Automated Vent Controller

Group 15

Sponsored By Chris Neiger

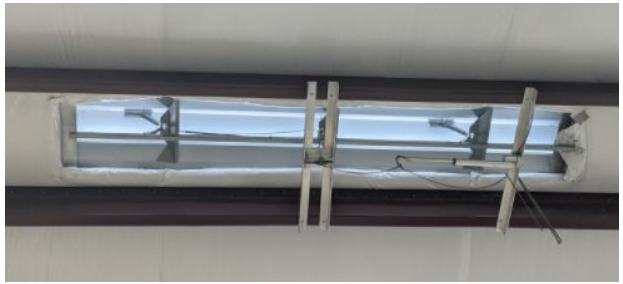
Wendy Dominguez - CPE
Gisela Griesheimer - EE
Angelica Longo - CPE
David Munyon - EE

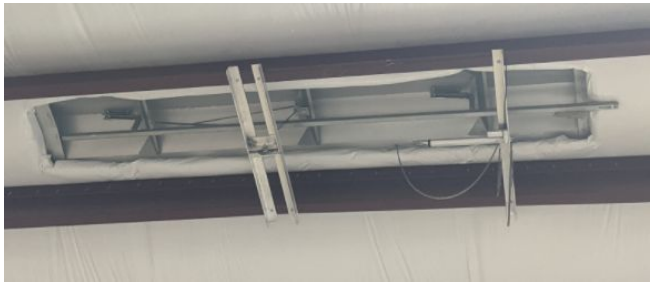
Background - The Warehouse

- Owned by our sponsor Chris Neiger
- 6000 sq ft warehouse in Niceville FL
- Majority of use is from 2-8pm
- Plasma cutter, TIG welder, CNC, and other machinery creates pockets of heat

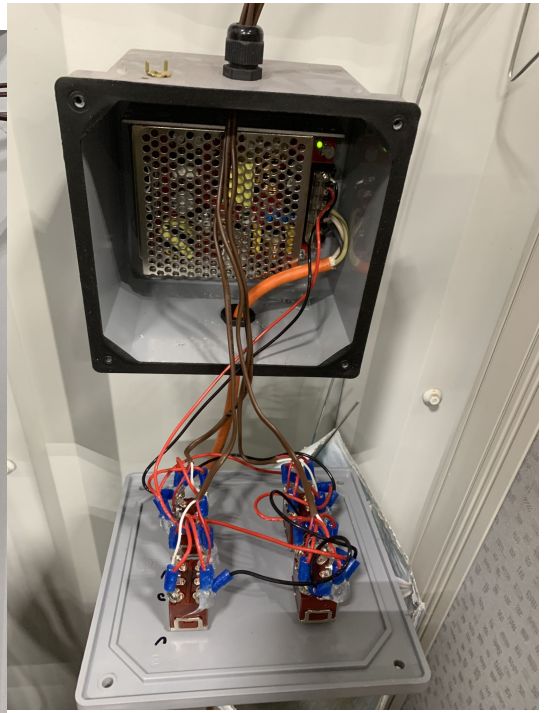
Background - The Warehouse

- 4 Vents
  - Can be fully open, closed, or paused between stages
  - Already installed and powered
- Full time from open to close ~ 25 seconds
- Operated manually through switches





Background - The Warehouse



Current Control System

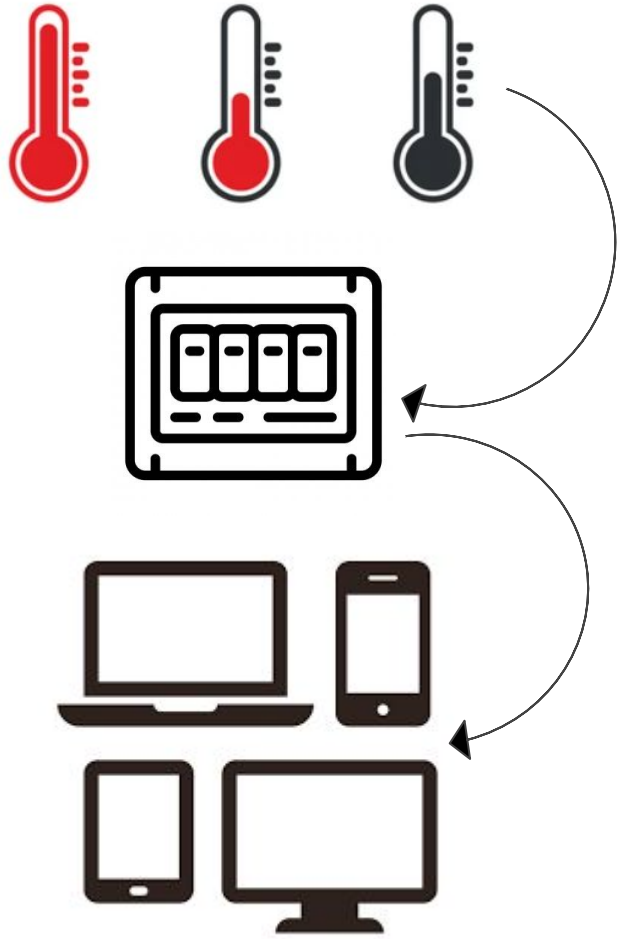
- Each vent controlled by one switch
- Switch up - open
- Switch down - closed
- Switch mid - paused

Motivations

- Automate Vents to cool warehouse
- Warehouse is large and expensive to air condition
- Space used during limited hours
- Smart Home/ IoT tech becoming increasingly more desired
- Natural cooling is better environmentally

Goals & Objectives

- Five indoor sensors to aggregate warehouse temperature and humidity
  - Sensors placed to find heat pockets
- Compare with outdoor temperature and humidity
- Control Unit interprets data and tells each vent which position to be in
- Touch screen installed in warehouse to see vent states and take manual control
- Website to check and adjust vents remotely



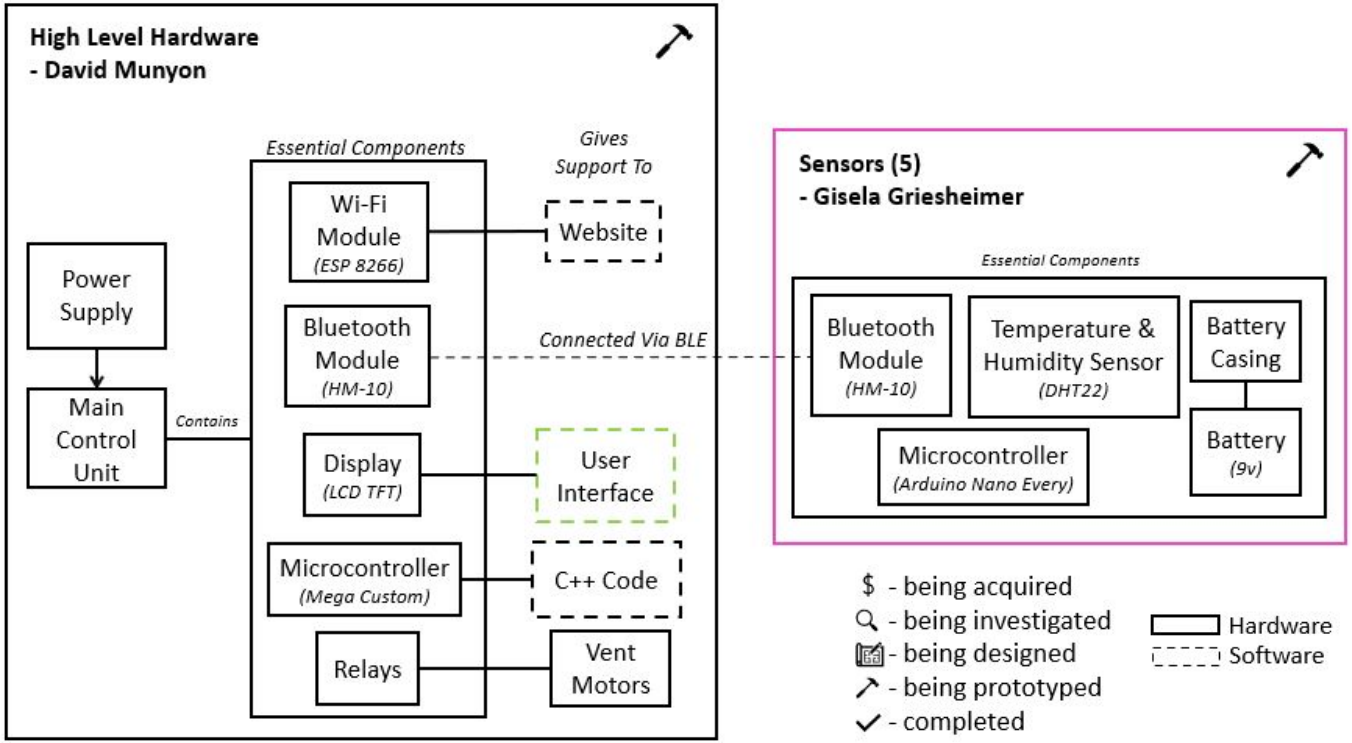
Requirement Specifications

Component	Parameter	Design Specification
*Sensor Unit Battery	Lifespan	1+ year
Sensor Unit	Maximum Range	100 feet
*Main Unit (Display)	Update Time	2 seconds
Main Unit (Automation)	Override Expiration	1 hour
Main Unit (Controls)	Response Time	1 second
Temperature Sensing	Accuracy	± .5 C
Humidity Sensing	Accuracy	2%
*Web Controller	Response Time	60 seconds
Web Scraping	Update Time	1x /second

Requirement Specifications

Component	Parameter	Design Specification
Sensor Unit	Maximum Range	100 feet
Main Unit (Display)	Update Time	40 seconds
Main Unit (Automation)	Override Expiration	3 hours
Main Unit (Controls)	Response Time	1 second
Temperature Sensing	Accuracy	± .5 C
Humidity Sensing	Accuracy	2%
Web Controller	Response Time	60 seconds
Web Scraping	Update Time	1x /second

Overall Block Diagram - Hardware



Main Control Unit

Power Supply- LM2576

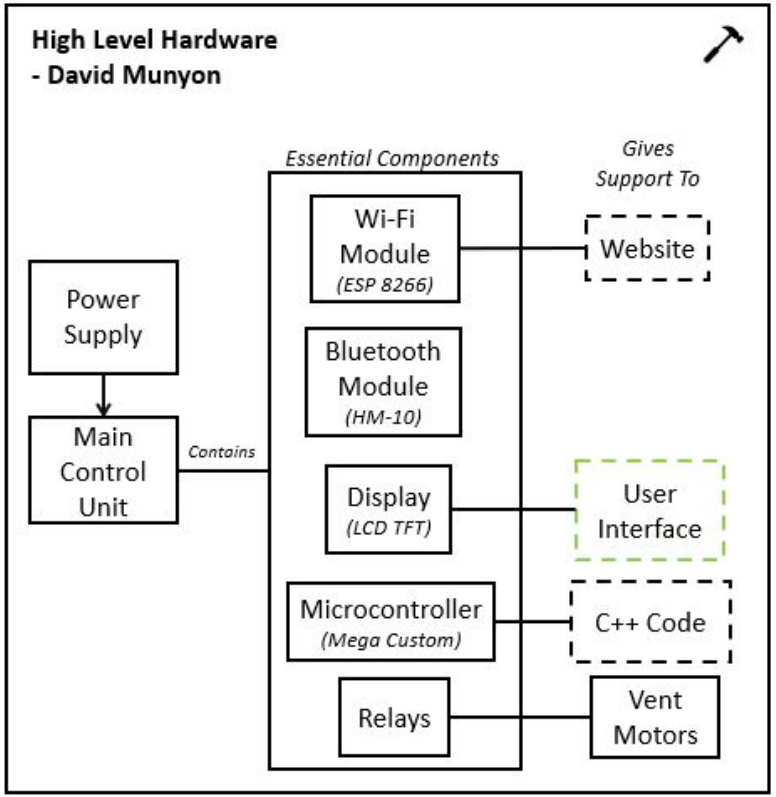
Bluetooth Module- HM-10

Wifi Module- ESP 8266

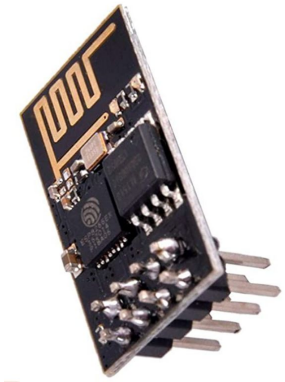
Touch Display- Adafruit 3.5” TFT Display w/ resistive touch sensing.

Relay Module - ELEGOO 4-Channel Relay Module

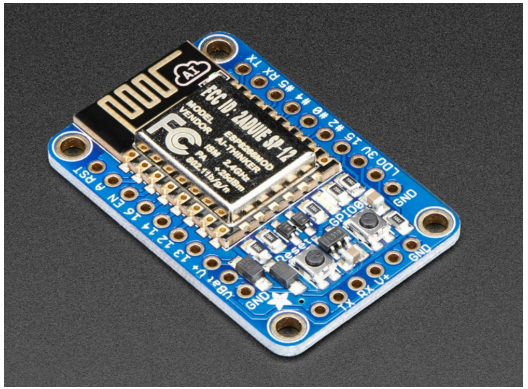
Microcontroller- Atmel ATMEGA2560



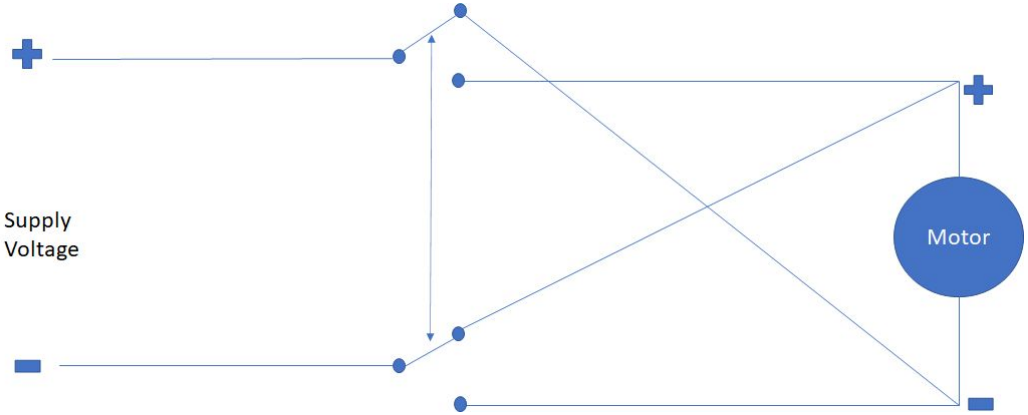
Part Selection-Wifi Module

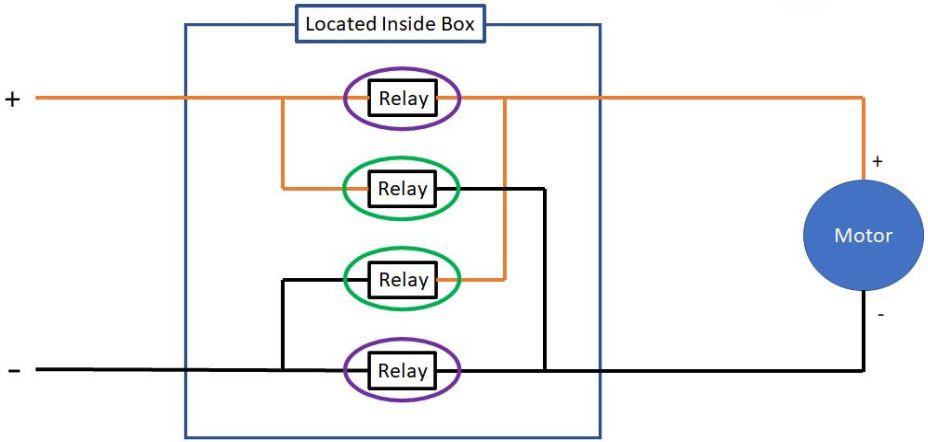


	ESP 8266	**Adafruit Huzzah**
Input Voltage	3.3V input	3-6V input
Logic Level	3.3V logic level	3.3V logic level
Core	ESP 8266	ESP 8266
Programming	Arduino IDE	Arduino IDE (Requires FTDI Cable)



Relay Modules



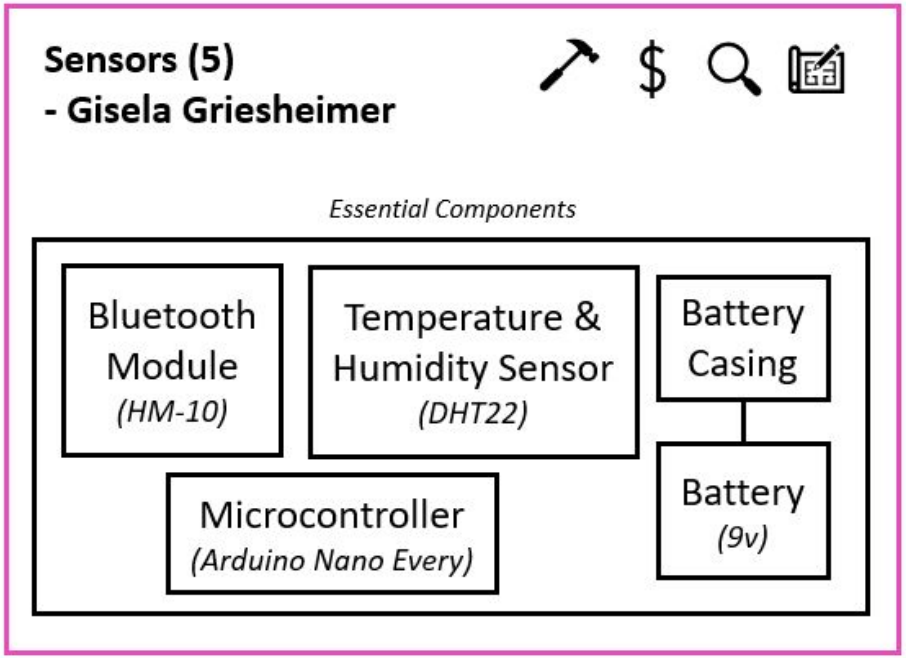


Opening Relays

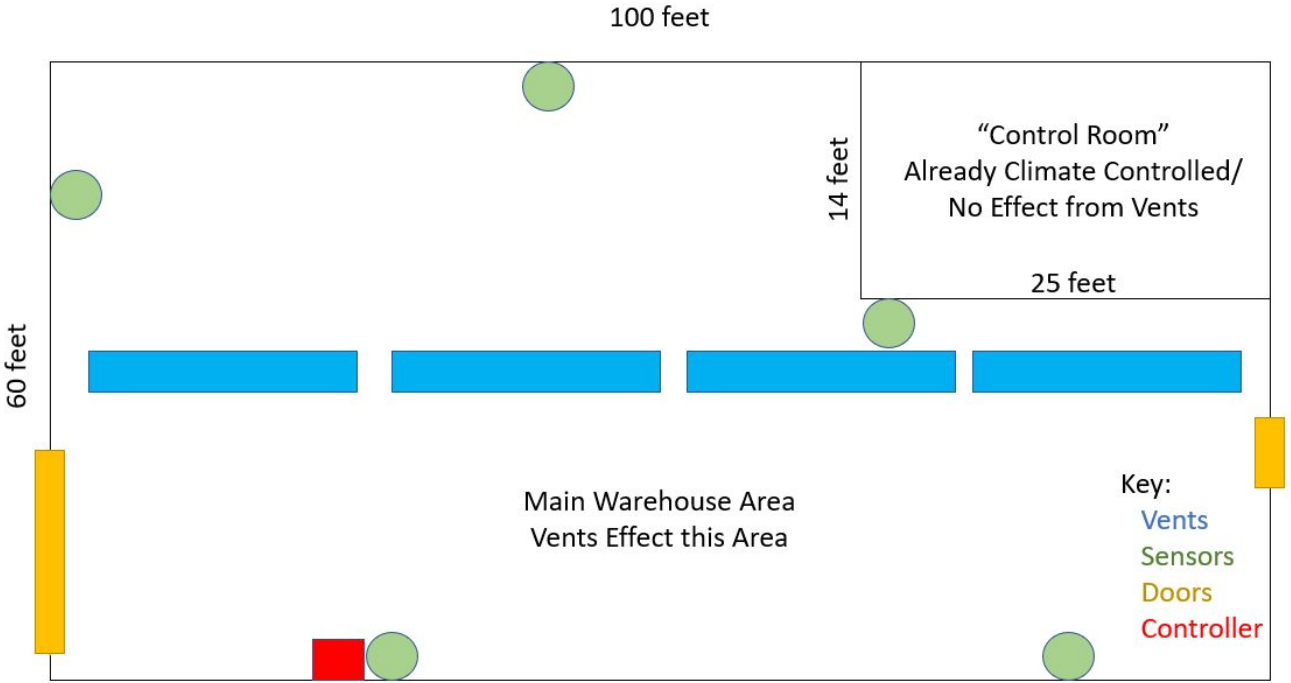
Closing Relays

Indoor Sensor Units

- 5 Sensors
  - Wall Mounted
- Detect temperature and humidity within warehouse
- Send Data to Main Control Unit
- Data aggregate for best accuracy
- Data collected 1x/minute



Proposed Sensor Placement



Parts Selection - Temperature/Humidity Sensor

Adafruit

Comparison of DHT11 and DHT22 Sensors

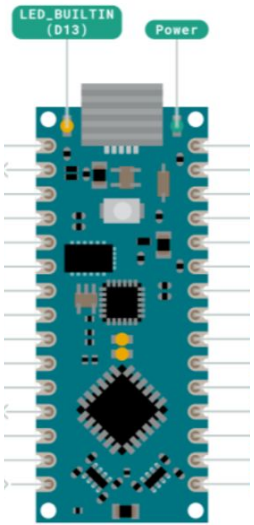
Parameter	DHT11	DHT22
Temp Range	0-50(C)	-40-80(C)
Temp Accuracy	+/-2(C)	+/-0.5(C)
Humidity Range	20%-90%	0%-100%
Humidity Accuracy	+/-5%	+/-2%
Sampling Time	1s	2s
Price	~$5/each	~$10/each

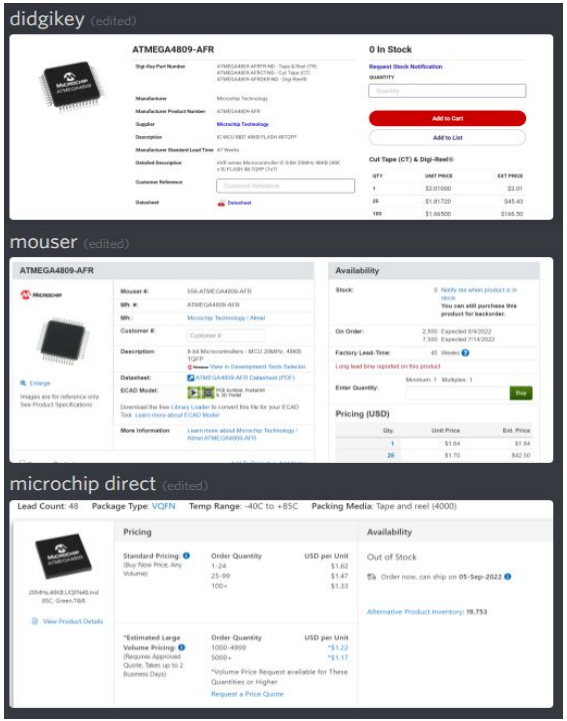
Parts Selection - BLE

Microcenter

Bluetooth Module	Configuration	Regular Bluetooth /BLE (Bluetooth 4.0)	Well Documented?	Price
HC 05	Master/minion	Bluetooth	yes	$7.99
HC 06	Minion only	Bluetooth	yes	$8.49
HM 10	Master/minion	BLE (Bluetooth 4.0)	yes	$10.99
HC 08	Master/minion	BLE (Bluetooth 4.0)	no	$7.99

Parts Selection - Arduino Nano Every





ATMEGA 4809 AFR

0 In Stock

Availability		
Stock:	0	Notify me when product is in stock. **You can still purchase this product for backorder.**
On Order:	2,500 7,500	Expected 6/9/2022 Expected 7/14/2022
Factory Lead-Time:	45	Weeks
Long lead time reported on this product.		

Availability

Out of Stock

Order now, can ship on **05-Sep-2022**

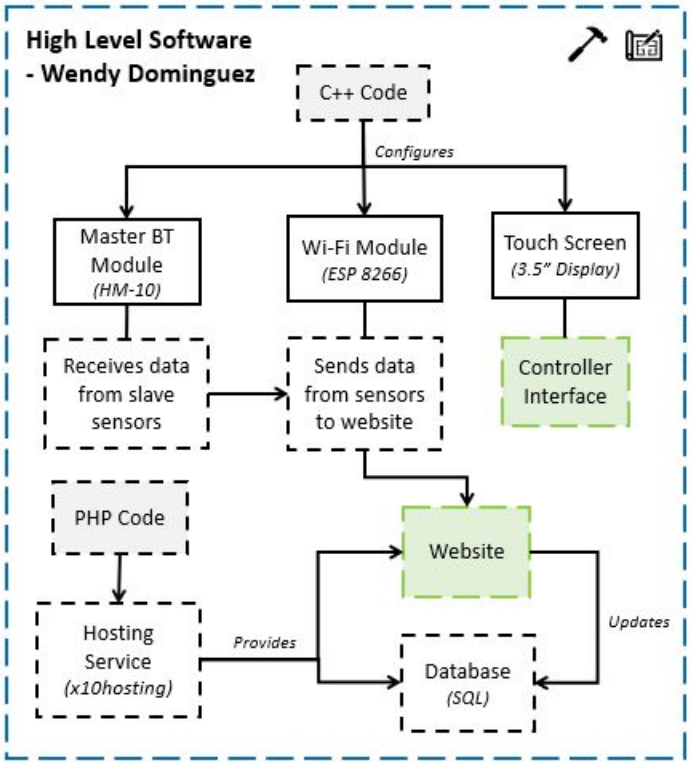
Parts Selection - Battery

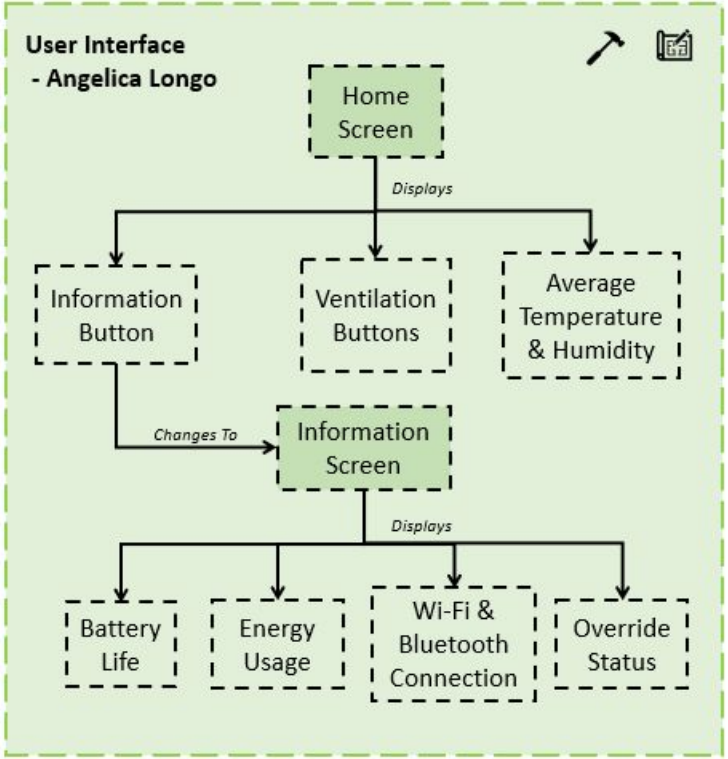
Battery	CR2	Lithium 9V
Voltage (V)	3	9
Number needed to meet Voltage requirement	3	1
Practical life (mAh)	800	1200
System Cost	$13.50	$6.89

Overall Block Diagram - Software

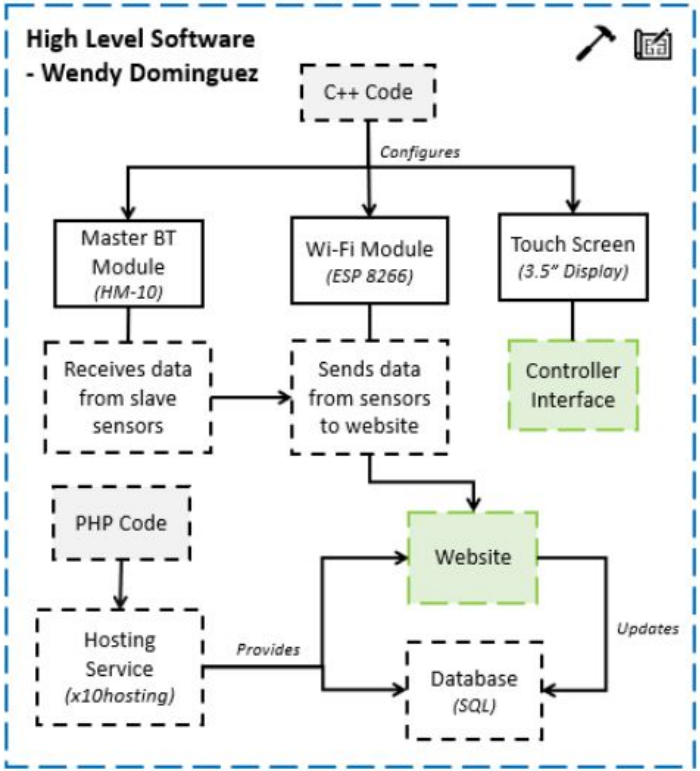
$ - being acquired
🔍 - being investigated
🏭 - being designed
↗ - being prototyped
✓ - completed

Hardware
Software



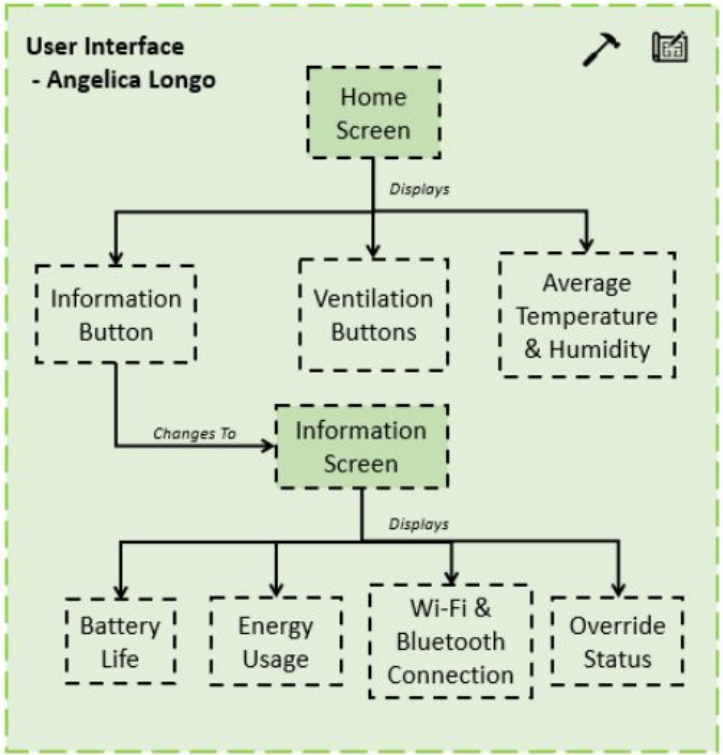


Software - Code Outline



- Sketches are uploaded using Arduino IDE to configure each module
- Hosting service provides our own server domain and database support
- All PHP files are placed into “File Manager’’ of the hosting service
  - PHP script to receive data and insert it into a MySQL database
  - PHP script that displays the database content on a web page
- Visualize the readings from anywhere by accessing our domain name.

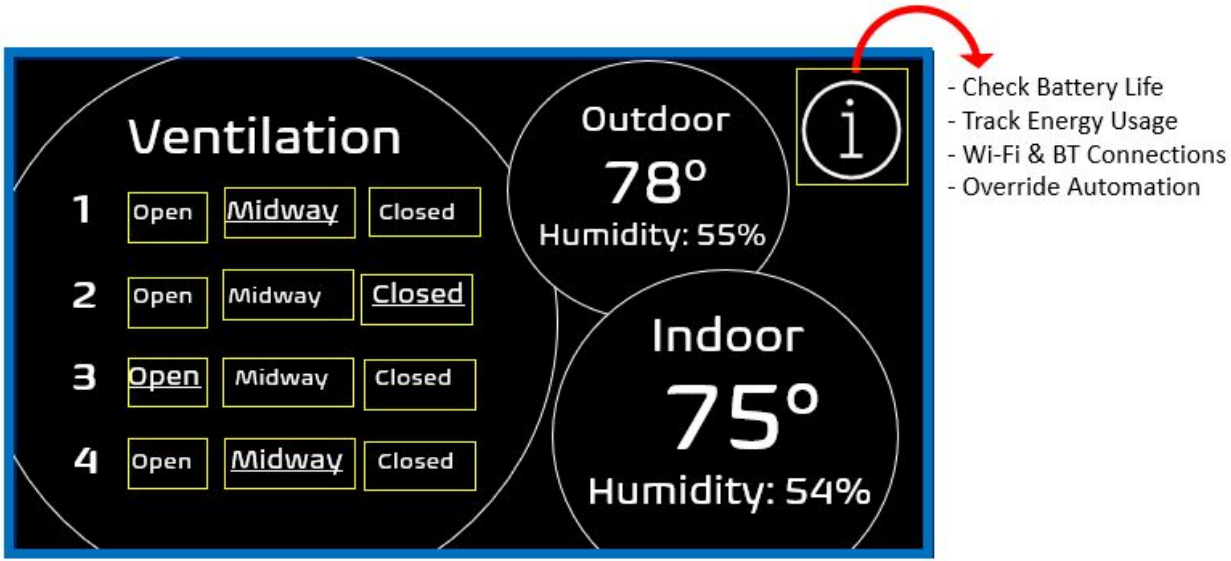
Software - UI Design



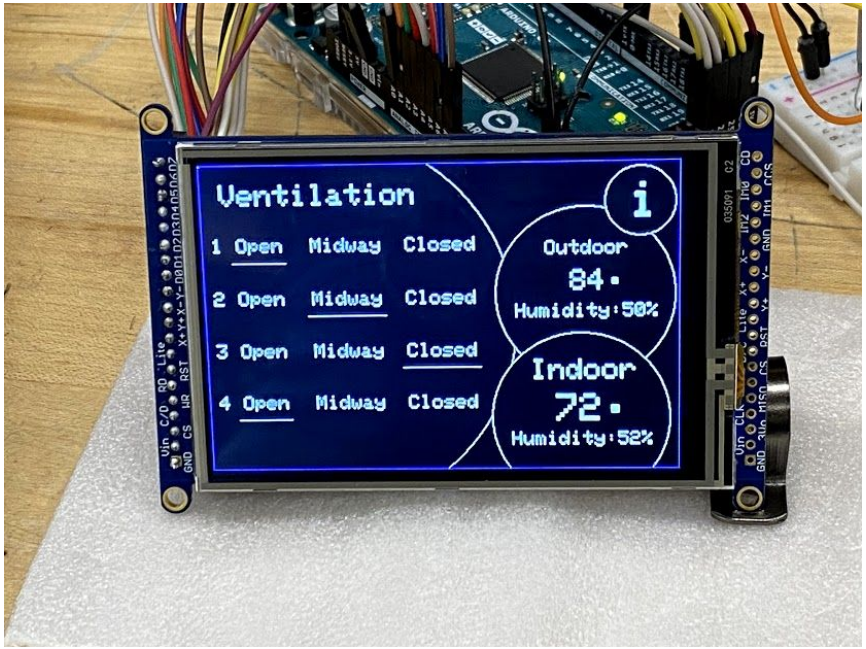
- Same user interface on the touch display and the website
- The main screen displays indoor and outdoor climate data, as well as buttons to control each vent
- The information screen displays additional device details/controls

Touch Display (concept illustration)

- Current status of each vent is underlined
- Outdoor data gathered by the API
- Overriding will stop automation for 1 hour



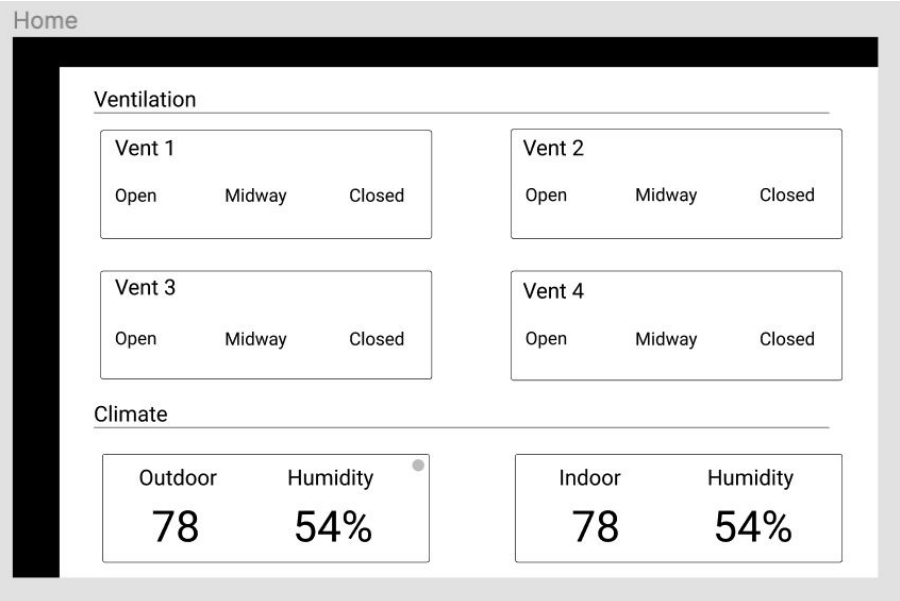
Touch Display (prototype)

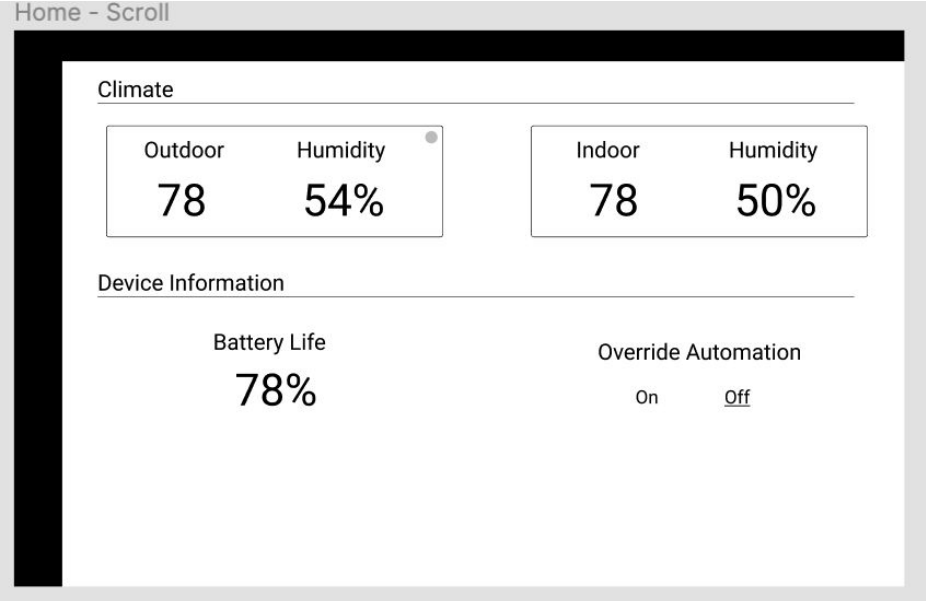


- Control each vent individually
- Easily compare indoor and outdoor temperature & humidity
- Access the information screen for additional details and options

Website (Wireframes)

- The functionality is the same as the touch display.
- The outdoor temperature can get updated by clicking on the refresh button in the top right corner



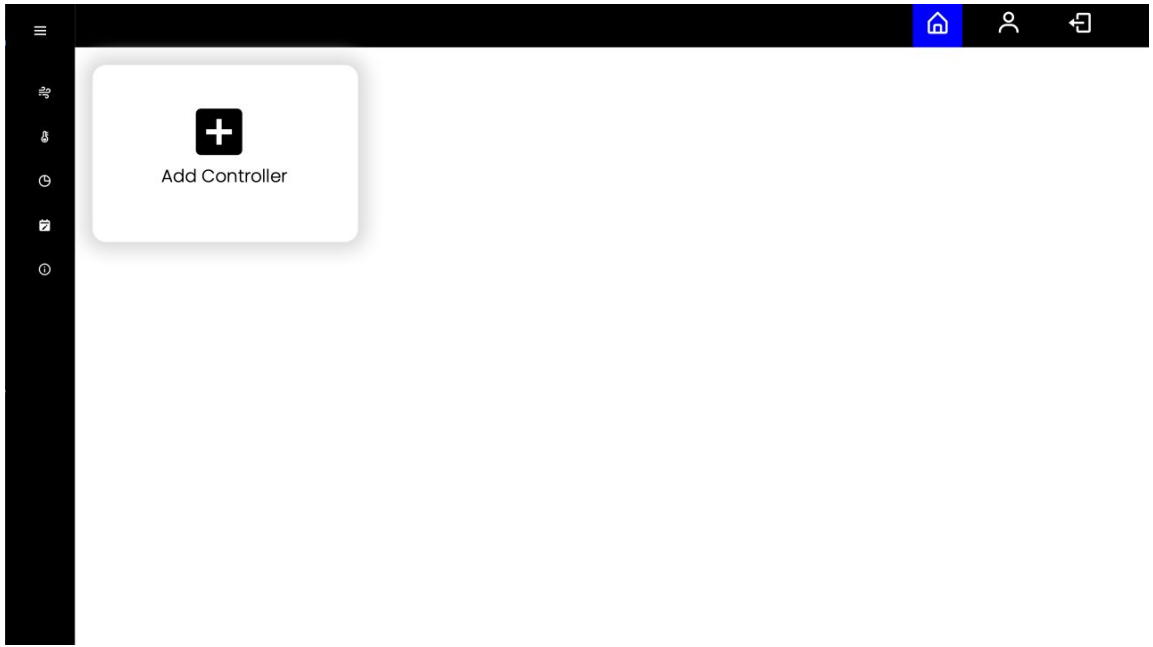


Outdoor Weather Data

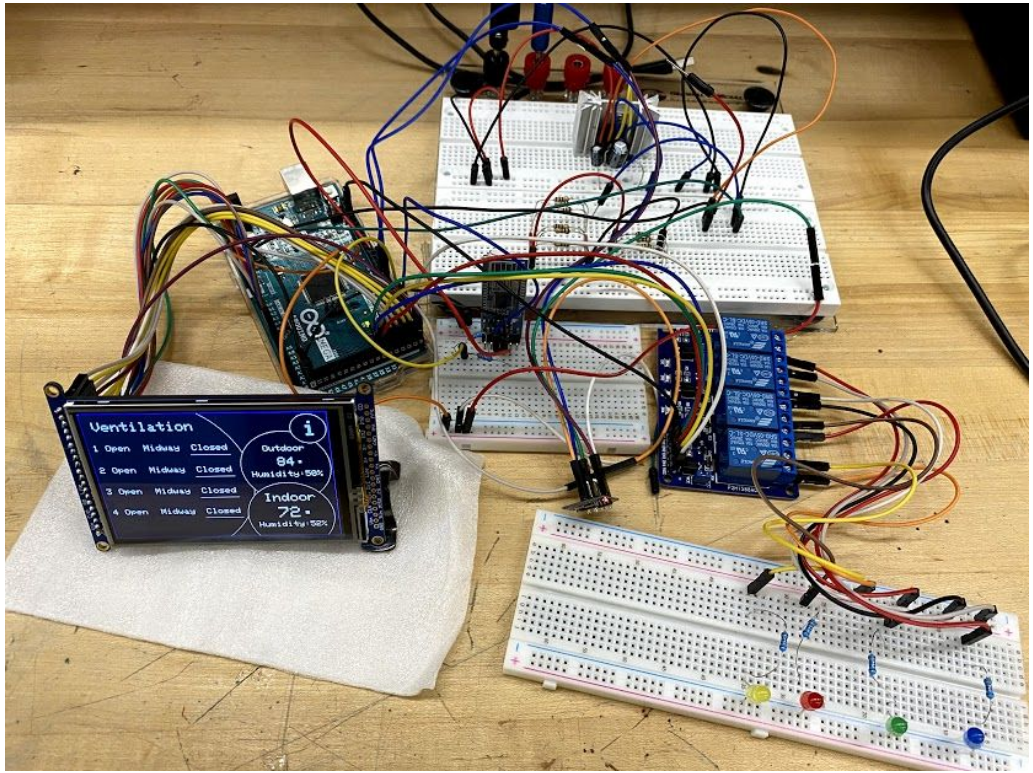
- With the time constraints we have, we are planning to use this free weather API.
- Allows for 60 calls per minute, has Niceville as one of the cities.

Website (Prototype)

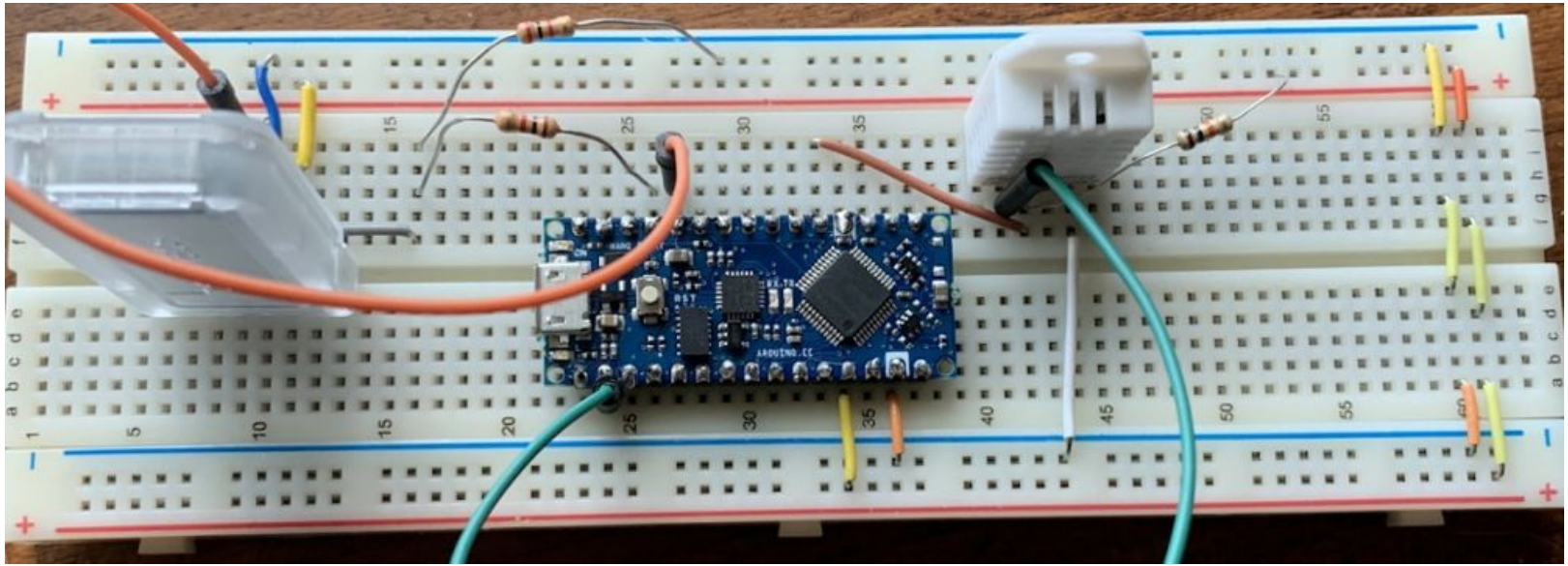
- The navigation bar at the top, is where links to the other available pages are in.
- The side navigation bar links to parts of the page, to make it easier for the user to get to the information they want.



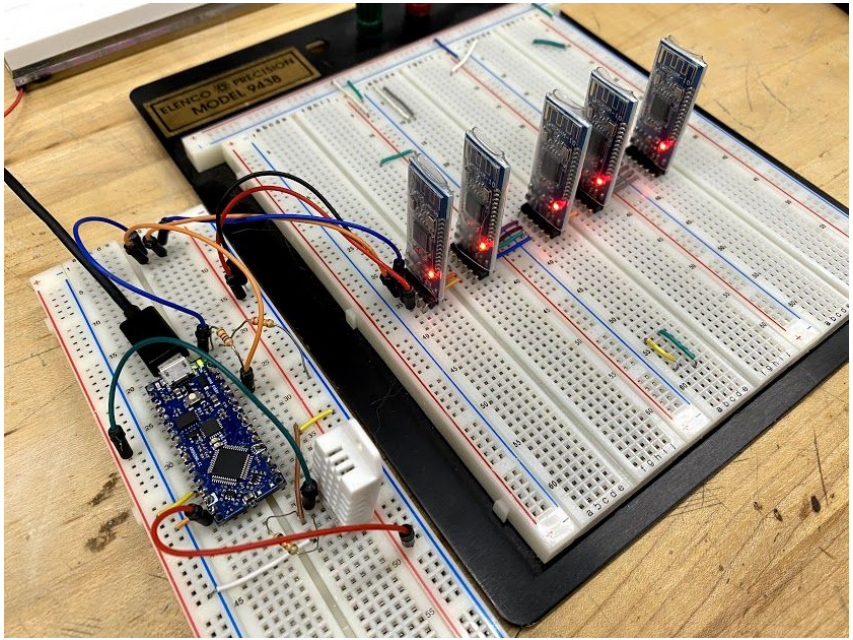
Prototype - Main Control Unit

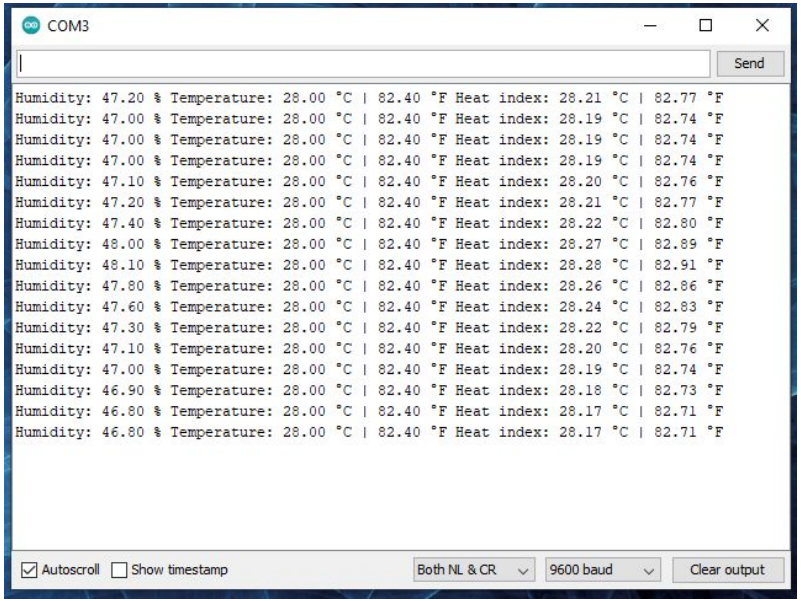


Prototype - Sensor Unit



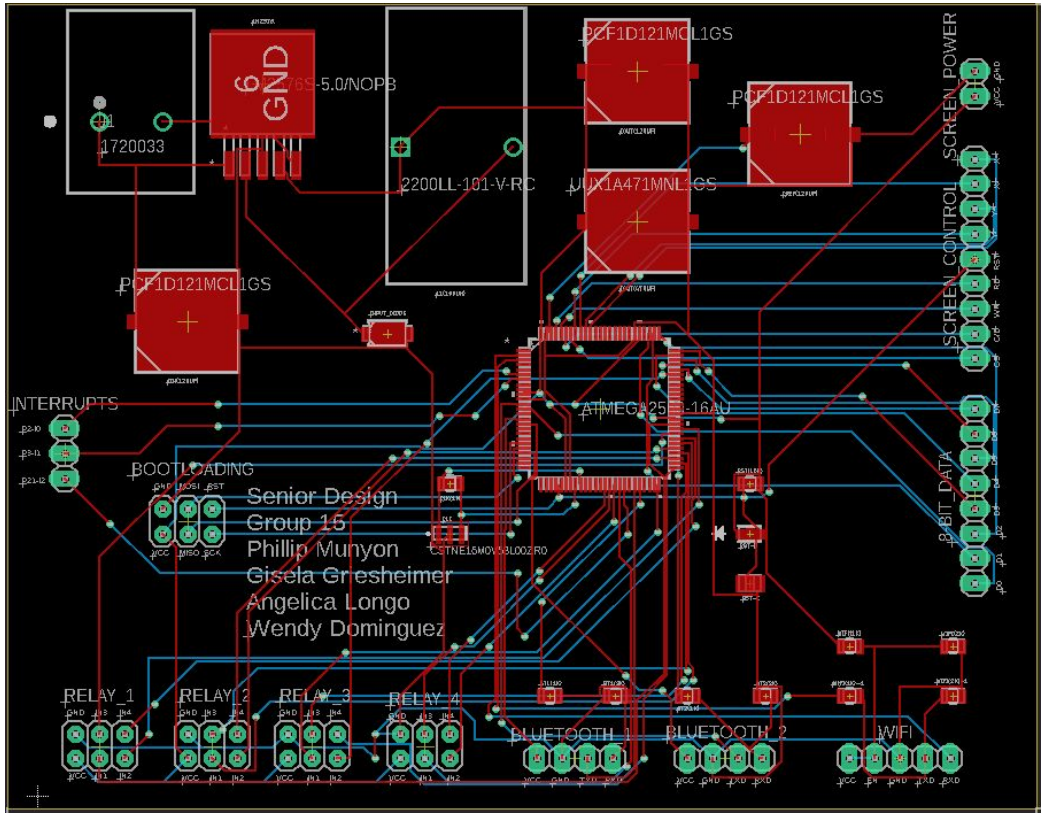
Prototype Testing





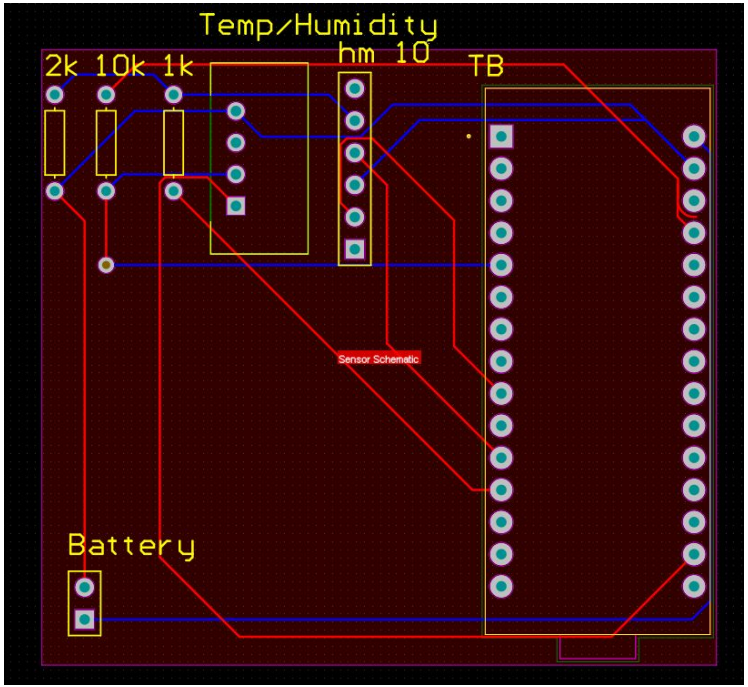
PCB Design- Main Control Unit

- Two Layer Design
- Center- ATMEGA2560
- Bottom- Relay and Communication Connections
- Right- Screen Power, Data, and Control
- Top- Power Supply and Auxiliary Components
- Left- Interrupts Connections and Bootloading Communication.



PCB Design - Sensor Unit

- Two-layer PCB for each sensor unit
- Arduino Nano Every, HM 10, DHT22, and 9V Battery on each board
- Approximately 5cm x 5cm



Finance and Budget

Running Total : $558.47

Order	Cost	Order	Cost	Order	Cost
HXD8357D (LCD Screen), DHT22 (Temp Sensor), ESP8266 (Wifi)	$75.60	Bluefruits, voltage regulators, and step converter	$61.46	SMD Components	$45.28
Arduino Nano Every	$24.72	Relay x4	$33.69	Wifi Module	$11.76
Arduino Mega	$54.12	Ship Sensor to Orlando	$8.45	Lithium 9V Battery	$7.34
DHT22 (Temp Sensor) x4	$54.52	Controller and sensor PCBs	$25.33	Switches	$16.02
HM 10 (BLE), Lithium 9V Battery, Battery Case 3 pack	$26.61	4x Arduino Nano Every	$43.17	Working HM 10s x5	$70.40

Current Progress & Future Plans

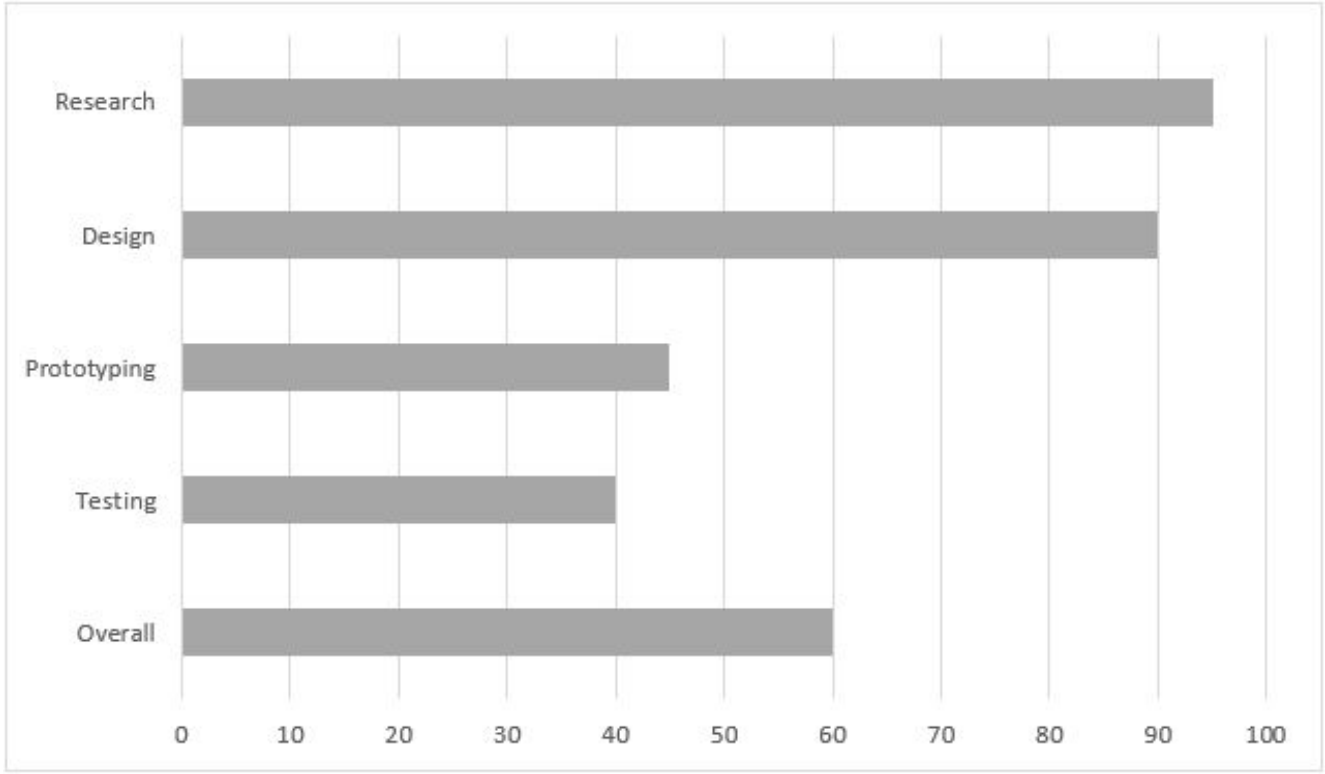
Completed

- Component Testing
  - HM-10 (6), 3.5” TFT Display, ESP8266, Relay (4), DHT22 (5), and power supply
- One-to-many BT communication loop
  - 1 master and 5 slaves (with DHTs)
- Database setup
  - Created tables for users, vent status, and climate data
- Basic website template
  - Register, login, view account, logout
- Designed and ordered PCBs

Going Forward

- Test wireless communication distance requirements
- Measure open/close time duration for each vent at warehouse
- Map the ventilation buttons to trigger the relays
- Code the automation logic
- Add details to information screen
- Send gathered information to database
- Install and evaluate at warehouse

Progress


Research
Design
Prototyping
Testing
Overall
0
10
20
30
40
50
60
70
80
90
100

Work Distributions

	High Level Hardware	Sensors	High Level Software	User Interface
Primary	David	Gisela	Wendy	Angelica
Secondary	Gisela	David	Angelica	Wendy

Questions?