Novel Approach to Autonomous Mosquito Habitat Detection using Satellite Imagery and Convolutional Neural Networks for Disease Risk Mapping

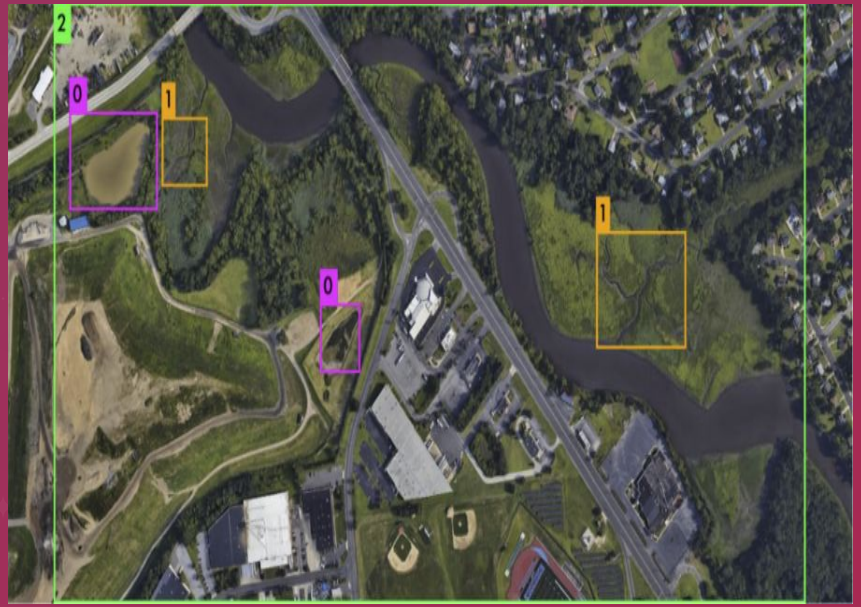
By Sriram Elango and Nandini Ramachandran

Problem Introduction

- Mosquito-borne vector diseases cause more than 1 million deaths each year
- Contemporary approaches and methods to identify mosquito habitats are expensive & difficult
- Ariel approaches include Drones, UAVs, Lidar, and Multispectral imaging from satellites.
- There are no efficient approaches for **macro** scale mosquito habitat detection
- No approaches are able to sufficiently identify habitats in impoverished and rural areas

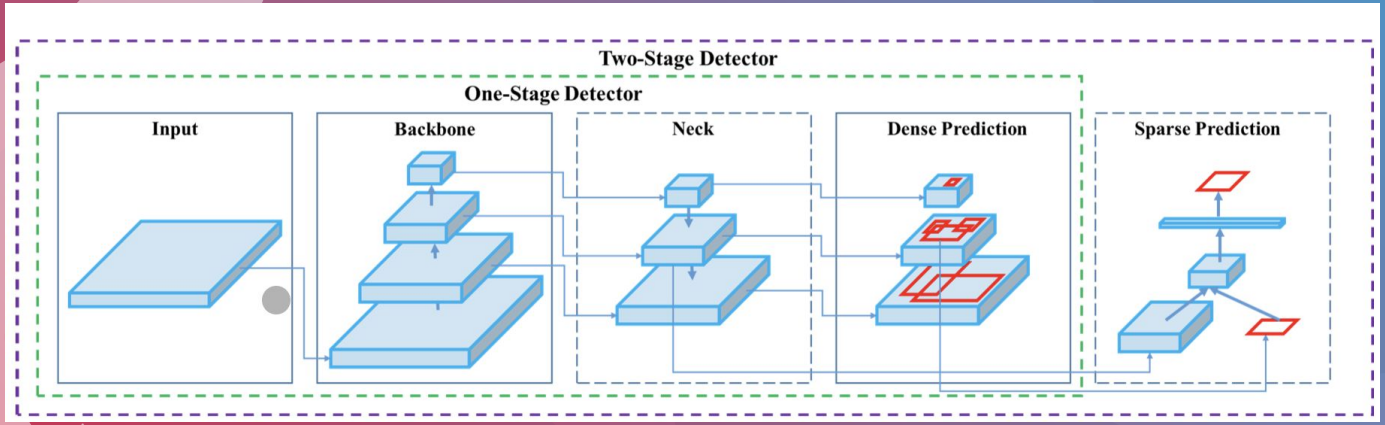
Solution

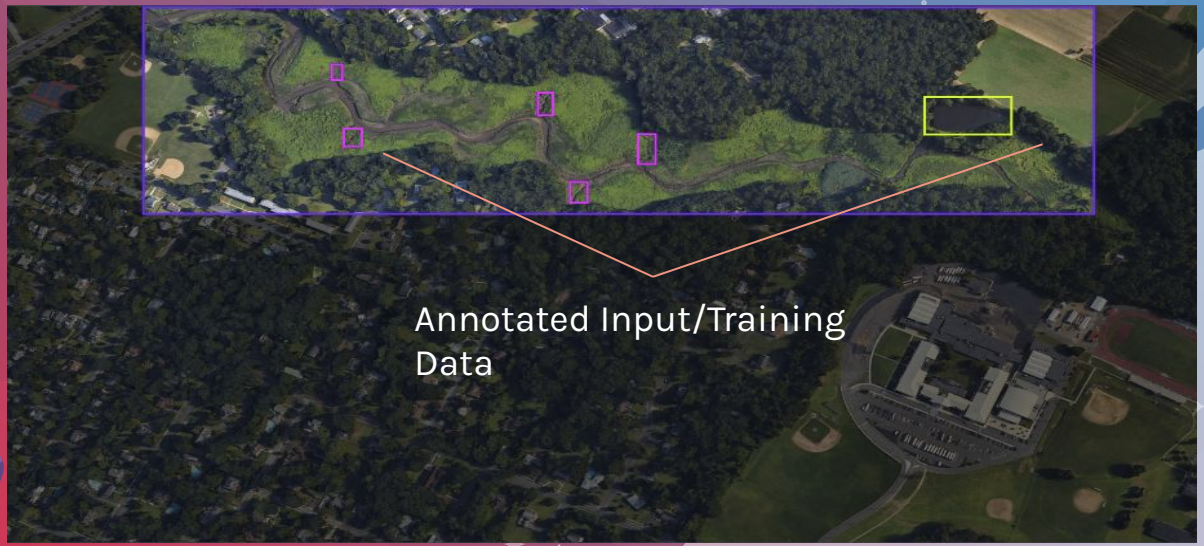
- Using available satellite imagery from Google Earth, mosquito habitats can be detected
- CNNs are highly efficient and accurate in image classification, so they can be used for macro identification
- Using CNNs, massive amounts of satellite imagery across Earth can be inputted and classified for mosquito habitats



CNN Architecture

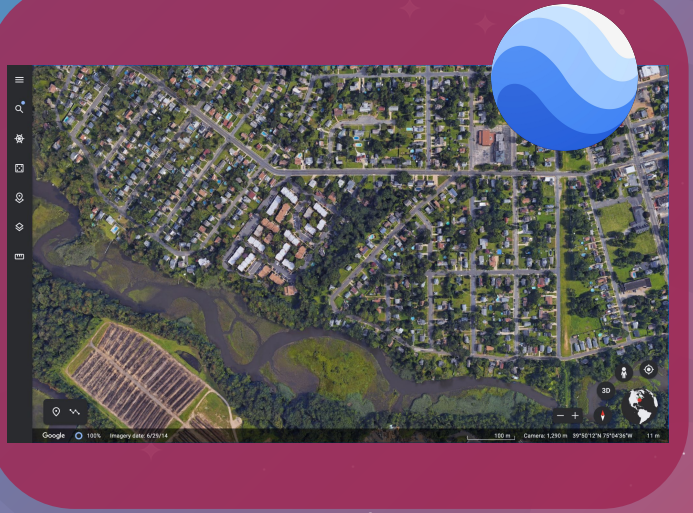
How does it work?


Two-Stage Detector
One-Stage Detector
Input
Backbone
Neck
Dense Prediction
Sparse Prediction

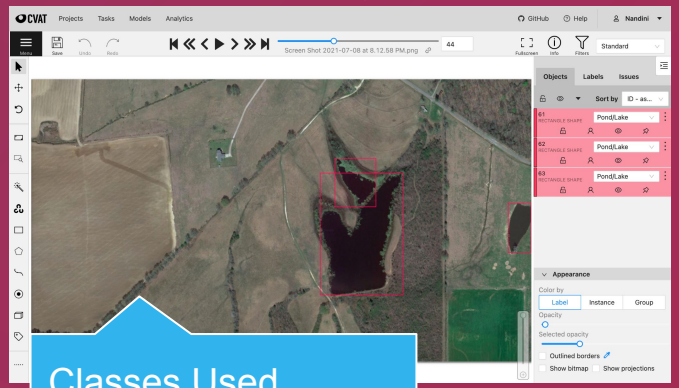

Annotated Input/Training Data

Preparing the Dataset

Satellite Images



Bounding Boxes for Object Detection (CVAT)

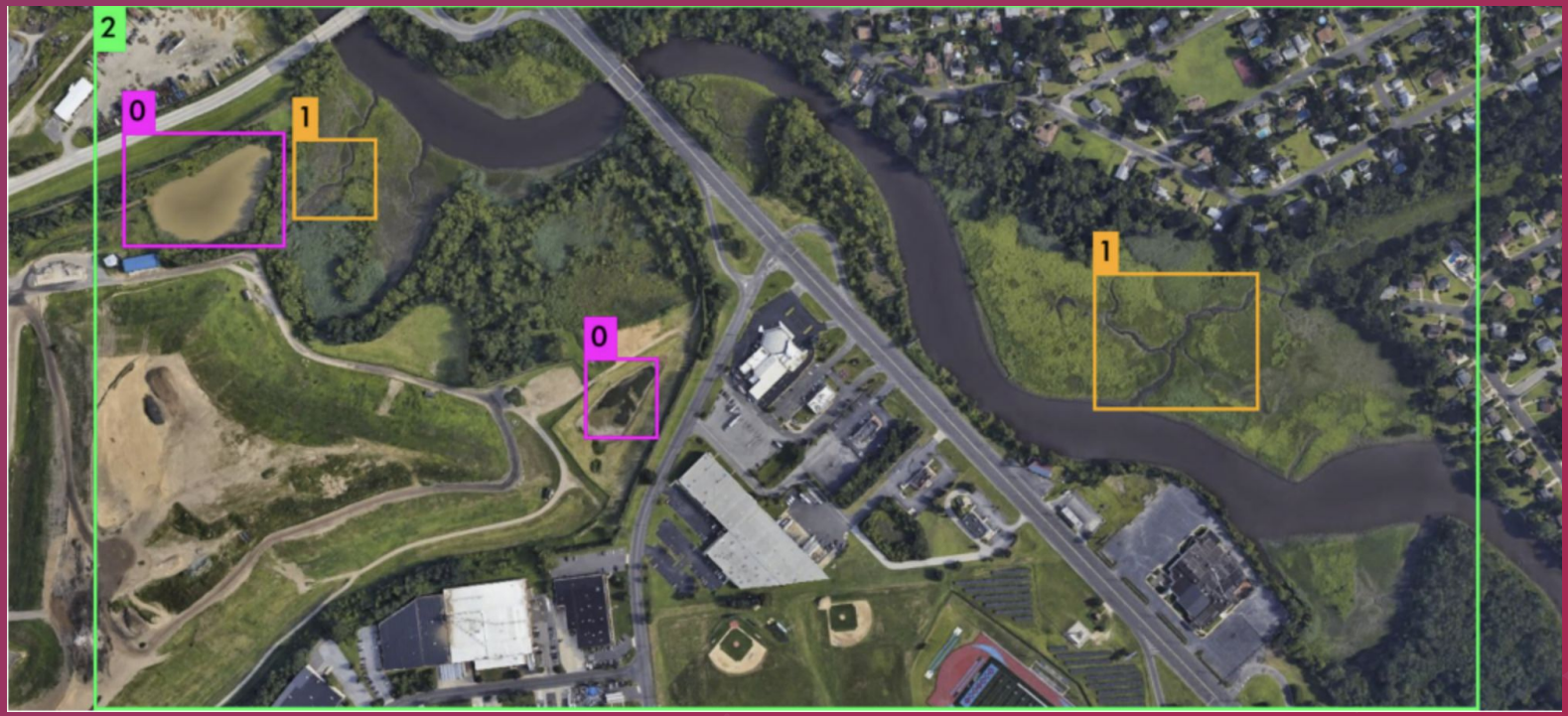


Classes Used

1. Ponds/Lakes
2. Inlets
3. Rivers

Predicted Output Image Samples

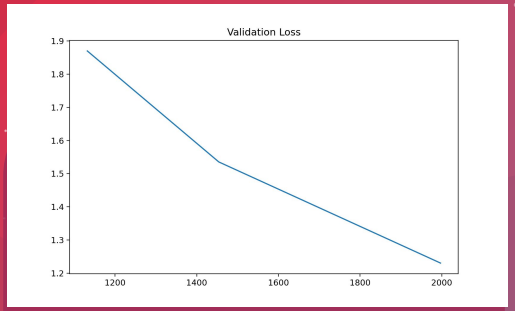
YOLOv4



YOLOv5

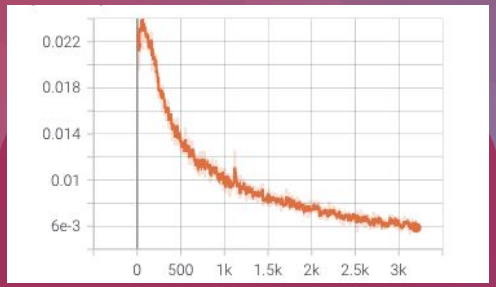
YOLOR

Loss/Accuracy Graphs



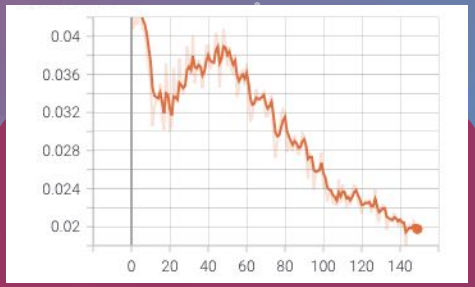
YOLOv4

Darknet Framework



YOLOv5

TensorFlow Framework

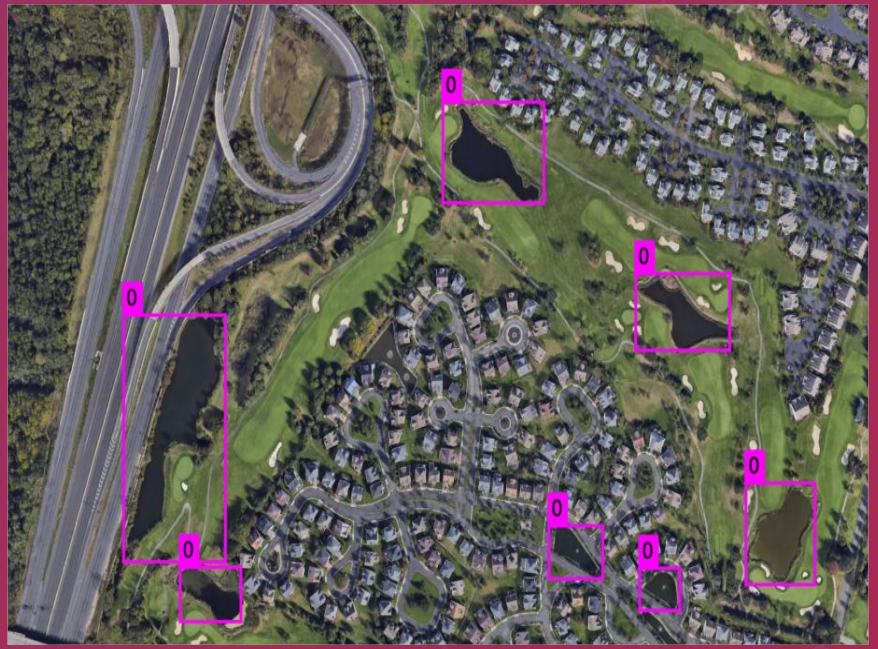


YOLOR

TensorFlow Framework

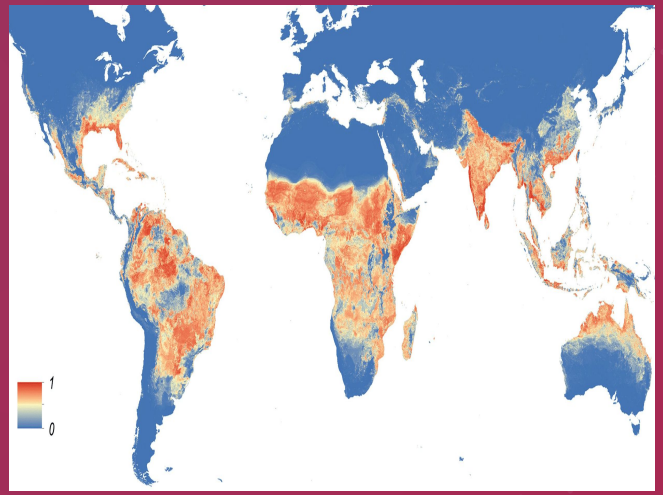
Conclusion

- Compared to other aerial approaches, CNNs are the quickest, most efficient, and cost effective way to go
- CNNs are the best for macro scale habitat identification and classification
- YOLOv4 performed with the highest accuracy



Applications

- Disease risk mapping based on distribution of mosquito habitats
- Integration with public health officials on where to guide preventative measures
- Mapping impoverished and hard to reach areas
- Identify mosquito spread and pathways
- Determine the effects of changes in weather patterns, soil moisture, and topographic data on mosquito habitat distribution



Thank You to our Amazing Mentors!