

Introduction

"The mortality rate of colonies is about one in every two hives each year."

- Co-advisor to the Oregon Tech Beekeeping Club, Christy VanRooyen



Fig. 1. Hive Maintenance: Internal hive frames

- Bee die-off in Klamath Falls commonly occurs in the colder months, but the cause is not well understood.
- Tracking environmental factors internally and externally to beehives year-round will allow researchers to analyze changes in the hive and work towards improved hive mortality.
- The Oregon Tech Beekeeping Club determined data regarding temperature, humidity, and hive weight is critical to understanding why the hives are dying.

Objectives

Our project aims to achieve these objectives

- Record Internal and external hive temperature, humidity, and hive weight at least 12 times a day.
- Provide simple data retrieval a safe distance from the hive.
- Include monitor housing that withstands long-term wear from weather, allowing our project to work for years after we graduate.
- Implement solar recharge for monitor battery, making the system self-sustaining for long periods.

Acknowledgements

Our team offers special thanks to:

- Christy Vanrooyen, Beekeeping Club Co-Advisor,
Assistant Professor Dep. Natural Sciences
- Terri Torres, Beekeeping Club Advisor,
Professor of Mathematics
- Michael Healy, Project Advisor,
Assistant Professor Dep. Computer Systems Engineering Tech
- George Drouant, Project Consultant
Instructor Dep. Computer Systems Engineering Tech

Method

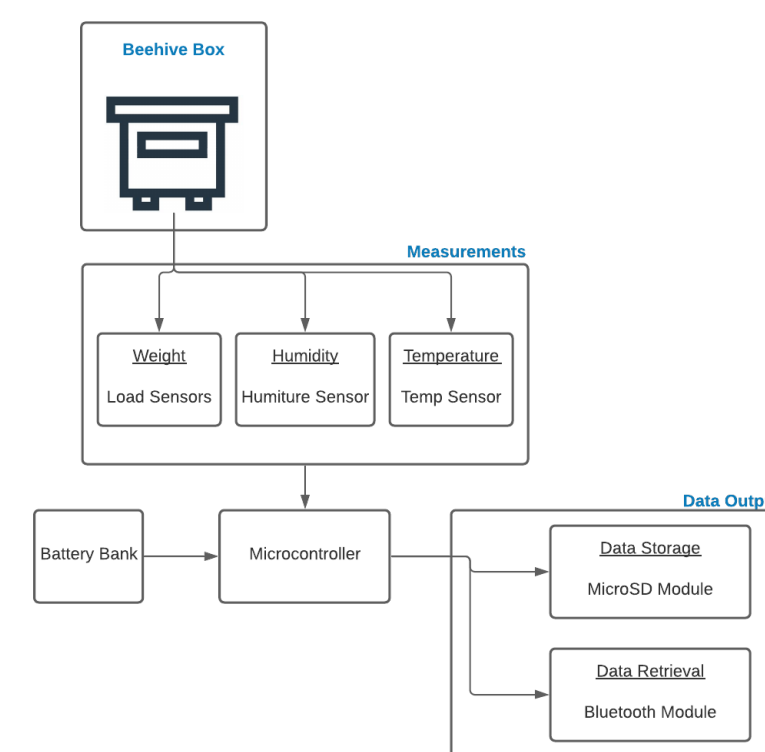


Fig. 2. Monitor Modules: functional outline

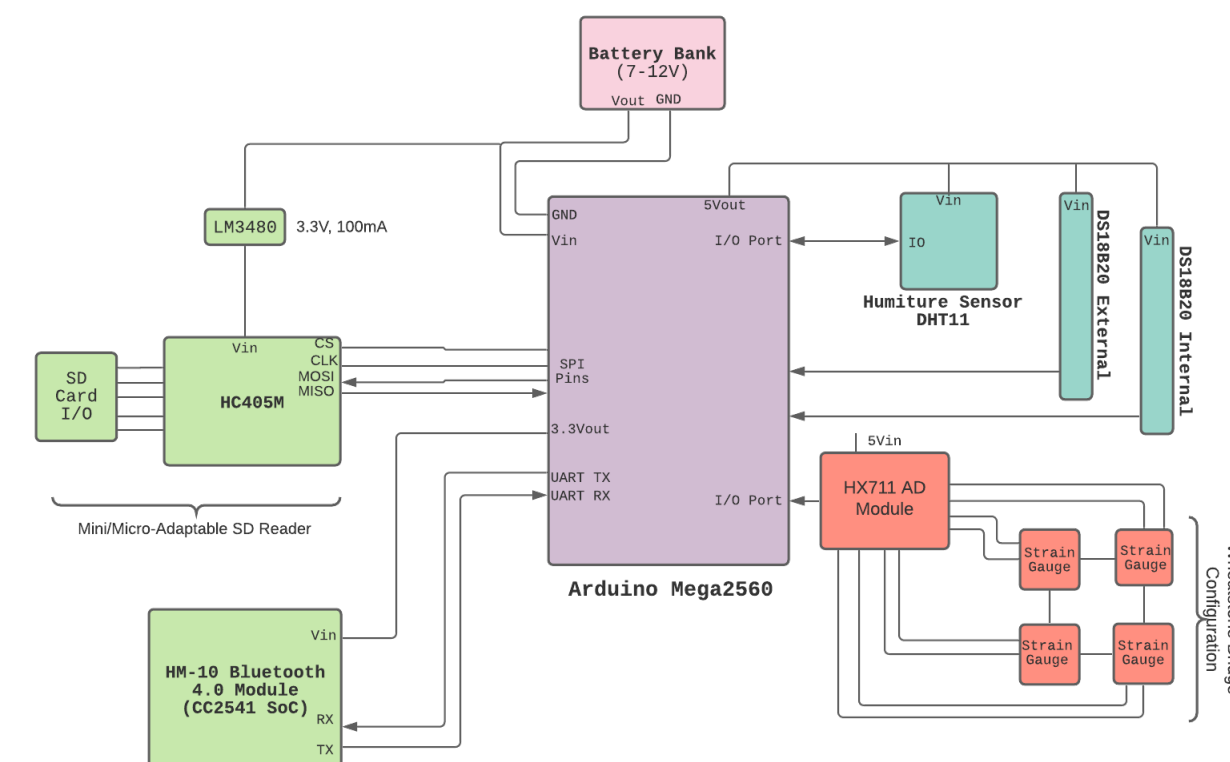


Fig. 3. Circuit Diagram: primary monitor modules

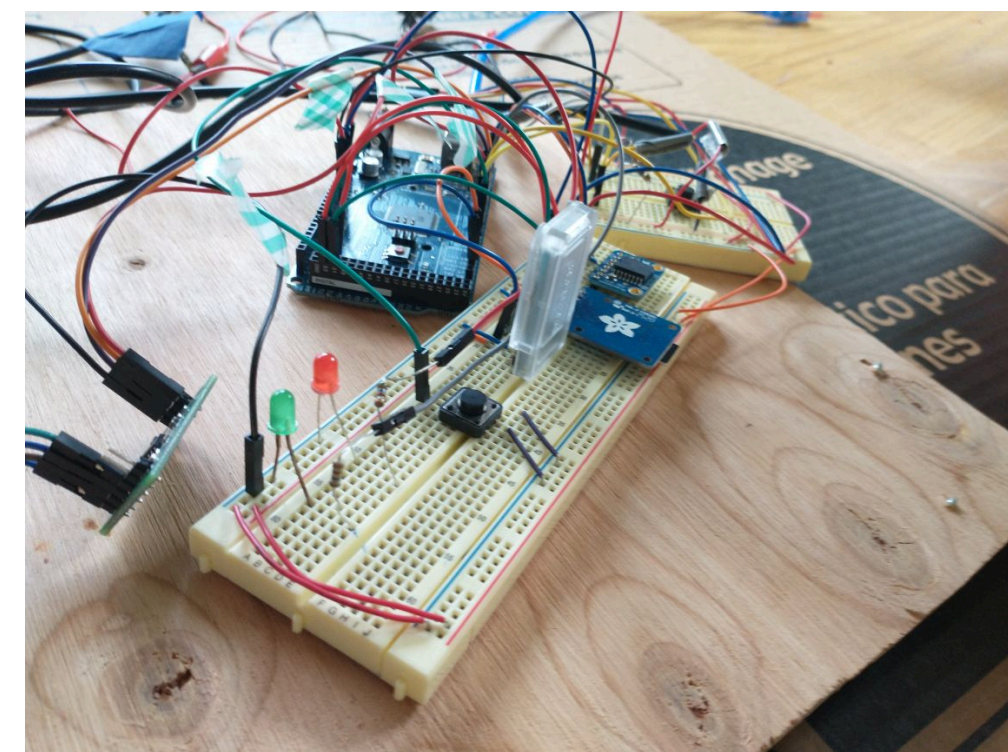


Fig.4. Fully implemented monitor before housing design.



Fig. 5. Full hive frames, where some monitor sensors will be placed.

Results

Complete:

Successful testing and implementation of the following sensors:

- Full Bridge Strain Gauge Load Sensor
- DHT11 Humiture Sensor
- DS18B20 Internal Temperature Sensor
- DS18B20 External Temperature Sensor

Successful testing and implementation of the following modules:

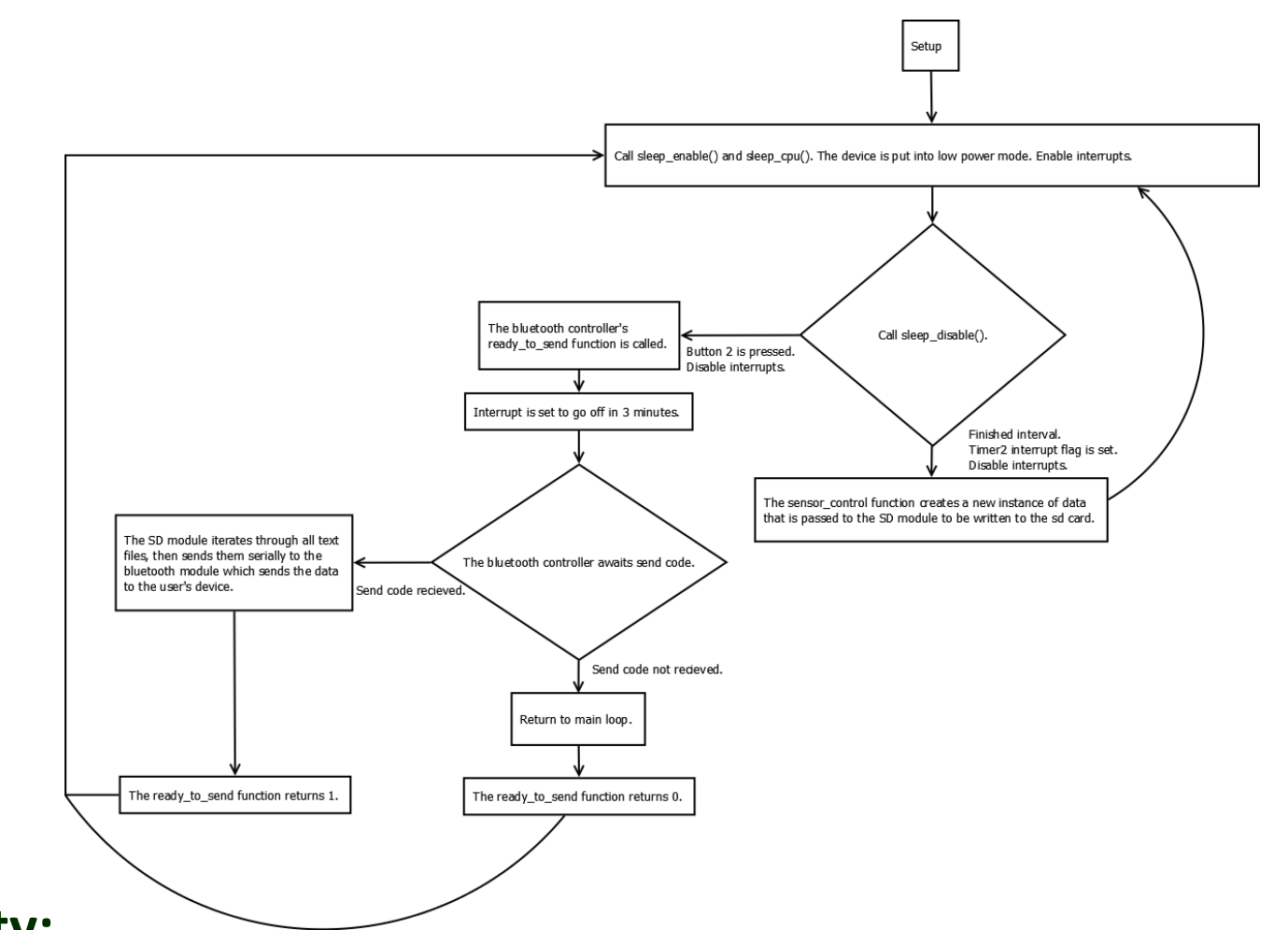
- Independent Power Supply
- MicroSD Breakout Board
- HM-10 BLE Bluetooth 4.0 Serial Wireless Chip

Successful implementation and demonstration of the following functionality:

- Device sleeps until user interaction or periodic data collection self-initiates.
- Collection and storage of sensor readings on a MicroSD card
- Pairing with another Bluetooth device on command
- Transmission of stored data over a Bluetooth connection on request
- Indicator LEDs to signal collection or transmission of data

In-Progress:

- Solar panel and controller for battery recharge.
- Weather-proof hive monitor housing



**Fig.6. Monitor Algorithm:
Full monitor functionality**

Conclusions



Fig. 7. Hive Maintenance: OIT'S Beekeeping Club at work



Fig. 8. Oregon Tech beehives. Monitor housing will be placed under the hive base.

The team has successfully implemented and tested all modules requested to meet the design requirements, except for monitor housing currently in development. This project has shown to effectively collect, store, and transmit data describing the environmental factors both inside and outside a beehive.

The success of this project will allow bee researchers to use environmental data in solving hive death, and aid in providing the conditions essential to foster a thriving hive and bee community. With plans to implement the device in the Oregon Tech Bee Keeping Club's beehive in the summer, this project will provide an immediate positive impact to both the local bees and the community which enjoys the gift of honey and relies on the power of bee pollination.