Gensense

Device for Indoor Agricultural Sensing

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Background

Indoor farming is a rapidly growing industry which demands innovation in technology. Genoptic, a research and development company, is dedicated to providing the industry with the adequate tools and technology to flourish. Gensense is a product in development at Genoptic which aims to monitor factors vital to plant growth by enclosing numerous sensors into a single device.

The immediate application of this device will be in a research environment to be collect and store data that will be used to train a machine learning model to be able to take in inputs and provide feedback that would be useful to an indoor farmer.

Scope

The design and validation of a sensor box capable of monitoring factors vital to plant growth in an indoor farming setting, then sending gathered data to the cloud.

Impact

This device may be used in vertical farming, an innovative practice in which crops are grown indoors, in vertically stacked layers. This practice may significantly reduce the carbon footprint of farming by reducing transportation costs and allowing more land to be reclaimed.

Methods

Design a PCB containing elements to read continuous data for plant growth. These parameters include ambient temperature, humidity, leaf surface temperature, Carbon Dioxide concentration, light intensity, and spectrum.

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Test and calibrate components individually on a breadboard.

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Print PCB and ensure that all of the hardware components are integrated together.

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Real-time data is processed and transferred remotely to a centralised data storage location using Zigbee modules.

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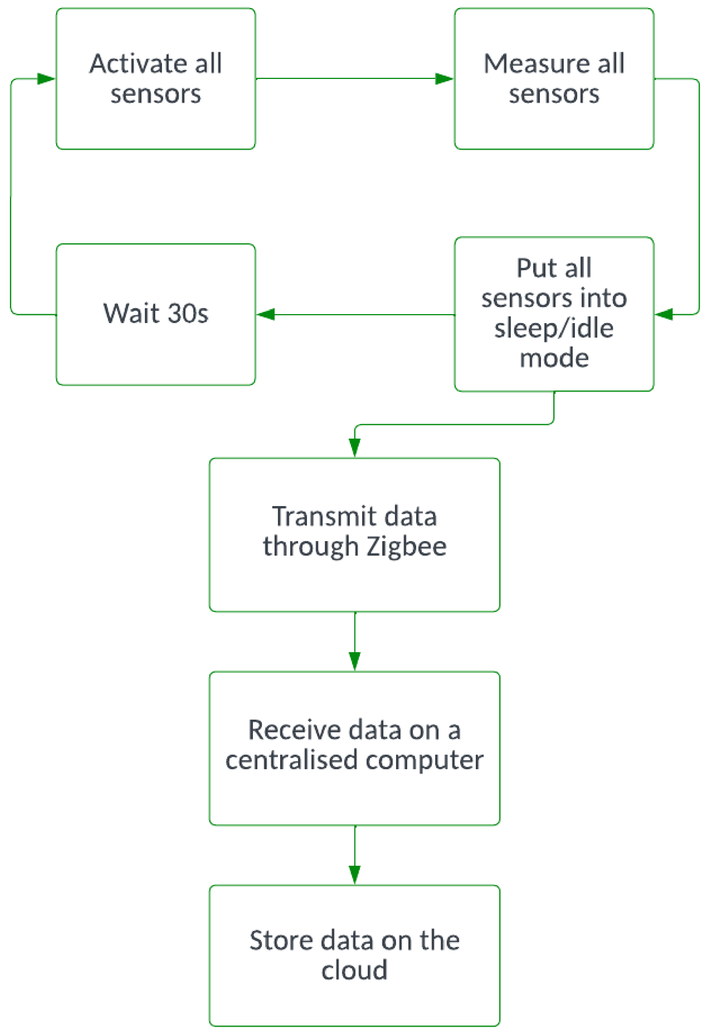
Ensure the device can sufficiently be powered by PV (Photovoltaic) panels in an indoor lighting setting.

Operation



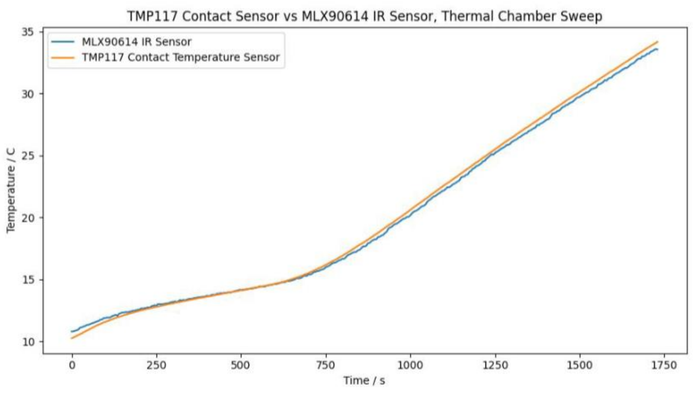
Validation

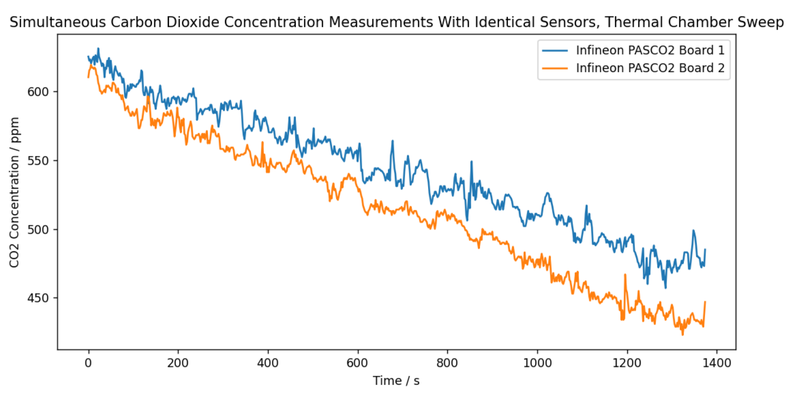
All functionalities of the Gensense product must be tested and validated. This includes:

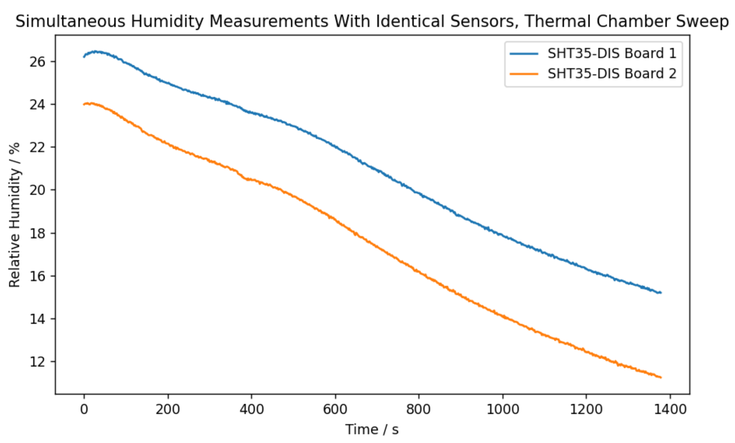
- Validating the accuracy and precision of the collected measurements.
- Testing wireless communication of the board with a central node and measuring the range and data transfer rate.
- Can sufficiently be powered using PV panels and indoor grow lights.

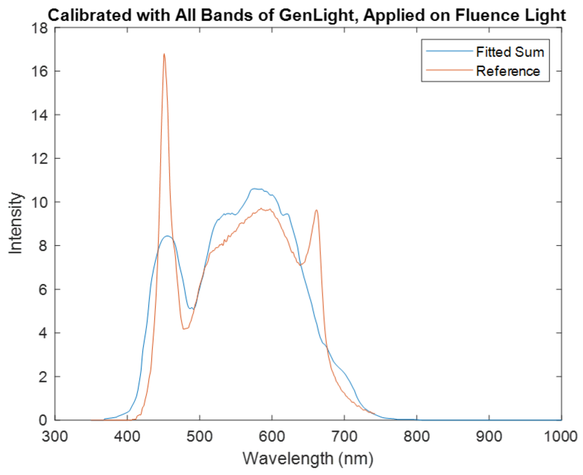
To validate each device the collected data was compared with a reference measurement.

- IR temperature sensor was tested against a 0.1 C accuracy surface contact thermometer.
- Temperature and humidity sensor was tested in a temperature chamber.
- Carbon Dioxide sensor precision will be assessed using 2 identical sensors in varying temperatures.
- Light intensity sensor was tested in various light settings with known lux levels.
- Spectrum sensor was tested against StellarNet research grade spectrometer using various light sources.









Discussion

Further data validation is required to validate sensor accuracy. No sensors are available on the market with higher accuracy than sensors on the device. Therefore, costly test chambers are required to be able to control environmental parameters.

Precision tests need to be redone in more identical conditions to rule out any environmental factors causing the offset in readings in the CO2 and humidity precision tests.

Gensense will likely be paired with another Genoptic product, a grow light called Genlight. This is because Genlight can sufficiently power the device and also contains preset spectrum settings. Therefore, the inaccurate spectrum sensor currently being used is not required as the spectrum is already known.

The spectrum sensor used only cost $7.5 whereas research grade spectrometer cost upwards of $1000. This lead to inaccurate light spectrum measurements.

The design and construction of the device's enclosure was not a priority of our team but is a next step in the design process of this product. Our team have submitted a requirement specification document to the mechanical design team at Genoptic to build an enclosure.

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