Early Wildfire Detection

Victoria Marques (10851837@uvu.edu)

BACKGROUND

As wildfires have grown in prevalence, it has become increasingly clear that it is necessary to find a way to identify wildfires before they become destructive. There is a technology called YOLO which , for our purposes, is used to identify wildfires and allows drones to be used as the vehicle for this type of identification.

DEFINITIONS

YOLO – "You Only Look Once", the machine learning model that was specifically made to recognize whatever images it is trained on, on sight.
mAP – "Mean Average Precision", a measure of the confidence the model has in recognizing an object within a bounding box.
Box Loss - A measure of how well the model was able to predict the placement of a bounding box.
CLS Loss – "Class Loss", a measure of how well the model correctly identifies an object within a bounding box.
DFL Loss – "Distribution Focal Loss", improves upon the precision of the model when identifying finer details within a bounding box.

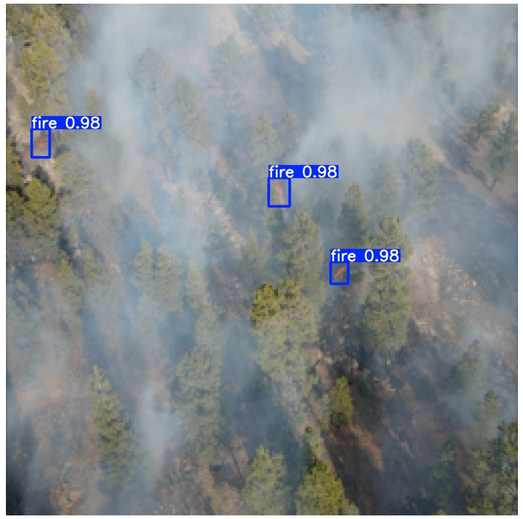

Figure 1: 98% Confidence Machine Recognition

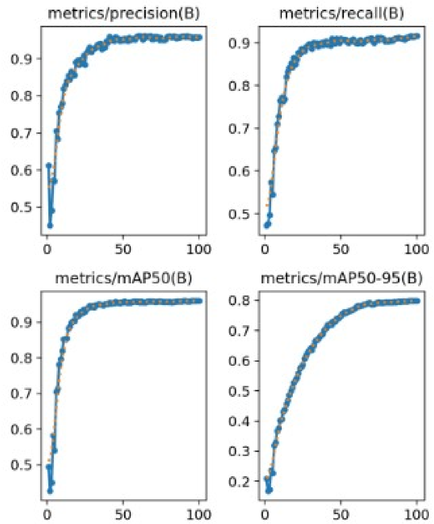

Figure 2: 98% Model Outputs

METHODS

Through Utah Valley University's Fire Project, I worked with YOLOv10. I began by running the nano version for 10 epochs, then increased to 50 and switched to the small version for better results. I tuned hyperparameters for Box, CLS, and DFL Loss, removed data augmentation to avoid synthetic data, and resized images to 1024×1024. Finally, I trained the extra-large model for 100 epochs to maximize fire detection accuracy.

RESULTS

I was able to get a precision score of 0.953, a Box Loss score of 0.4109, A CLS Loss score of 0.2028, a DFL Loss score of 1.535 (for loss, the lower the value the better), a mAP50 score of 0.959 (the percentage of bounding boxes that have a confidence level of 50% or more) an mAP50-95 score of 0.789 (the percentage of bounding boxes that have a confidence level of above 50%), and an overall accuracy of 88.92%.

CONCLUSIONS

The model was able to identify fires in some images with up to 98% confidence, therefore I feel that the outcomes of my final model were pretty favorable, especially considering the fact that I used an older model. With the ever-improving models available to YOLO this technology has so much potential to be used in order to identify wildfires within their beginning stages, and therefore prevent these fires from becoming hard to control.

REFERENCES

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