WINTER BEEHIVE LIFE DETECTOR

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Abstract

The winter beehive life detector is a battery powered, handheld device that uses a sensor array to take in data from a man-made beehive and detect whether there a living bees inside the hive. This device will be the first of its kind, offering great improvements to the speed and accuracy of beehive management.

Designs, Methods, and Materials

Hardware:

Sensor Array:

Analog Microphone: OWMMOA-271811A-S421QA

Thermal Camera: AMG8833

Movement Sensor IRA-S210ST01

Core: STM32F103VBT7

LCD Display: EADOGS 164W-A

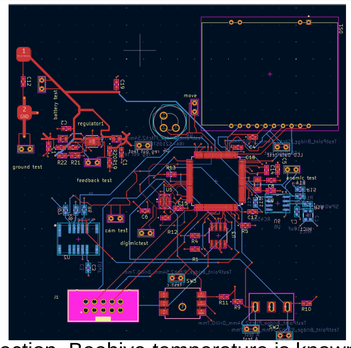
Eeprom:AT24C04C-SSHM-T

DPDT and Toggle Switches

Hardware Tools:

STM32VLDiscovery with STM32F100RB :development board.

EECE Lab Soldering Stations and Oscilloscopes



PCB Design

Software:

Detection Algorithm: The detection algorithm uses well known beehive characteristics as the base of its detection. Beehive temperature is known to be stable at around 70 degrees Fahrenheit and to start dying at 40 degrees Fahrenheit. Bee buzzing is known to be in the 200-300Hz range. The detector interprets sensor data and compares the values to these known characteristics.

Software Tools:

The code for the detector was made in C using the STM32CubeIDE version 1.18.

PCB was made using KiCad V 9.0.

Methods:

Testing Procedures: WWU has two beehives on campus maintained by a student run club. These hives were used to test on a live beehive. Beekeeping safety procedure to act at dusk or dawn was followed to minimize risk to both bees and people. These hives are confirmed to be alive and active, making them a reliable base case to test on.

Background

Beehives are closed off during wintertime. Opening them to check on the bees directly risks the bees freezing to death. This makes winter beekeeping unpredictable and hard.

A man-made beehive looks like this when closed. Checking on bees inside it is difficult when they cannot be opened, as there are no visual or hearable indicators

References

Manufacturer provided Datasheets for all parts used.

Results

Successes

- Detection algorithm was developed function in the scenarios where traditional beekeeping methods fail.

- Thermal camera usage and data interpretation was successful, and this on its own is enough for most of the detection to work.

-The EEprom was successfully integrated, storing the different sensor data and their unique data types.

The detector is incomplete but looks promising, offering a unique and tangible function that no device currently provides.

Setbacks

- The development board had outdated hardware that delayed development
-Testing the detector in outdoor conditions was destructive at times, resulting in lost hardware and time spent rebuilding.
- The early PCBs designed for the detector were riddled with design flaws.

But these setbacks were worked through. The development board was fixed, the destroyed parts were replaced, and the flawed PCB was used to test as much as possible before shifting development to operate on the development

Future Direction

The detector can have its detection algorithm improved for higher accuracy, and its hardware can be upgraded with a higher budget.

A better casing for the detector to make it more weatherproof would help if function better in winter conditions, but the mechanical design of a casing was outside the scope of this project

Hardware integration with a fully customized PCB can be completed with experience gained over the course of this project.

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