Tech Expo, Spring 2026 – Team 34

Facilities Engineering and Operations

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JOHN DEERE

Problem Statement

Creating an environmental sensor box capable of detecting different environmental measurements and capable of withstanding John Deere's facility floor poses numerous challenges. Due to the complexity of the building control system, it can be hard to discern the cause of an alert or system error. The team aims to resolve the difficulty of verification of building control systems and their programming. This solution will provide a simple and effective way for facility operators to verify the building control system.

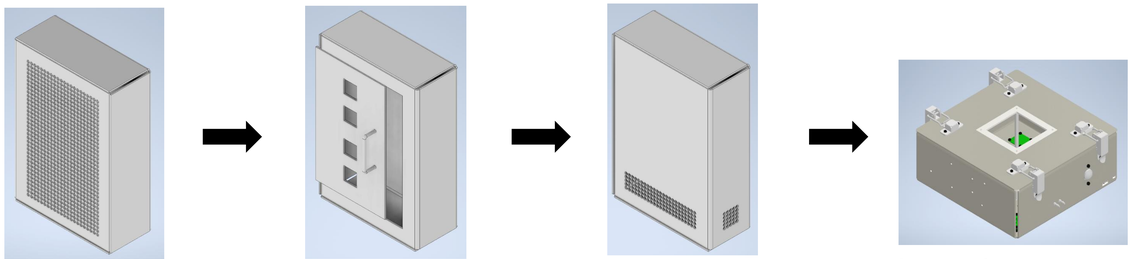
Customer Background

John Deere was investigating a way to verify their current building control system of reading accurate environmental data. John Deere's facility in Moline, IL,, covers several acres, so they wanted a way to measure environmental factors across different locations in their facility with the sensor box being simple to move to the locations required.

Requirements

Req #	Requirement	Description	Test
1	Temperature and Humidity	Measure 0°C - 105°C and 0% RH – 100% RH	Expose device to calibrated environment, compare to a reference
2	Sound Level	Measure up to 115 dB and 8kHz	Generate standardized tones and noise at known SPLs, compare to reference
3	Light Level	Measure up to 60-foot candles	Utilize device to measure the light level of a lamp or lighting element, compare to a reference
4	Motion	Provide readings within 5m	Move item at set of ranges
5	Differential Pressure	Measure up to 100 kPa (15 PSI)	Expose sensor to pressure calibrator and apply set amounts, compare to a reference
6	Air Flow	Measure 0 to 67 m/s (0 – 150 MPH)	Utilize fan or similar device, compare to a reference
7	Air Particulate	Measure 0-1000µg/m3	Place device in particle test chamber, compare to a reference
8	Battery	Sensor box remain powered for at least 24 hours	Tests at a minimum of 24 hours
9	Industrially Hardened	Sensor box remain functional after damage	Device drop tested with multiple heights and floor materials
10	Electrical Connections	All connections reinforced to remain secure from stress	I/O shield connected to Arduino allowing connections to be soldered

Experimentation and Concepts



Concept 1: Box with Mesh Filter in the Center

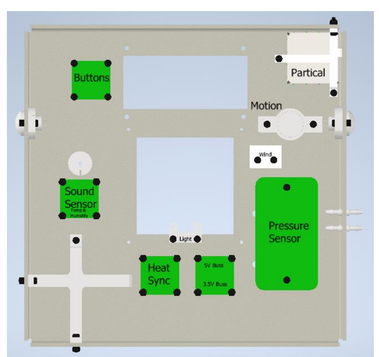
Concept 2: Box with Sliding Door

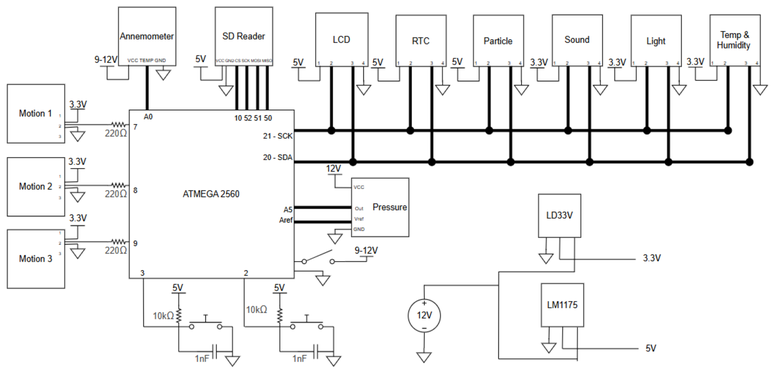
Concept 3: Box with Mesh Filter Along the Bottom

Concept 4: Box with Mesh Filter in the Center and Latches (Final Design)

During the experimentation and concept exploration phase, different box designs were created. A mesh filter was considered important to protect the sensors from dust and other potential debris. Different sized mesh filters were compared and how the box would open for access to the internal system through a sliding door compared to latches.

Final Design





The final design is a donut shaped box incorporating the mesh filter from the earlier designs. Latches are used for the box to stay secure and for easy access to the internal system. The electrical schematic shows the complete sensor system.

Testing and Results

Req #	Test Name	Test Description	Test Results
1-4, 6-7	Light, Sound, Temperature, Humidity, Wind Speed, Motion, air quality	6-hour test conducted for the following sensors	Sensors reading precise data, light sensor did not record data. Data collection interval to be increased from every 1 second to every 30 seconds to reduce data overflow
1-4, 6-7	Light, Sound, Temperature, Humidity, Wind, Speed, Motion, Air Quality	12-hour test conducted for the following sensors	Sensors reading precise data, motion sensors did not record data due to damage, new motion sensors ordered with plan on soldering motion sensors
1-7	Light, Sound, Temperature, Humidity, Wind, Speed, Motion, Air Quality, Air differential pressure	24-hour test conducted for the following sensors	Sensors reading precise data, motion sensors and differential pressure sensor did not record data when integrated, code to be reviewed and wiring for it adjusted, waiting on motions sensors to arrive
1-7	Light, Sound, Temperature, Humidity, Wind, Speed, Motion, Air Quality, Air differential pressure	24-hour test conducted for the following sensors	Sensors reading precise data, sound sensor did not record data due to damage, new sound sensor ordered
1-10	Light, Sound, Temperature, Humidity, Wind, Speed, Motion, Air Quality, Air differential pressure	24-hour test conducted with final design, integration of all sensors with box design	Sensors reading precise data with incorporation of box

During the testing phase, problems were discovered when integrating the sensors. These problems were resolved through adjusting the way the data was presented and changing the wiring within the system. Results of the tests show changes in the environment. Light, Air Quality, and Temperature are shown: