

# Bee Project

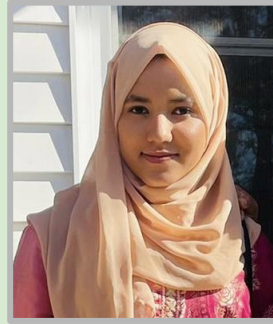
WINLAB 2022 Summer



# Team Members



Joel Paley



Fairuz Zahin



Izabela Bigos



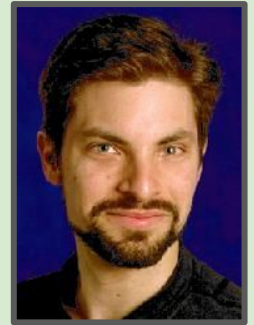
Agni Rajinikanth



Sarah Marty

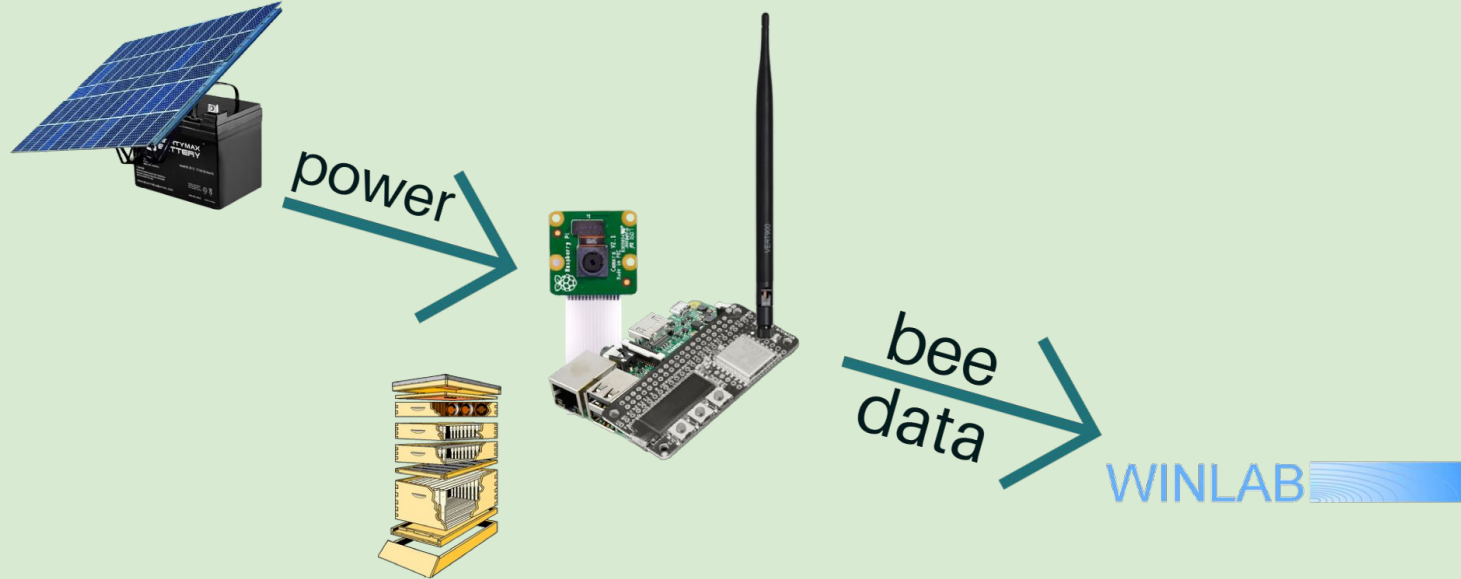


Alan Shi



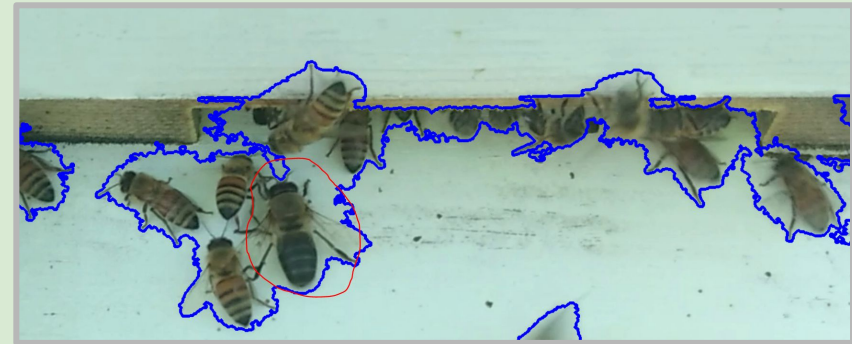
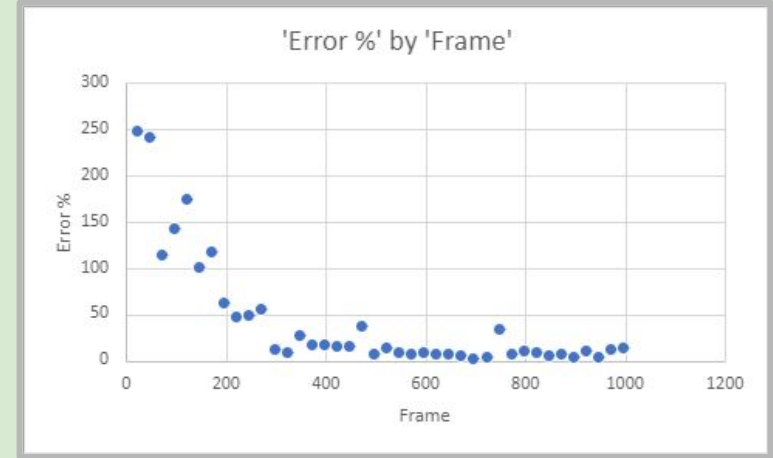
Mentor:  
Prof. Richard  
Martin

# Motivation and Design



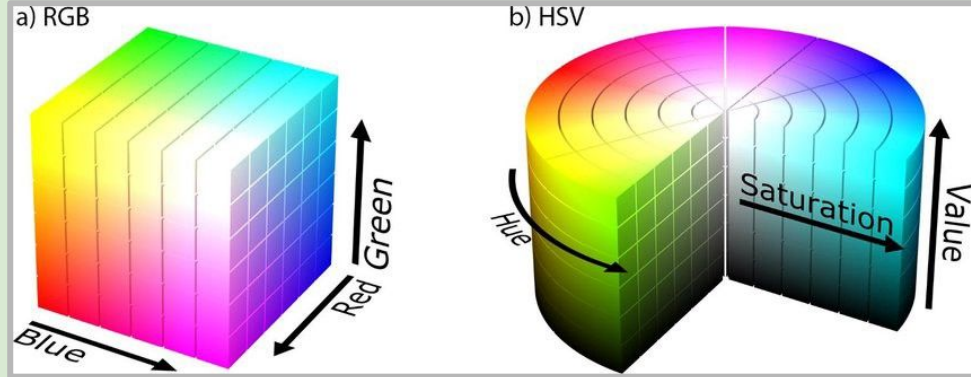
# Background Subtraction

- YOLO Model Darknet Framework: 90%
  - Processing Power > Accuracy
- KNearestNeighbors Background Subtraction Algorithm
  - History: 500, Distance Threshold: 400
  - Shadows: False
- Limit Noise
  - Gaussian Blur
  - Area > 1100
- Accuracy
  - Contour Accuracy increases as frame increases
  - Entire sample accuracy: 60.4%
  - Last 500 Frames accuracy: 92.64%
- Errors:
  - Bee Size, Shadows, Stagnant Bees
  - Camera Positioning/Videography, Lighting

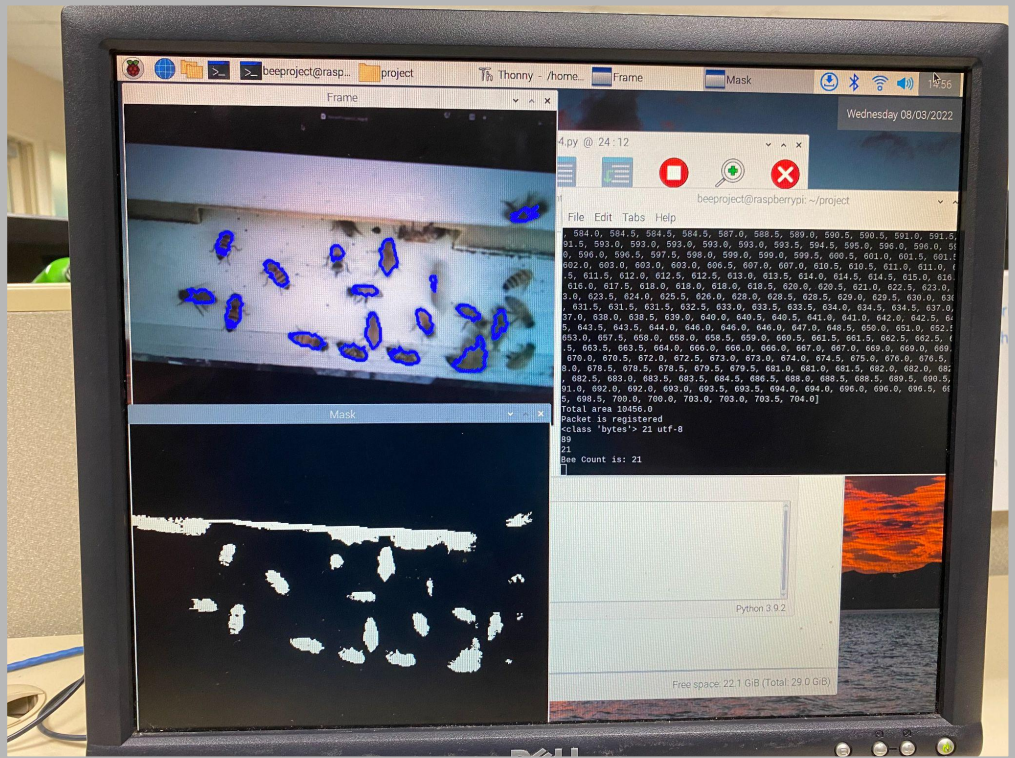
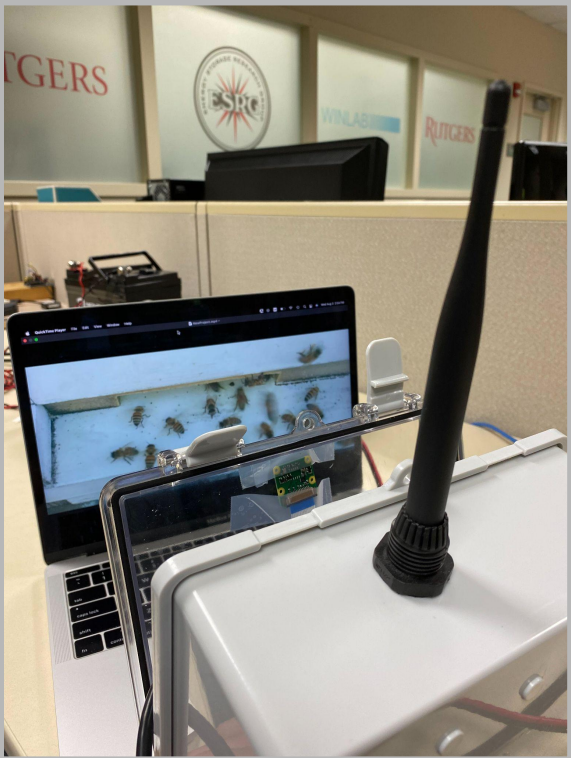


# Color Hue

- Using the color of the pixels to choose what is a bee and what is not
- RGB is converted to HSV, and we extract the hue only
- HSV is more reliable than RGB for computer vision algorithms



# OpenCV Implementation

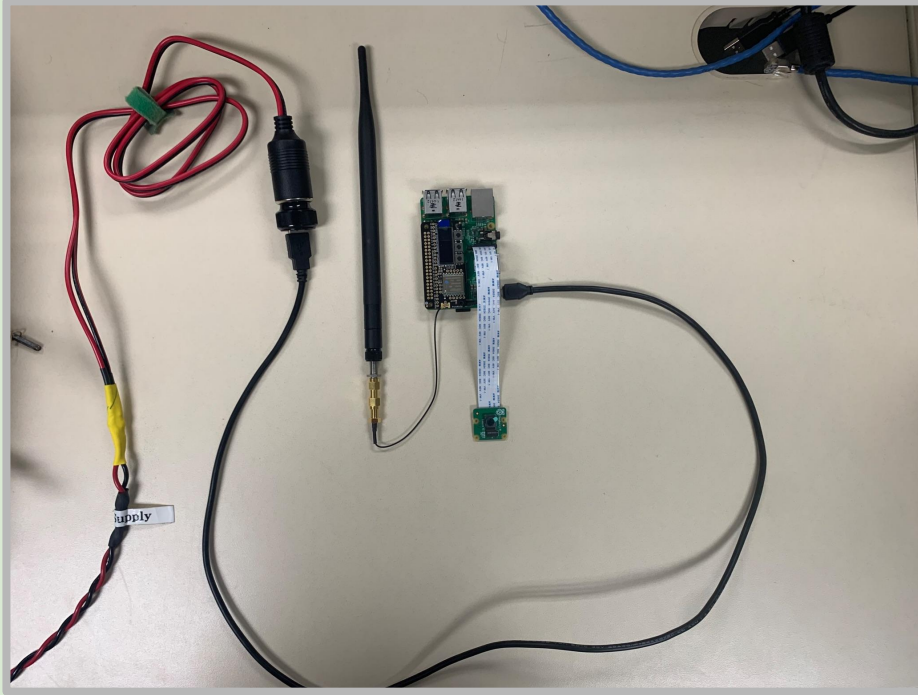


# Long Range Radio (LoRa)



- One radio module sends the bee count calculated by the Open Computer Vision Algorithm, while the other receives and displays the data
- Low Power, Long Range, Small Amounts of Data

# Power Supply

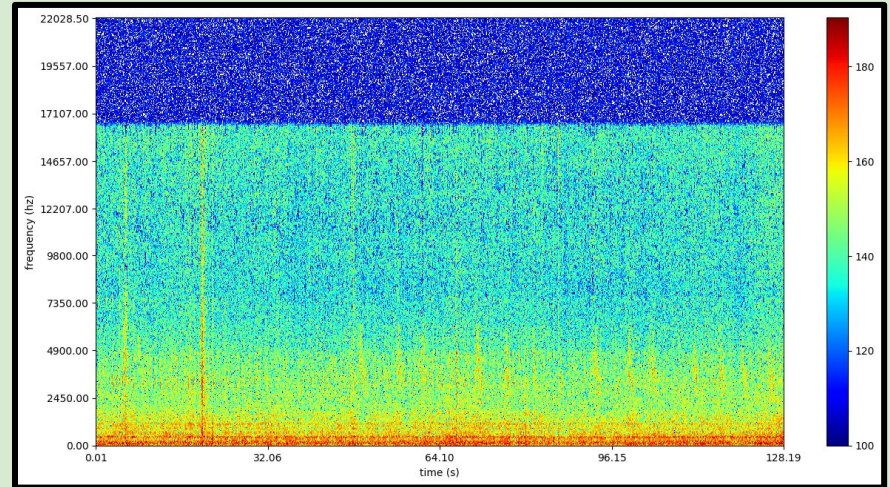
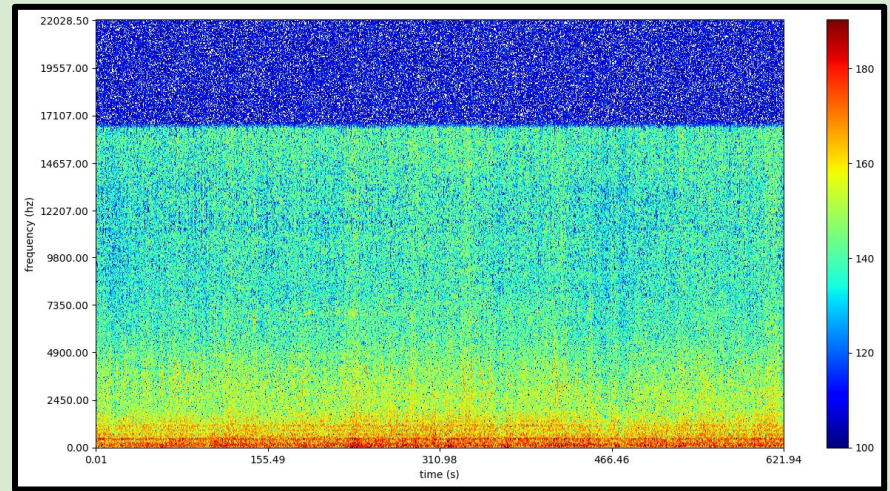


- 100W Solar Panel, 12V Battery
- Power Output with 12V socket
- 0.5 A of current from power supply



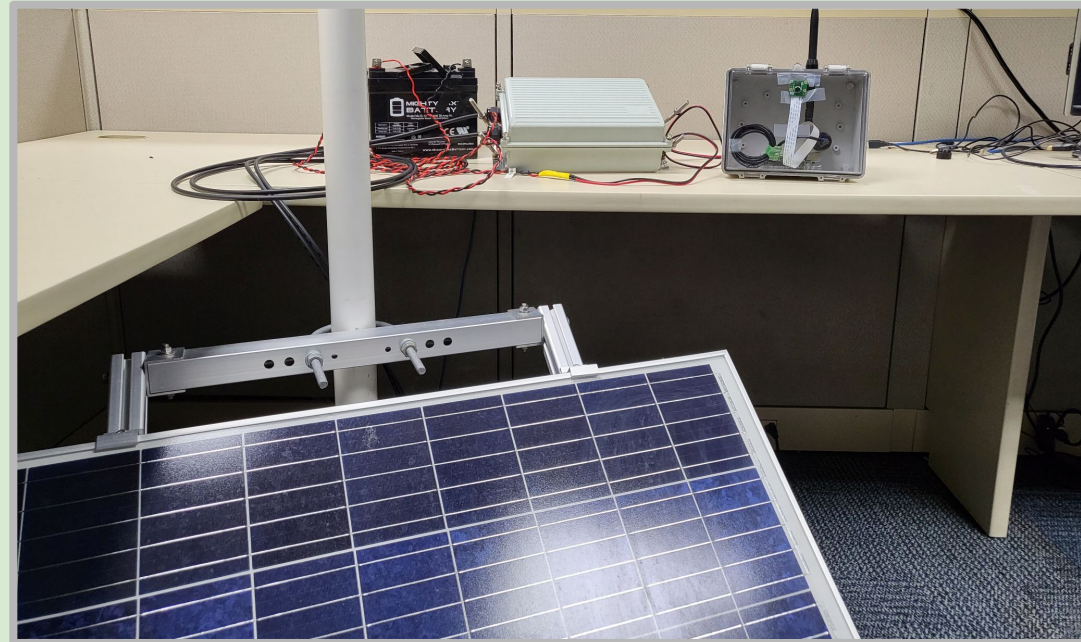
# Audio Analysis

- Amplitude analysis (scrapped)
- Frequency analysis
  - Orientation flights (top)
  - Angry hives
- Removing background noise
  - High-frequency filter



# Results/Conclusions

- The bee counting algorithm shows accuracy of around 90%
- The Raspberry Pi receives a sufficient 0.5 A of current
- The system is weatherproofed for outdoor implementation
- The radio sends data over the distance of about half a mile rather than theoretical two miles



# Future Work

- Using third radio as a relay node to increase range of sending data
- Implementing one raspberry pi as a gateway that sends data to the internet and stores it into a cloud server
- Working with temperature/humidity detection as an additional way of monitoring bee hive population
- Testing accuracy of entire system over long periods of time

Questions?

