALUE PROPOSITION

- On Average, Wildfires impact over 7.2 Million Acres annually, harming communities, ecosystems, and lives.
- Our Devices can identify Wildfires by the acoustic sound they produce, Reporting the event and Location to First Responders, long before traditional methods.

PAST WORK

- Past Teams prioritized Samara Leaf Payload and Testing
- Designed PCB boards for signal Filtering, Radio, and GPS.
- Per unit cost of \$32 and Battery life of 24hrs.



OUR GOALS

- Reduce Unit Size and Cost.
- Estimate and Visualize Wildfire location.
- Extend the working life of Device.
- Create Mesh Network .

THE FIRE FINDERS

- Kurian Georly Kunnathushery (CS)
- Abdalrahman Alhajri (EE)
- Meshari Alhajeri (EE)
- Jiaqi Shi (EE)
- Mairen Chard (BE)
- Jack Lewis (BE)
- Christian Vega (ME)



THANK YOU

Lead Instructor: **Dr. Herb Hess**

Grad-Mentor: **Sebastian Garcia**

Client: **Joe Stanley**



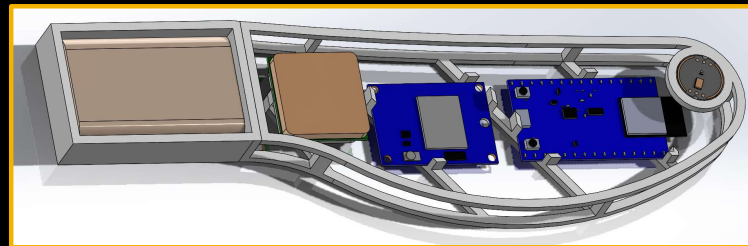
CONCEPT DEVELOPMENT

- Further Research indicates Wildfires exhibit Frequencies within 0-500Hz, emphasis at 250 -400Hz.
- This information allowed us to choose a simple, cost-effective Microphone, not needing to detect infrasonic frequencies.



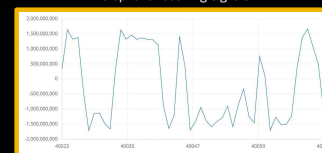
SAMARA LEAF DELIVERY

- Redesigned to simplify manufacturing and move components to the wing.
- Footprint of approximately 8" x 2".



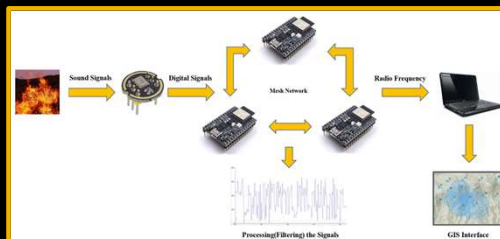
SIGNAL FILTERING

- Designed 3rd Order Butterworth bandpass Filter to isolate 250-400Hz.
- Cosine matrix, sine matrix, Filter magnitude response stored in header (.h)
- Custom-made functions in C to calculate:
 - Discrete Fourier Transform (DFT)
 - The Magnitude from real/imaginary
 - Output after multiplication with Filter



MESH NETWORK AND SIGNAL TRANSMISSION

- Using the Internal Mesh Development Framework: Devices will relay data between Nodes and Database Using internal Wi-fi protocols and C programming language.



USER INTERFACE

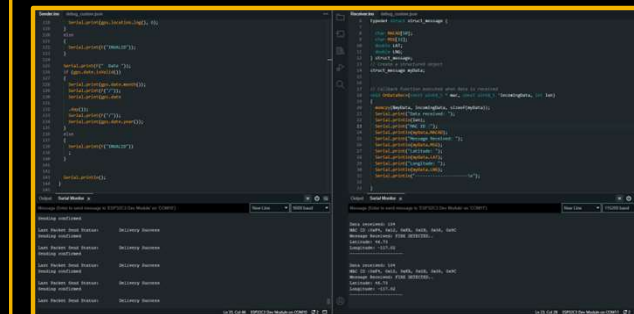
- Utilizing GIS online software; Display locations of each Device and estimated locations of Wildfire Events.
- Fire localization using Time of Arrival (TOA) Method.
- Automated Data updates using ArcGIS Python API; allowing for near-real time data visualization.

DESIGN VALIDATION

- Successful User Interface with Real-Time data and Dashboard updates.
- Successful Mesh Network Node Connections.



SCAN ME



DESIGN IMPROVEMENTS

- Designed User Interface from the Ground up.
- Eliminating PCB Design and Upgraded components reducing price per Unit to \$23.79 a 26% decrease.
- Extended Life of Device by over 300%.
- Identified Pro PLA 3D Printing Filament for Biodegradability.

FUTURE WORK

- Field Testing for Wildfire Frequency Range.
- Investigate use of LoRa Radio Data Transmission.

