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Prediction of fire boundary through semantic segmentation

BACKGROUND - Unlike traditional remote fire monitoring systems, which rely on satellite imagery, drone-based wildfire detection and modeling methodologies allow for high-precision, real-time fire monitoring. Rapid and efficient wildfire control and intervention tactics are made possible by precise and up-to-date information. Drone systems are useful instruments for early wildfire detection and evaluation because of their simplicity of deployment, omnidirectional maneuverability, and robust sensing capabilities. This is especially true in areas that are difficult for people or terrestrial vehicles to access. For this project a high quality, well-annotated, aerial wildfire dataset has been used. The included dataset provides a collection of side-by-side infrared and visible spectrum video pairs taken by drones during an open canopy prescribed fire in Northern Arizona in 2021. The frames have been classified by two independent classifiers with two binary classifications. The Fire label is applied when the classifiers visually observe indications of fire in either RGB or IR frame for each frame pair. The Smoke label is applied when the classifiers visually estimate that at least 50% of the RGB frame is filled with smoke.

OVERVIEW - The goal for our Task in the project is to predict fire spread using deep learning and scale from various spatial resolutions. We should have an understanding of the fire boundary/perimeter and the landscape temperature evolution during fire events since it is crucial for fire modeling.

SHORT TERM OVERVIEW : The short term goal for this project is Fire prediction. The main goal of this project is to implement a fire prediction system. In particular, we will focus on using thermal imagery from a UAS or satellite to segment images into burned/not burned areas. We would also like to be able to identify the fire line (actual moving fire portion) and potentially remaining “hot” spots inside of the burned areas.

DATASET - The dataset that has been used binary semantic segmentation mask prediction is the Fire dataset which is a set of 2000 training images along with 1000 testing images of 1920x1080 resolution.

ALGORITHMS - A well known semantic segmentation algorithm - UNET has been used to predict a binary mask (binary since everything other than fire is considered a background or non fire). The UNET algorithm has been trained on the model with epochs ranging from 3 to 100 and as expected, the prediction accuracy improved significantly.

FUTURE DIRECTIONS - We are planning on augmenting the dataset and and further train and test our model based on the new augmented dataset and will mark down the comparison results to test the performance accuracy of the model when trained on the original and augmented dataset.