

Fire Scout

Drew Sansom

Nick Bollone

Jacob Hagan

Matthew Briody

Kenneth Klawitter





Team Fire Scout

Team Leader



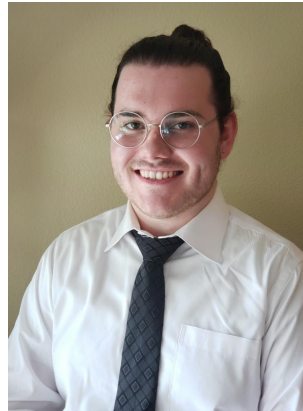
Drew
Sansom

Release Manager



Nick
Bollone

Recorder



Jacob
Hagan

Hardware Researcher



Matthew
Briody

Interface Manager



Kenneth
Klawitter



Mentor

Sambashiva Kethireddy

- Masters student in Computer Science at NAU
- Graduate Teaching Assistant





Client

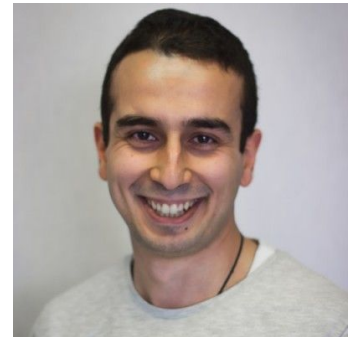
Dr. Fatemeh Afghah

- Assistant Professor, School of Informatics, Computing and Cyber Systems (SICSS)
- Director, Wireless Networking and Information Processing (WiNIP) Laboratory



Alireza Samsoshoara

- Client Assistant
- Ph.D. Candidate At NAU
- Graduate Research & Teaching Assistant





Problem

Fires

- Unpredictable
 - USA 2019 - **4,664,364 acres**
 - USA 2018 - **8,767,492 acres**
- California 2020
 - 4.2 million acres burnt
 - 33 direct lives lost
 - Indirect deaths of 1,200+
 - \$10 Billion total economic loss

Analysis

- Not real-time
- Information gap
- Expensive
- Risk human lives



Solution



- Unmanned Aerial Vehicles (UAVs)
 - Remove humans from fire
 - Provide real-time data
 - Implement AI
- Onboard Hardware
 - Nvidia Jetson Nano
 - HD and thermal cameras
 - Image processing algorithms
 - SDR communication



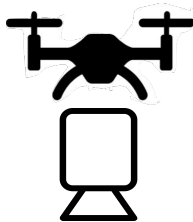
The Process



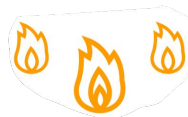
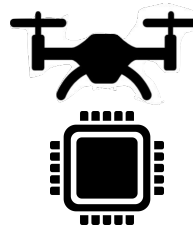
1. Pilot Flies the Drone



2. Drone Finds Fires



3. Drone Processes Fires



4. Drone Sends Data to User



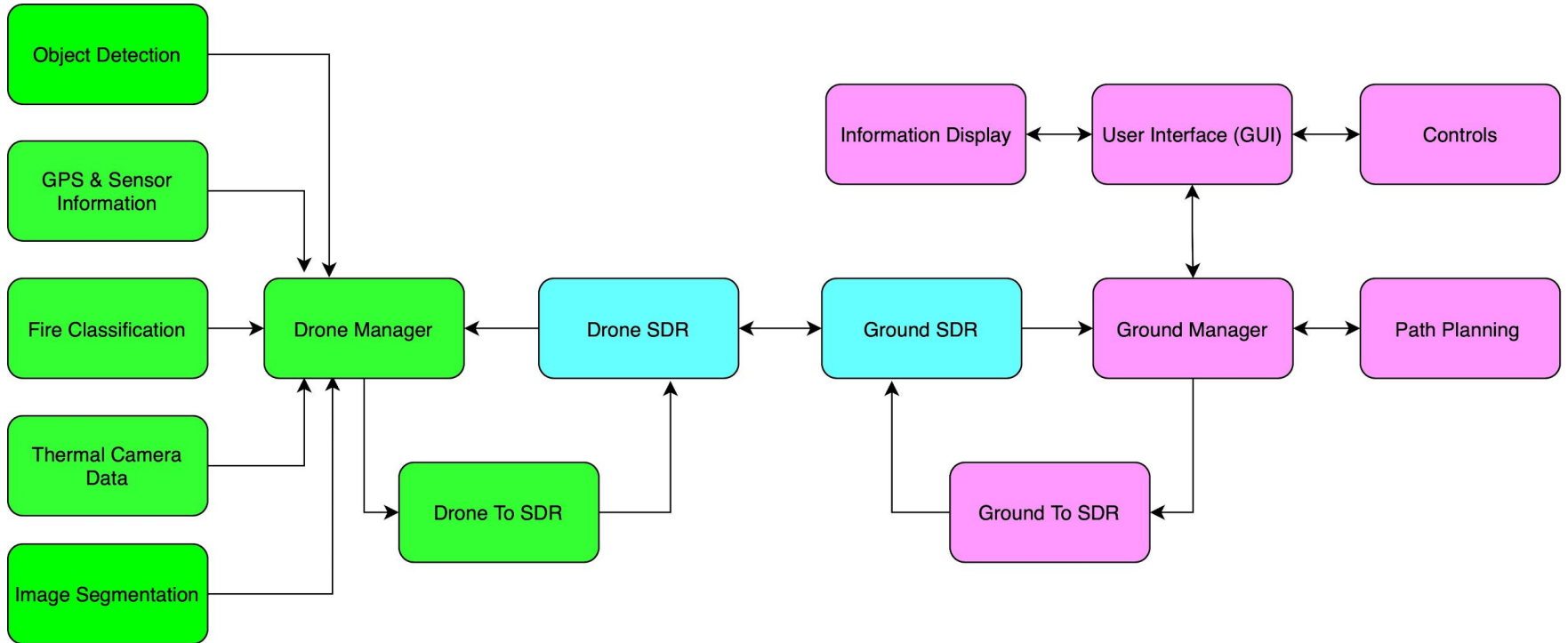


Architectural Overview

- **Drone Station**
 - Run AI models
 - Gather info from sensors
 - Pass it to the SDR
- **SDRs**
 - Relay information
- **Ground Station**
 - Display info
 - Present user with drone System Controls



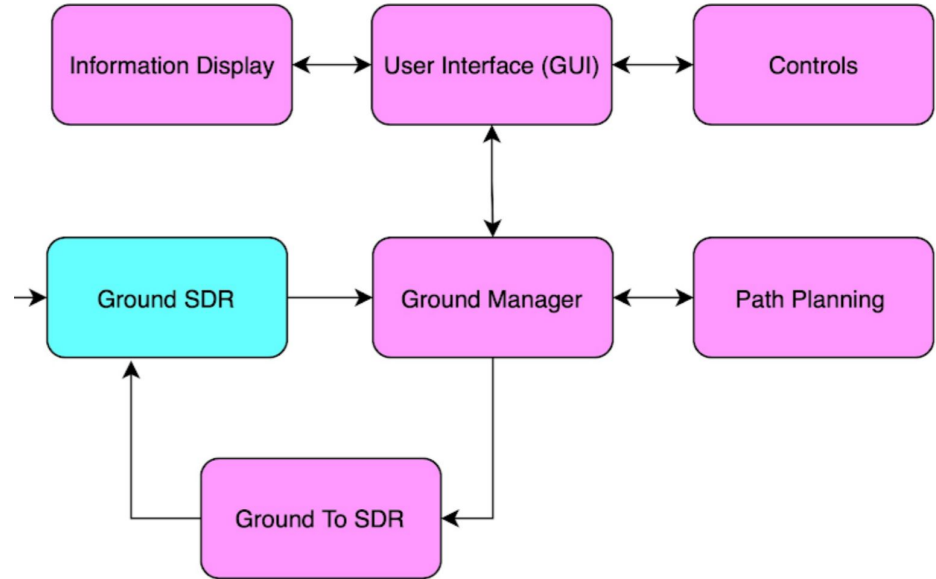
Architectural Overview





Ground System

1. Contains only front end
2. Controls Drone System
3. Displays Drone's System findings





User Interface

☰ Title of Current Operation

HD or Thermal view

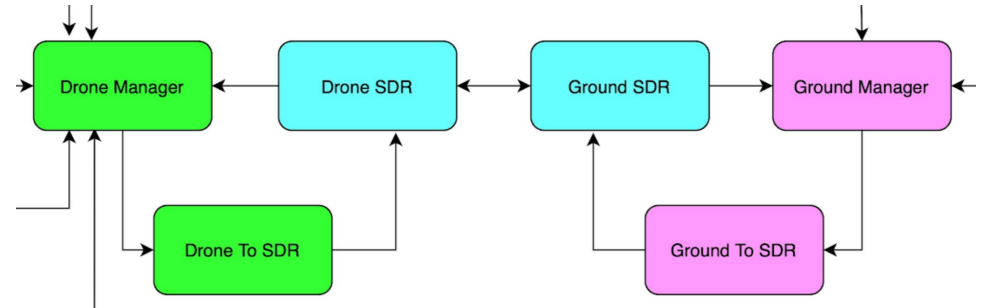
Request HD	Begin Fire Classification	Fire Segmentation...	Object Detection...
Request Thermal...			

Temp + Humidity ----- Temperature: 33 ° F Humidity: 22%	CO2 ----- CO2: 350 ppm
GPS ----- Longitude: -111.6528 Latitude: 35.1878 Altitude: 7020 ft Direction: NW	
Weather Data in Flagstaff, AZ ----- Current Weather: Sunny Wind speed: 11 mph E	



SDRs

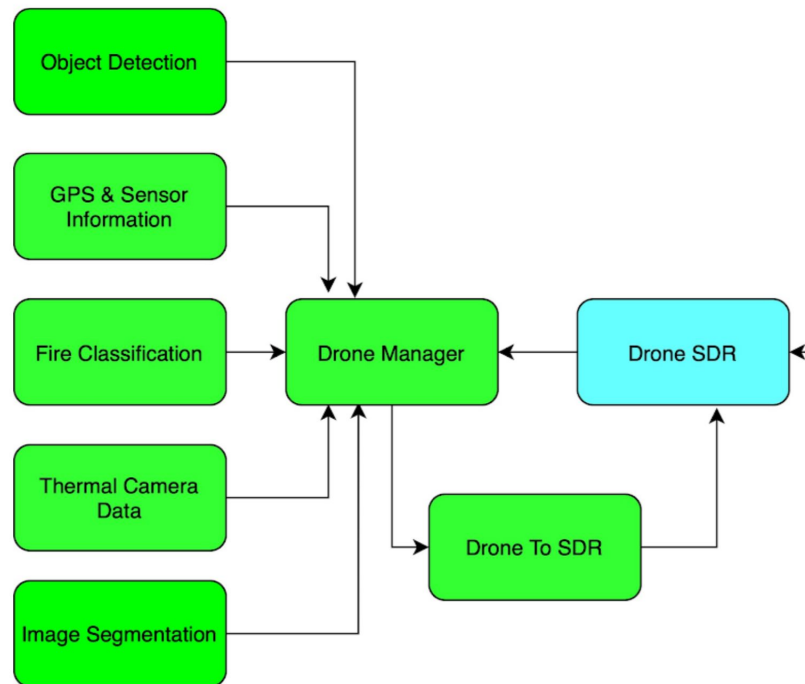
1. EE component
2. Send signals from Drone-to-Ground
3. Info is *written* by protocols
4. Info is *read* by managers





Drone System

1. NVIDIA Jetson Nano
2. Runs CNN Models
3. Collects sensor data

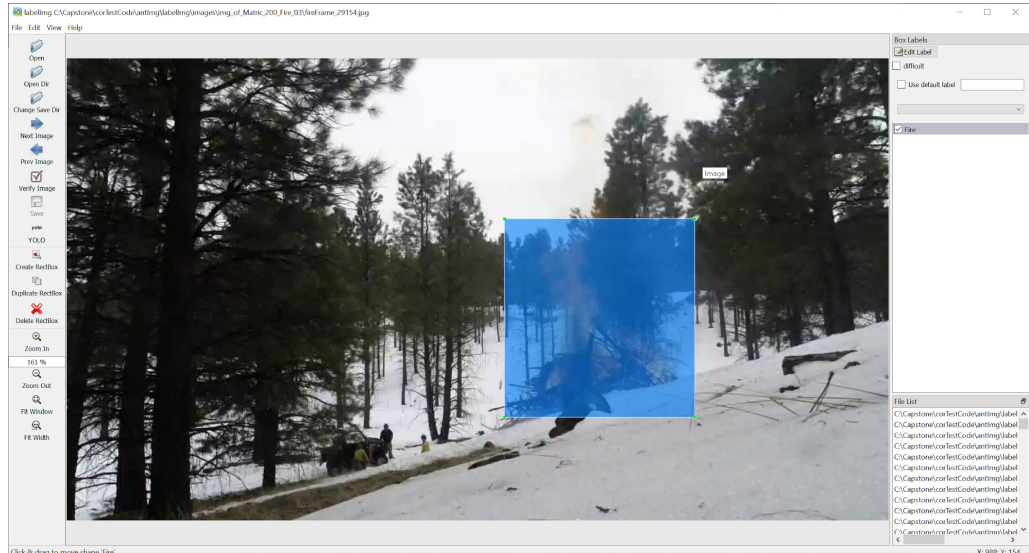


Note: Attached to drone, not built in



Training our Models

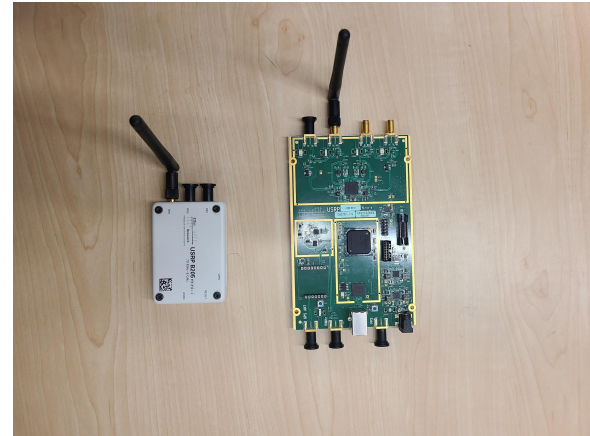
- Tensorflow/Keras
 - numpy
- OpenCV
 - VideoStream
- Annotation programs
 - Labeling
 - MatLab



Challenges



- Nvidia Jetson Nano
 - Converting models to Nvidia Jetson Nano
 - Different versions (Python, Tensorflow)
 - OOM errors
 - Lack of documentation
- SDR pipeline

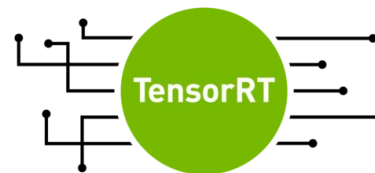


Drone SDR (left) and Ground Station SDR (right)

Solutions



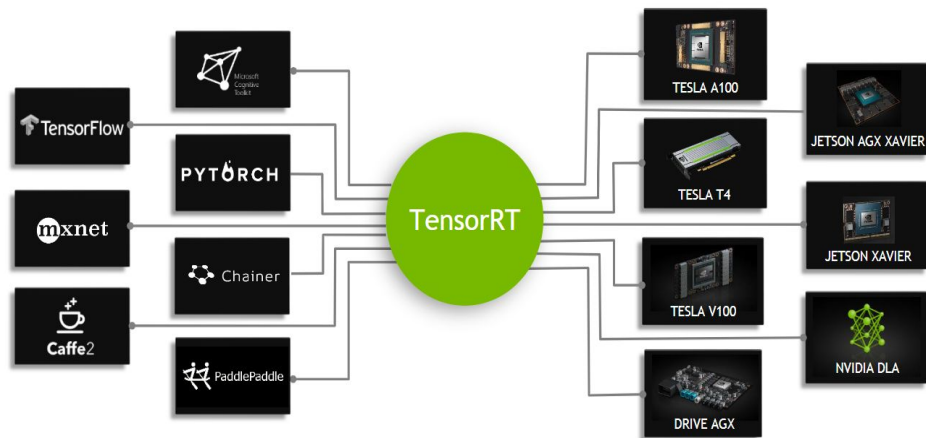
- TensorRT
- Virtual Environments
- Working with EE to get the SDR to an acceptable state





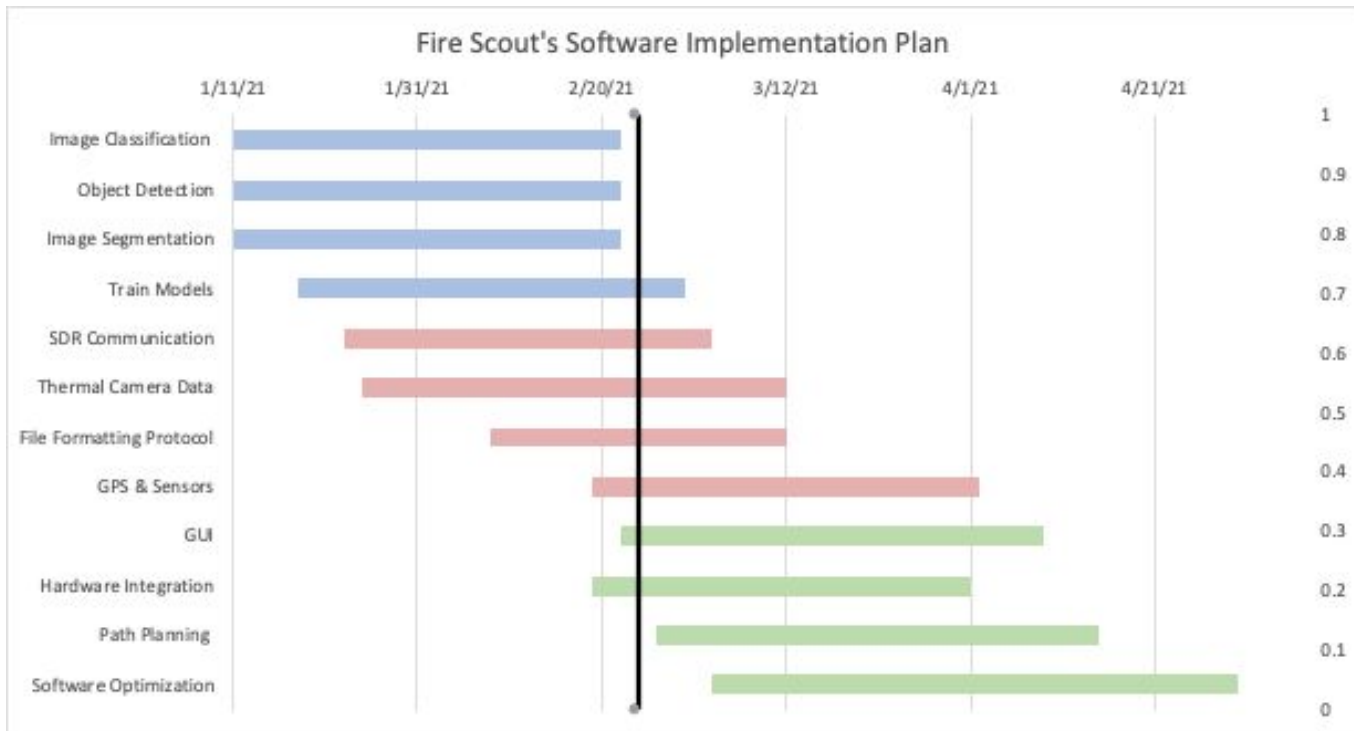
Optimization

- Models → tensorRT models
 - FPS
 - Boot time
 - No decrease in accuracy
- Neural Networks optimized for Nvidia Jetson Nano
- GUI
- Managers and SDR protocols





Schedule





Current Progress

- Image Classification running on Nvidia Jetson Nano
- Updated GUI
- Managers and Protocols
- Models and cameras run based on a text file that simulates the SDR process

Conclusion



- Fires kill and need to be fought in a unique ways
- Fire Scout saves lives and fights fires in a modern way
 - AI can detect and analyze fires
 - Emphasis on future developers
- Continue to build



Sources

- <https://docs.nvidia.com/deeplearning/tensorrt/developer-guide/index.html>