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FACULTY OF ENGINEERING

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OBERLAND agriscience

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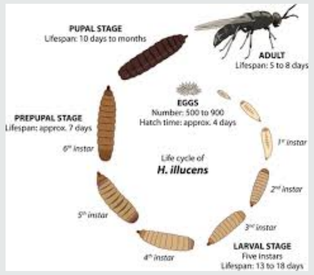
Larvae Activity Monitoring Bin (LAMB)

Background

Black Soldier Fly

- 4th most consumed insect
- A non-evasive species
- Has large reproductive capacity
- Short life cycle & rapid growth rates
- Can use 100% of the fly larvae as:
  - Protein, Chitin, Frass



Black Soldier Fly Life Cycle (De Smet J, Wynants E, Cos P, Van Campenhout L. 2018)

Client's Business

- Farming black soldier flies for 2.5 years
- Developed life cycle processes
- Visual check used for monitoring over life cycle
- Minimal data collected on growth cycle

Project Objectives

- Capture larvae life cycle from day 5-20
- Monitor feeding cycles and growth rate
- Capture client requested scientific data
- Store and display captured data
- The main objective of this project is to design and build a prototype to monitor the growth and activity of the BFS larvae to gain insight into this cruel development stage.

Proposed Solution

Trough Environment

- 2 main sensors
  - Moisture and Temperature
- Focused on feed properties and grub movement

Ambient Environment

- 4 main sensors
  - Temperature, Humidity, Pressure and Light
- Focused on creating baseline data for comparison

Visual Environment

- 2 main sensors
  - Thermal and Infrared Camera
- Focused on tracing thermal movement and size

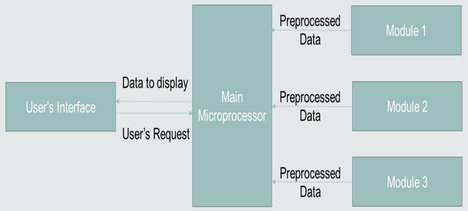
Integrated Prototype

- Integration of Ambient, Trough and Visual Module
- One main processor and data storage unit
- Graphical User Interface (GUI)
- Data analyzing algorithm/Machine Learning Program

System Architecture

System

- Main processor starts program
- Sensor collects the relevant data
- Data is preprocessed
- Data sent to main processor

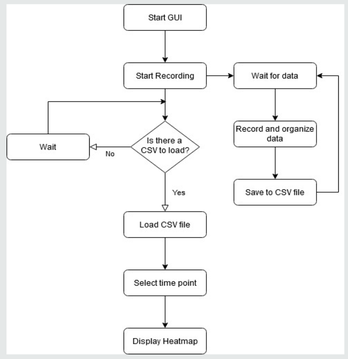


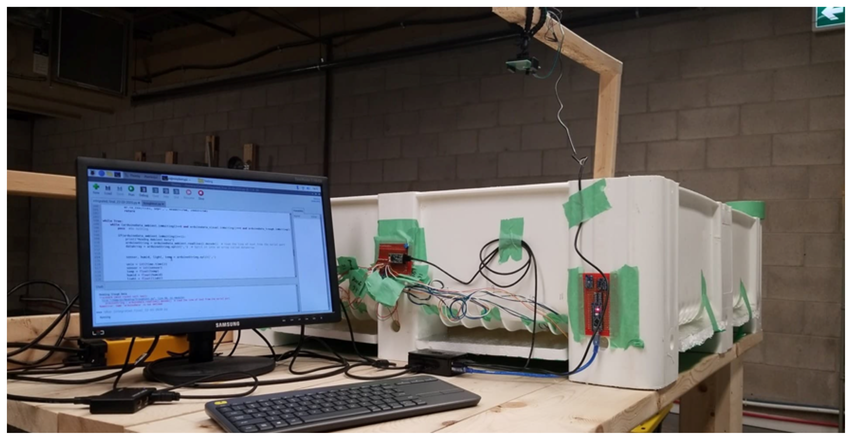
Module

- Initialization of each module
- Modules collect data and deliver to main processor
- Main processor analysis data and send data to user interface

Program

- Program initiated by the GUI start button
- Initialize communication and start recording
- Wait for the data to be transmitted
- Once data is received, record and organize
- Save into a CVS file
- GUI continually checking data file for update



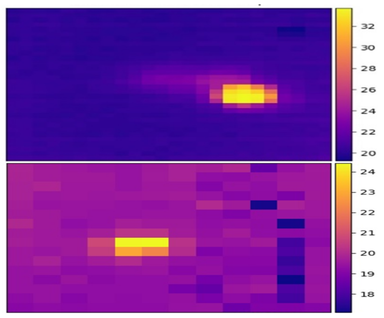


Test Parameters

- Orientated individual modules first
- Completed Initial data collection test
- Used simulated heat signature
- Collected data for 1 hour

Test Results

- Completed first data collection test
  - Thermal camera output
    - Higher resolution
    - Comparable to actual temperature
    - Orientation must be reconfigured to align with Trough Module
  - Trough Temperature output
    - Lower resolution
    - Heat loss found
    - Lower temperature compared to thermal camera and actual temperature



Conclusion

- Completed the first Iteration of integrated system prototype
- Collected vital test data
- Verified functionality of system integration
- Unable to complete Data analyzing Algorithm/Machine Learning Program

Recommendations

- Implement start code for the individual modules that:
  - Initiates averaging time
  - Initiates module start sequence
- Integrate more complicated graphical layout in GUI
- Implement warning messages when the buttons are pressed
- Submit Data analyzing Algorithm/Machine Learning Program as a Project Next year

References

- De Smet J, Wynants E, Cos P, Van Campenhout L. 2018. Microbial community dynamics during rearing of black soldier fly larvae (Hermetia illucens) and impact on exploitation potential. Appl Environ Microbiol 84:e02722-17. https://doi.org/10.1128/AEM.02722-17.