Fire Scout

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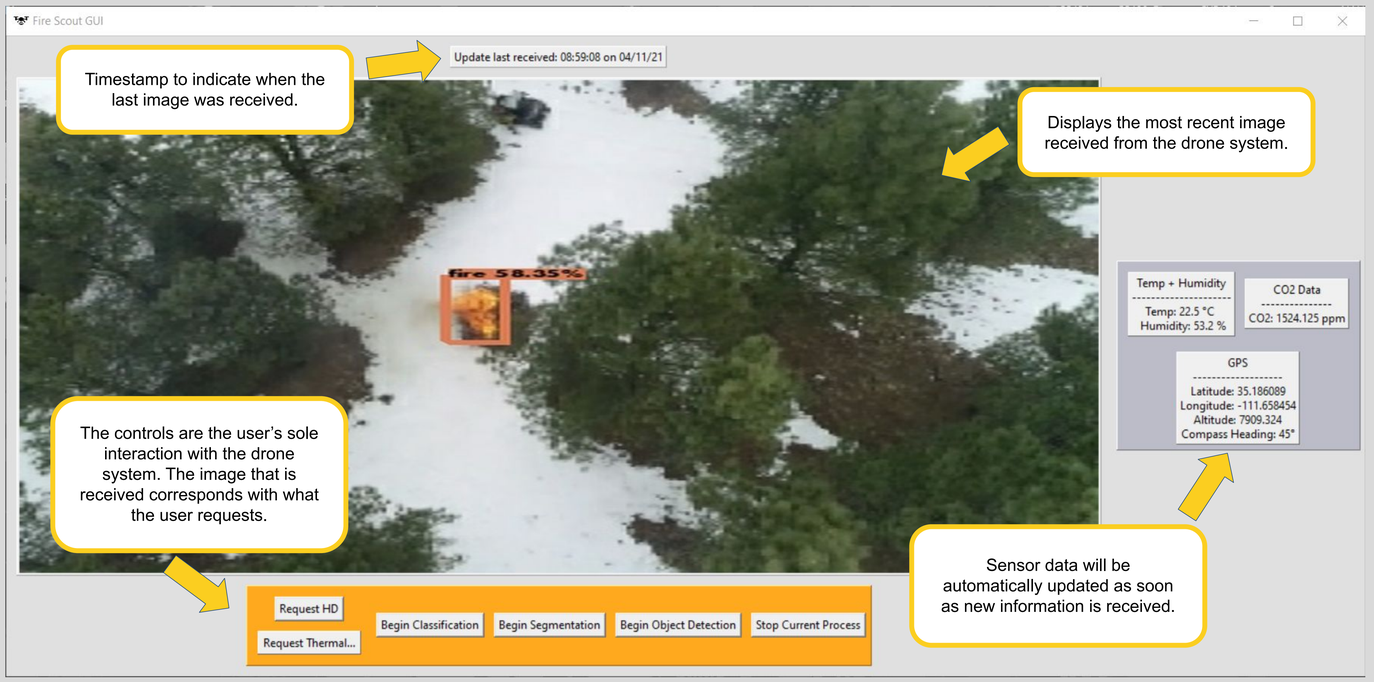
Problem

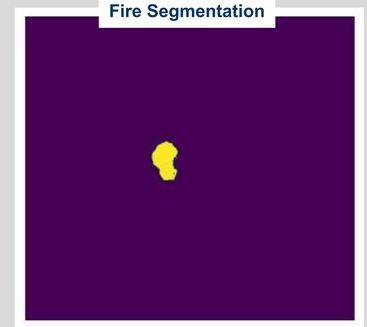
Each year wildfires cause billions of dollars in damages and take countless lives. The US experiences an average of 8000 wildfires annually. In California alone during 2020 over 4.2 million acres were burned, 33 lives were lost directly, and over 1200 lives were lost indirectly due to reduced air quality. In order to fight fires and reduce these catastrophic figures, wildfires need to be analyzed. However, current fire analysis techniques such as satellite imagery and manned aircraft are not real-time, expensive, and potentially dangerous. This results in a critical information gap between what is currently happening with a wildfire, and what stakeholders think is happening.

Solution

A brilliant solution that solves these problems was proposed by Dr. Fatemeh Afghah. By using unmanned aerial systems, commonly called UAVs or drones, stakeholders can analyze fires in real time in an inexpensive and risk free manner. With the help of her P.h.D. candidate Alireza Shamsoshoara, the Fire Scout Project was born.

Not only is Fire Scout able to analyze fires in real time, but is improves upon current techniques by using artificial intelligence to help identify where fires are located, as well as detect people and vehicles nearby. Additionally, the drone can carry sensors that detect location, direction, and carbon dioxide to enhance data collection. Both the AI models and sensor data collection are performed onboard the drone before the images and results are sent back to the users through software defined radios (SDRs). Once received they are displayed in a custom GUI that also allows users to control the drone's operations.





Technologies

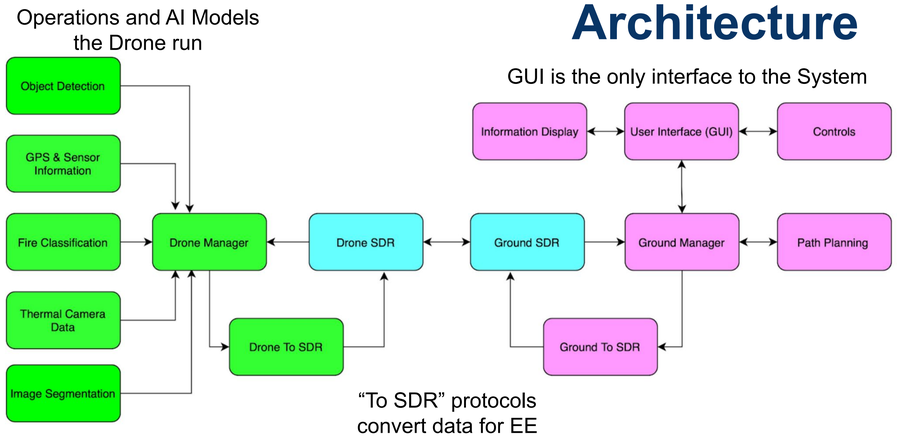
Python and OpenCV
Used across whole system for architecture and image processing

NVIDIA Jetson Nano
Mini-computer that runs the AI models, sensors, and cameras.

Keras and Tensorflow
Used for image classification

Yolo (You Only Look Once)
Used for Object detection

Architecture



Ground System (Pink)
The ground system is where the user interacts with the Fire Scout System. It is responsible for displaying collected information such as the processed images and sensor info, and lets the user control what models the Drone System is running.

SDRs (Blue)
The SDRs are implemented by the EE team and communicate between the drone and ground.

Drone System (Green)
The Drone System consists of the mini-computer, sensors, and cameras that can be attached to any drone. The mini-computer runs the AI models and collects sensor data to be sent back to the ground.

Acknowledgements

Team Fire Scout would like to thank our client, Dr. Afghah and her Ph.D. candidate, Alireza Samsoshoara, for being there to provide feedback and offer guidance every step of the way throughout the entirety of this project. We would also like to thank our mentor Sambashiva Kethireddy for being a great mentor, by consistently offering his help and providing the team with constructive feedback.

Future Work

Fire Scout prepared the way for future developers by creating a scalable architecture and implemented basic features needed for fire analysis and path planning. In the future, Dr. Afghah hopes to use Fire Scout's work to fly drones autonomously. A drone could identify a fire using our AI models, and then fly towards it with minimal human intervention. In the distant future, our AI models can be expanded upon to predict the path of fires.