Deliverable D - Conceptual Design

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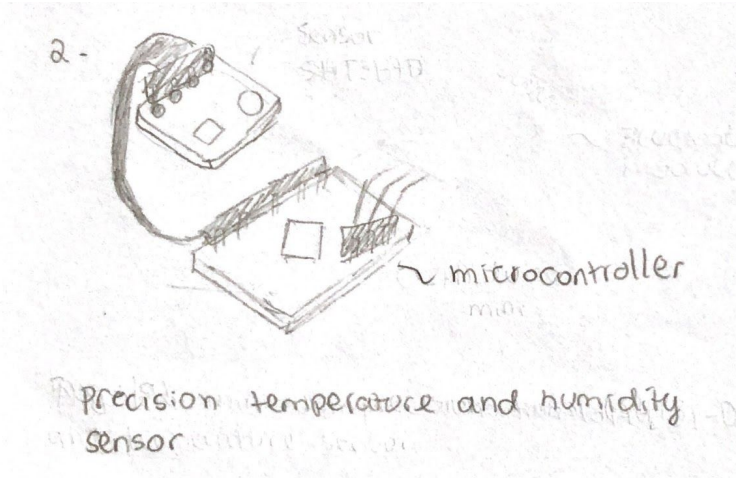
Introduction

JAMZ Automated Delivery is a drone delivery service focused mainly on the shipment of food from restaurants to the client. Their drones are ready for use, however, some essential features, like a climate sensor inside the package, are not functional yet. The main goal of this project is to develop a reliable solution that generates information about the content of the package during delivery. The device should provide valid and consistent data on the temperature and humidity of the food and communicate via radio with an operator from JAMZ. In this document, the group D8 presents the brainstorming process and final concept selection for three subsystems of the project: the sensor, the microcontroller and a housing for the system.

Concepts

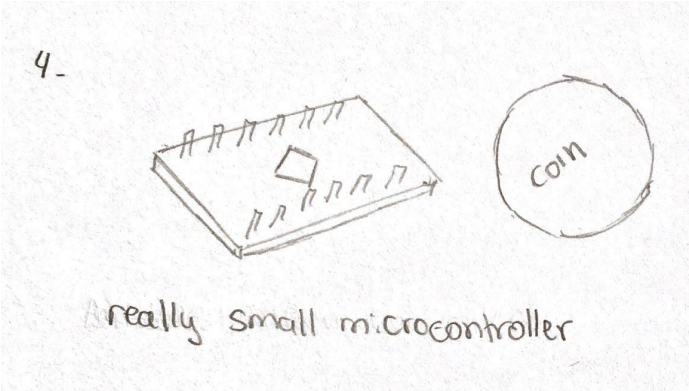
This section presents the conceptual ideas of each subsystem with their corresponding author. Sketches and brief descriptions were used as a resource to make the understanding of each part more accessible.

Amanda's concepts



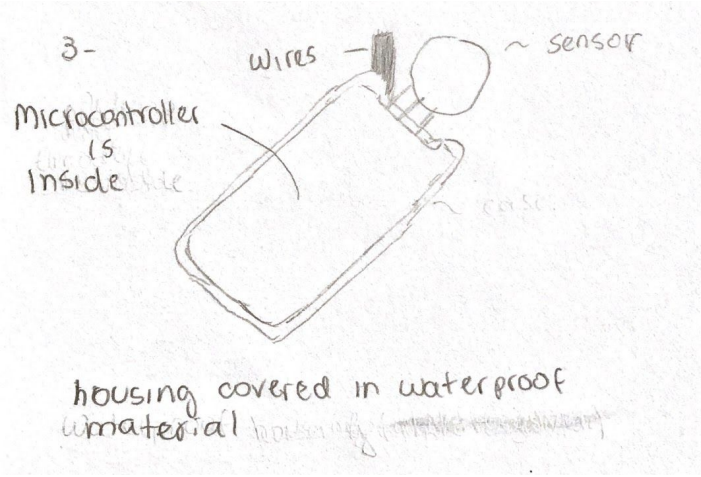
Sensor
A precision temperature and humidity sensor connected to a microcontroller

Microcontroller



Small and light microcontroller with low power consumption

Housing

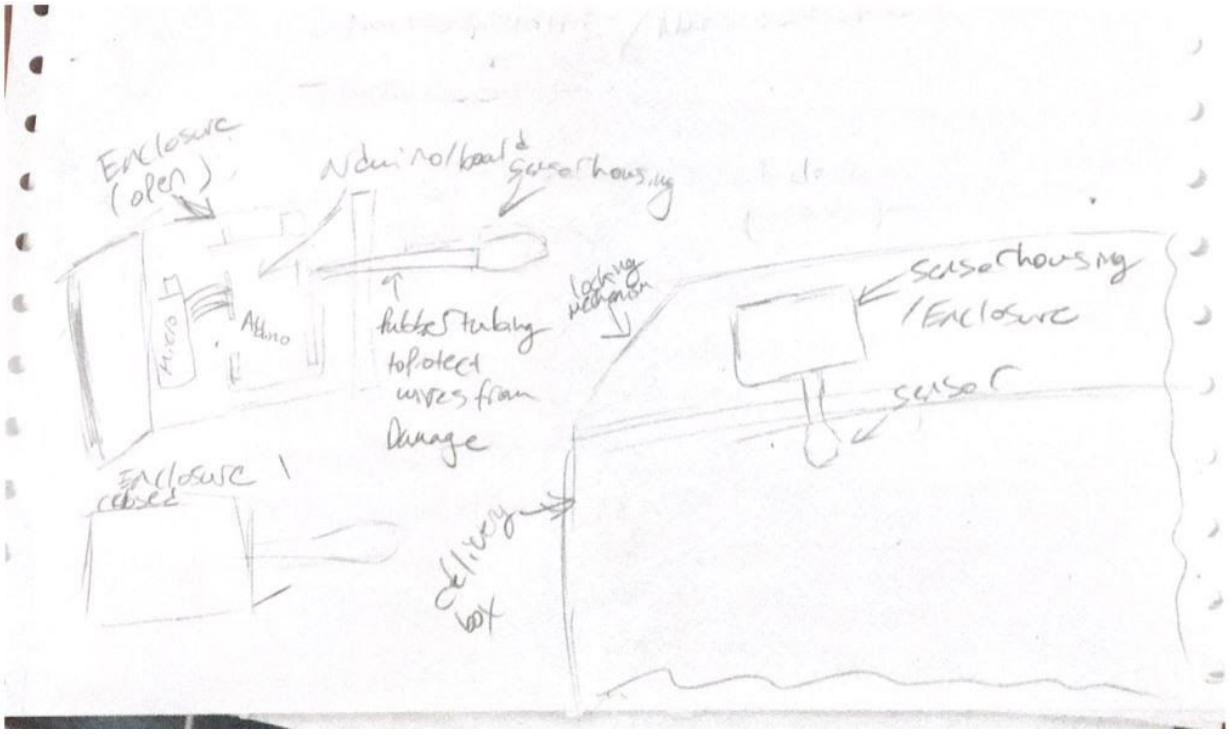


Waterproof cover made for the housing, preventing contact of the microcontroller with water

Aaron's concepts:

I chose option 3 of my subsystem concepts; it most optimally met the design criteria listed from our client. The Sensirion AG SHT31-DIHIH8120-021-001S-P2.5KS sensor scored the highest on our design criteria analysis in deliverable C. The Arduino Uno and Micro microntroller use an IDE already familiar to our team,and will be easier to troubleshoot coding. The other microcontroller options use unfamiliar IDE's and may produce complications or unnecessary difficulty during the coding phase of the project.The Bopla 96011115 housing was selected because this housing is waterproof , has built in microcontroller mounts, and has addition space internally to fit our microcontrollers and circuit

components.As an additional layer of protection for the wiring, I included latex rubber tubing. We can feed the wires through this tubing, and create a protective housing for them as well as additional insulation.A small hole will be drilled in the side of the enclosure to feed the enclosed wires through. The sensor will be attached to the external side of these wires/tubing. This allows the sensor to not be constrained in it's position, so that we can easily insert it into the takeout container. Lastly, I decided on either plastic cement or zip ties for mounting options. The housing will be mounted on the side or top of the delivery box locking mechanism/release. This way, it can monitor the food's temperature and humidity status at all times of the delivery process. One particular drawback is cost ,as the arduino brand microcontrollers are more expensive than the alternatives, but the reliability of the brand and the abundance of information online for learning the Arduino IDE make the increased cost worthwhile.



Shayleen's Concept:

Sensor's

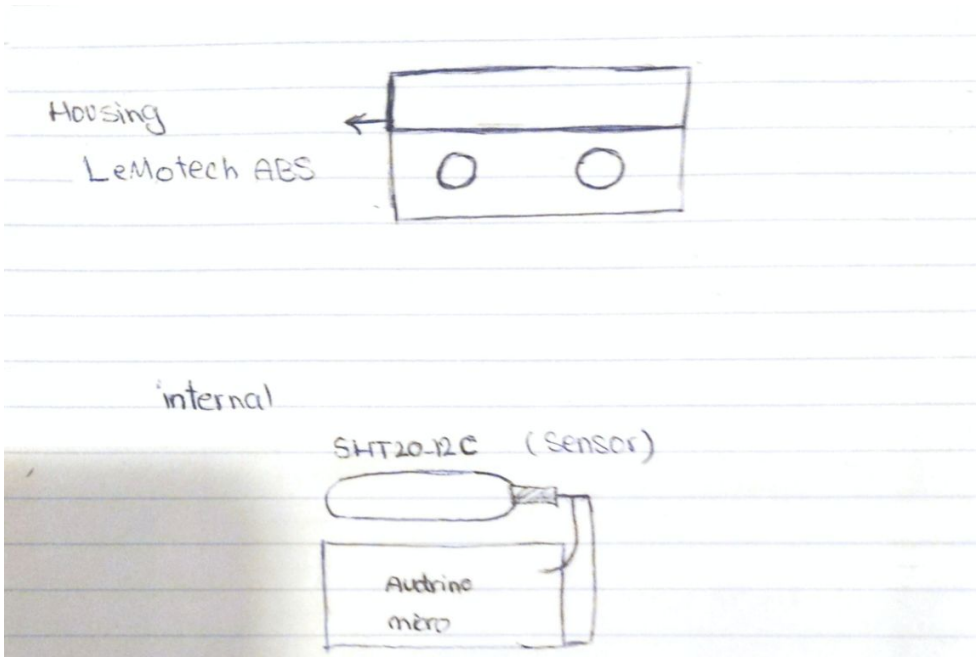
This is a SHT20 I2C temperature & humidity sensor with waterproof probe. This is a special waterproof breathable material that allows water molecules to seep in, blocking water droplets from seeping in. With the accuracy of ±3% RH. The response time is 8 second. The operating voltage is 3.3V The sensor deimons is 73mm * 17mm / 2.87 * 0.67 inches, it can measure a range of -40 to 125 ℃.

Hosing

In the matter of hosting the LeMotech ABS was chosen. This housing has a weight of 160g, 7 cables can enter this housing. One of the greatest advantages of this product can be it is Waterproof/Dustproof junction boxes, perfect for use outdoors. These are well protected from rain and water splash back, making them perfect for joining wires inside.

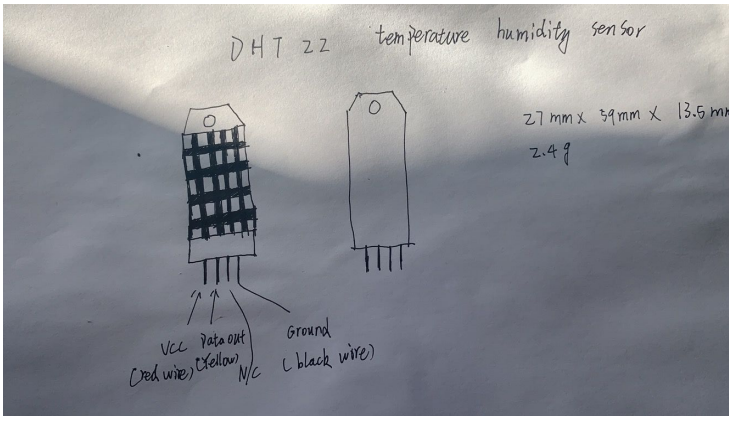
Microcontroller

The arduino micro was chosen. It can simply connect it to a computer with a micro USB cable to get started. It has 20 digital input/output pins, a 16 MHz crystal oscillator, and a ICSP header, and a reset button. This micro has an operation voltage of 5V. This micro has built-in USB communication, eliminating the need for a secondary processor. This allows the Micro to appear to a connected computer as a mouse and keyboard, in addition to a virtual (CDC) serial / COM port.

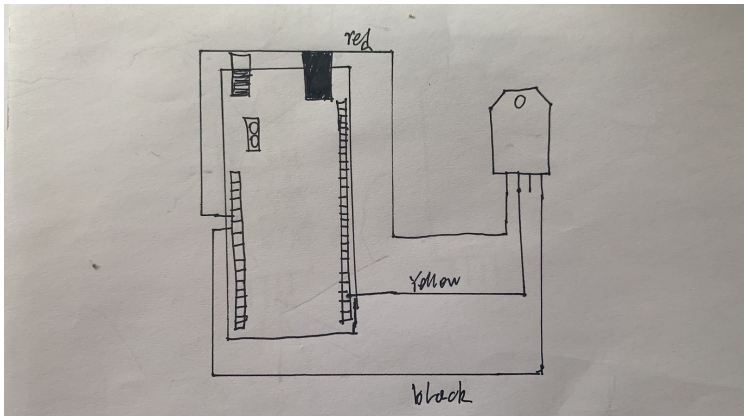


DongYu's Concept

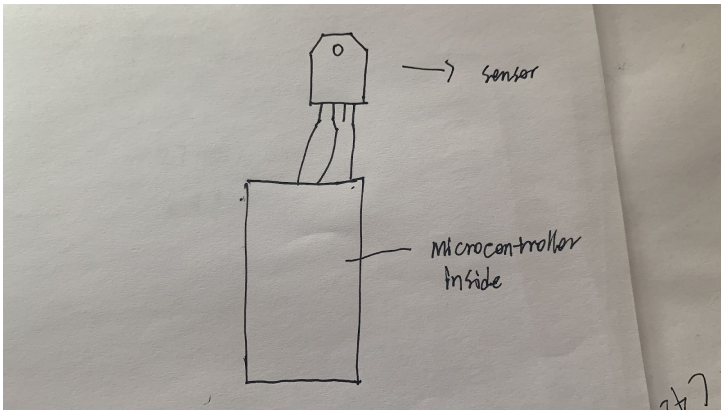
Sensor:
The reason why I thought drones should be equipped with this sensor is that it has an operating range of -40 to 8-0 degrees Celsius and an accuracy to within 5% and can measure humidity in the range of 20 to 100 percent.



Microcontroller:
The microcontroller should be tight and economical.

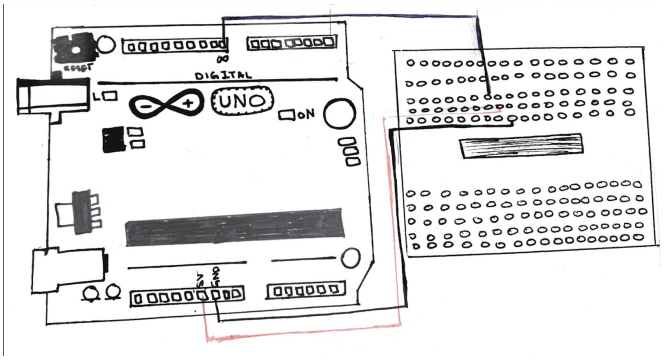


Housing:
The housing should be waterproof and reliably sealing, so the microcontroller inside would not be damaged.

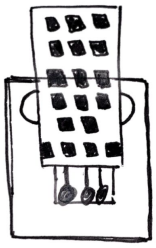


Nada's Concept:

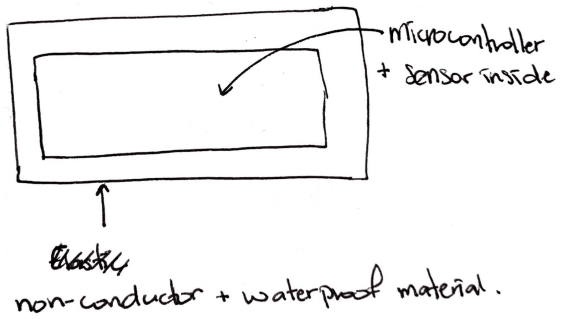
Microcontroller:
The microcontroller is composed from an arduino and a breadboard. The components are affordable and reliable.



Sensor:
The humidity and temperature sensor is connected to the breadboard



Housing:
The housing should be a non-conductor material inorder to not interfere with the circuits. It should also be made from waterproof material in order to not ruin the sensor and create a malfunction.



Selection matrix

On the selection matrix the brainstormed concepts were ranked from 1 to 5, 5 being the greatest score possible, considering their efficiency in attending the design criterion.

Table 1.1 Selection matrix for the sensor

Design criterion	Amanda's concept	Aaron's concept	Shayleen's concept	Nada's concept	DongYu's concept
Reliability	4	4	4	4	3
Precision	5	4	4	3	4
Size	5	5	4	2	4
Cost	2	5	3	4	4
Final score	16	18	15	13	15

Table 1.2 Selection matrix for the microcontroller

Design criterion	Amanda's concept	Aaron's concept	Shayleen's concept	Nada's concept	DongYu's concept
Size	5	4	4	2	2
Weight	5	4	4	3	3
Cost	2	2	3	4	3
Final score	12	10	11	9	8

Table 1.3 Selection matrix for the housing

Design criterion	Amanda's concept	Aaron's concept	Shayleen's concept	Nada's concept	DongYu's concept
Water Resistance	5	5	5	5	5
Durability	2	5	4	3	4
Weight	5	3	5	5	3
Cost	3	2	4	4	3
Aesthetics	4	2	4	4	4
Final score	19	17	22	21	19

Final design concept

We were able to obtain a final concept for the project using the ideas that had a reasonable score at the selection matrix.

Sensor

In the regards of reliability and precision all the individuals concepts had the very same score. However Aaron's temperature and humidity sensor had an upper hand in the matter of the cost and size. The sensor has low cost and small in size, fulfilling the design criteria that were stipulated before.

Microcontroller

Amanda's Microcontroller was the best option. Her design is compact and lightweight. Although compared to the other microcontroller it is high-priced.

Housing

In the matter of housing. Shayleen's concept was the best choice. It is lightweight and waterproof. As well as its listed at an affordable price. However, the durability, costs and aesthetics is rated good but not the best and can be improved on.

Conclusion

Using the best ideas for each subsystem, it was possible to define a final concept that will guide all decisions making processes of the group in the following weeks. For the next steps, the group will plan and estimate costs for prototypes I, II and III while also updating the Wrike project for next week.

Appendix

Aaron's Concepts:

Subsystem #	Sensor	Microcontrollers Pair	Housing	Wire Insulator	Mounting
subsystem 1	Senserion AG SHT31-DIS-P2.5KS	Ada fruit METRO ATMEGA328 Arduino Micro	Bopla 96011115	Latex / rubber tubing	Zip Tie / Plastic Cement
subsystem 2	Honey Well HIH8120-021-001	STM Micro electronics NUCLEO-F401RE/NUCLEO-L432KC			
subsystem 3	Senserion AG SHT31-DIS-P2.5KS	Arduino Uno/ Arduino Micro			

Links:
https://www.digikey.ca/en/products/compare?s=N4IgzCBcDaICwCYCcBGAbAg7CANCDKCKYcuImADHGEmhALp6mQgD0ApgHasAOATgHsAJgFcAxgBcAzqwBmASwA2E9n1YALEQFt5Q%2BRICeAWi0D5UiSL7sjUrlIF8ZAVmQB%2BKQF4AcnACSAOYAVgDCAEJiAgAyAIpCfgAiAOIAqmFaYQkAgt4BAFoA7gDSAJphAjFhmEVZAEYASllhJVkA8k3qWVFZCXkGYa0AolkAGjF%2BWWKjRYPDUXCDJc5FRUkAyvUUCLKDAGqBWXxZSS0AKgCyAgEAYgYobQAe6oqYUXwUQQAcYQBSAlkgAC%2BQA

https://www.amazon.ca/Arduino-A000073-Uno-REV3-SMD/dp/B00PUOVSYS/ref=sr_1_7?dchild=1&keywords=arduino+uno&qid=1613769312&sr=8-7

https://www.amazon.ca/Arduino-Micro-Development-Boards-A000053/dp/B01EK91KKK/ref=sr_1_6?dchild=1&keywords=arduino+micro&qid=1613769343&sr=8-6

https://www.digikey.ca/en/products/detail/bopla-enclosures/96011115/4318297?s=N4IgTCBcDaIEYHsAOAbAhgAgJwDYAMAjEQQKwgC6AvkA
https://www.adafruit.com/product/385