Flying Under the Radar

Team A6
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Use Case

Goal

Help identify humans during search and rescue (SAR) missions

MVP

We will build a universal drone attachment to search through fire, fog, and rock with mmWave radar. It will detect humans at a close-range (<20 m) that may not be visible to the naked eye. Upon successful detection, our web application enables the user to save a victim's location so that they can be finally rescued.

ECE Areas

I. Software
II. Signal processing
III. Hardware

User Requirements

Size

Weight

Price

Market
~$3000

Flying Under the Radar
~$520

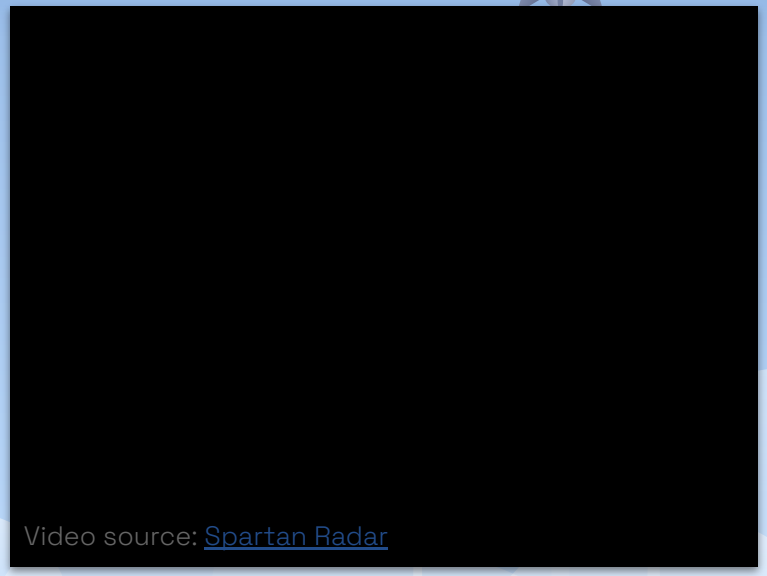
User Requirements

Drone compatible

Safe detection range

Withstands SAR conditions

Overcomes low visibility conditions



Video source: Spartan Radar

Design Requirements

- mmWave Radar (2 ⅝” x 3 ¼”) with Antenna (1 sq. in)
- 2 Watts
- 2000-6000 hours total before breaking
- Detect non-moving people from 5-10 meters
- Detect moving people from up to 30 meters
- Attachable to drone controlled by first responder
  - Coverage
  - Radar can withstand up to 125° C

Design Requirements - Hardware

mmWave radar for scanning area

15 degrees by 50 degrees angular resolution

Able to locate device from GPS/IMU sensor

Minimum 30 minute scan periods

Design Requirements - Software

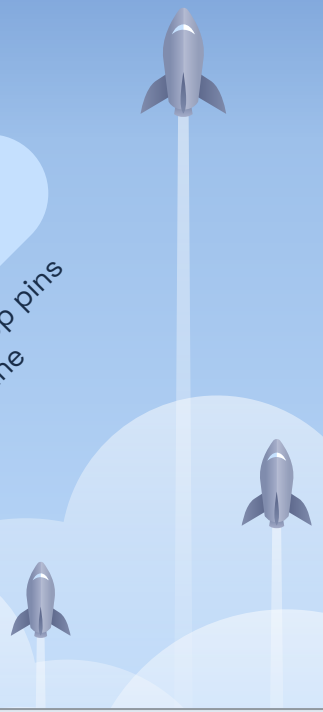
0.7 F1 score for human detection network

Pin victim geolocation

3 seconds end to end

Implementation

1. **Radar**
   Integration of mmWave radar and IMU/GPS sensor with drone, wireless communication to computer vision backend
2. **Computer Vision Backend**
   Train an image processing architecture to detect humans then deploying it with images captured by our own radar
3. **Web Application Frontend**
   Django user interface to drop pins of located victims using the Google Maps API

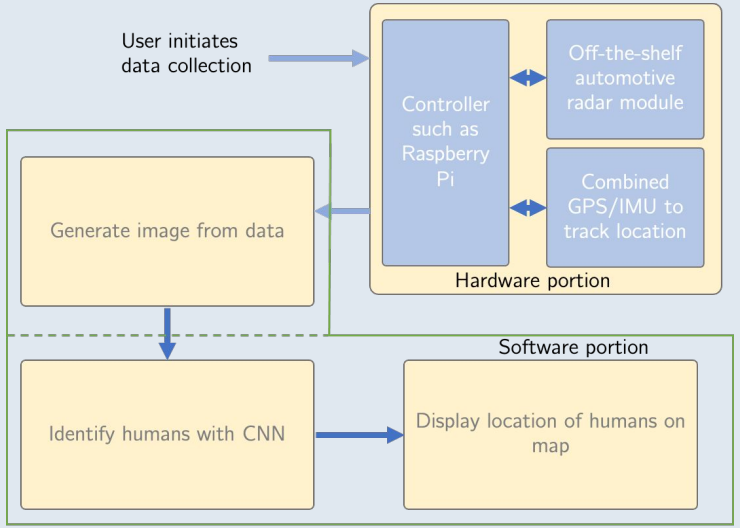


Components

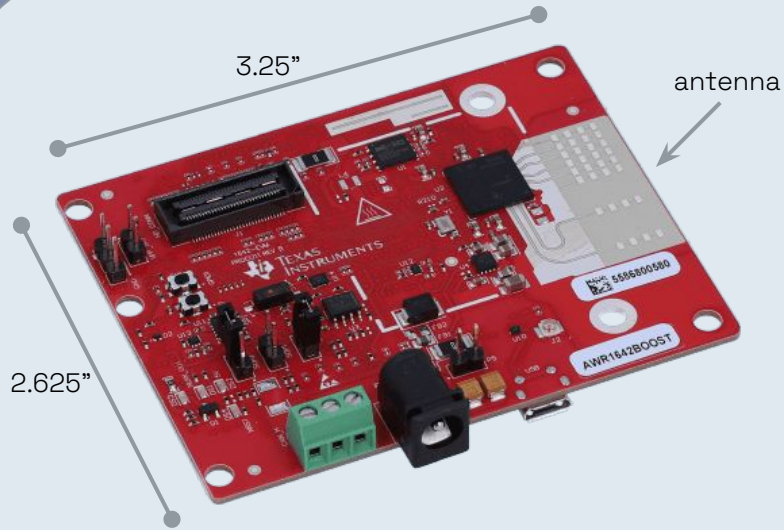
- mmWave radar
- IMU/GPS sensor
- Raspberry Pi
- KUL-UAVSAFE dataset
- Machine learning libraries
- Django
- Google Maps API

Implementation

Drone Attachment



Block Diagram



AWR1843Boost Radar

Test Plan

Radar

Holding the radar still at positions at various distances and determining its ability to detect humans that are completely/partially obstructed with various materials

CV Backend

Using a preexisting mmWave dataset, training various models and comparing accuracies and speeds to determine the best model to detect humans with radar images

Web App Frontend

Determining the speed with which the application can display processed images and drop pin markers to specific locations

All able to occur in parallel!

Tasks and Division of Labor

Angie

Getting the radar functioning and capturing images

Linsey

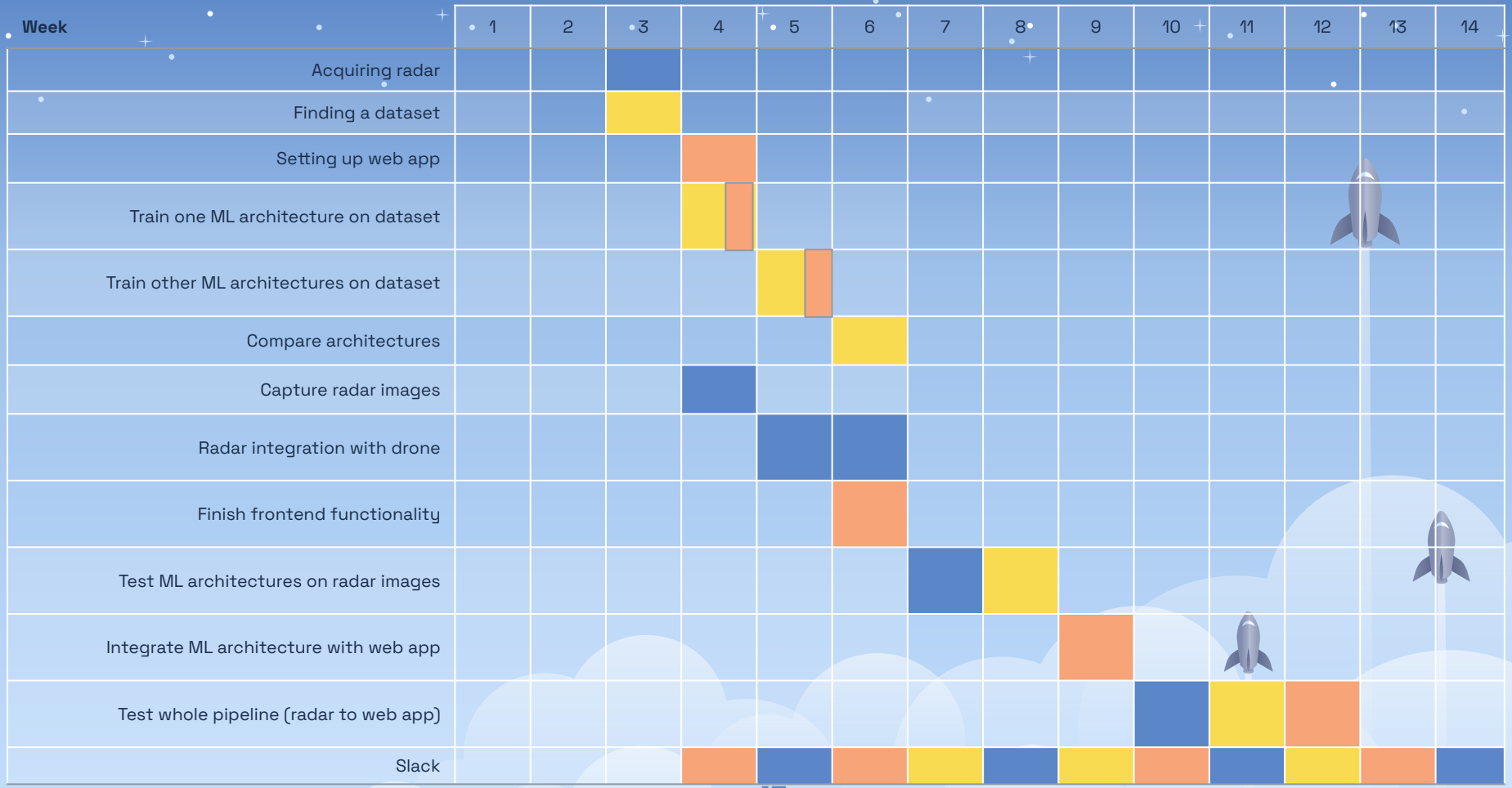
Building and testing the image processing architecture

Ayesha

Designing web application for first responders to keep track of victim locations

Angie specializes in hardware and signal processing, so she will focus on the radar.

Linsey and Ayesha both specialize in software, so after the frontend is complete, both can work to refine the machine learning architecture.


Week
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Acquiring radar
Finding a dataset
Setting up web app
Train one ML architecture on dataset
Train other ML architectures on dataset
Compare architectures
Capture radar images
Radar integration with drone
Finish frontend functionality
Test ML architectures on radar images
Integrate ML architecture with web app
Test whole pipeline (radar to web app)
Slack