Team Members

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Mentor:
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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?