Deliverable B - Needs Identification and Problem Statement

Introduction:

Automating food delivery requires technology to replicate human capabilities, such as accurately measure the temperature and humidity inside a payload. Any human driver can tell when food has gone bad. The last thing a person ordering delivery would want is to have their food delivered only to find out it went bad on the way there, with no knowledge why.

A climate sensor that measures temperature, humidity, and has a camera on the food the whole time of flight lets operators and businesses understand more precisely the conditions inside their packages during delivery. It gives the customer peace of mind that when their food arrives, it will be intact and edible. The need to measure temperature and humidity were identified in the client meeting with JAMZ delivery. Based on their answers to other questions during this meeting, these two traits were determined to be the most important to them in a climate sensor. Other needs from JAMZ include a preference for a lightweight and compact sensor, so that the total mass of the drone is not substantially higher.

The future of food delivery systems is automated, and companies like JAMZ must be able to understand what is going on inside their packages at all times. A climate sensor clarifies the conditions of the food they transport and allows for increased customer satisfaction and consumer confidence. In the future accurate data could be used to moderate the temperature of the package and keep different foods at different desired temperatures.

Problem Analysis:

- Information collection need table

Need Description	Priority /5	Solution
Safety	5	
A consistent and high volume of data	5	High-quality sensors
Measure humidity	5	Add humidity sensor
Measure temperature	5	Add temperature sensor
Send data to the central computer	5	Find correct wiring to send data and code to output correct data
Accurate data	4	High-quality sensors
A retractable sensor that can get close to the food/inside container but remain attached to the drone	4	
Attach to frame/hook	4	Correct size attachment

Low weight	3	
Low volume	3	
Low cost	3	Only buy the necessities
Provide visual feedback	2	Add camera
Aesthetic	2	Clean, modular add-on. No loose ends

Figure 1. List of prioritized needs based off of raw data from JAMZ in order from highest to lowest

Problem Statement

"JAMZ requires a design for a retractable climate sensor that consistently and accurately measures and transmits temperature and humidity data from inside the package to the central computer of the drone. The module must be safe, inexpensive, light-weight and compact."

Design: Research and User Benchmarking

Retractable component: No retractable wire component of a size suitable for an Arduino exists. Personal projects have been made before on various forums, but there is no product for purchase that retracts wires. Some alternatives include a spring reel or a winch.

Generic Temperature Sensor Benchmarking

Type of sensor	Thermocouples	Resistance Temperature Detector (RTD)	Thermistors	Diode sensor
Range (Celsius)	-200 to 2000	-250 to 850	-100 to 300	-200 to 1000
Accuracy	High	Low	Medium	Low
Cost	Low	High	Medium	Low
Longevity	Low	High	Medium	High
Size	Medium to Large	Small to Medium	Small to Medium	Very Small
Response Time	Fast	Slow	Fast	Fast

Figure 2. Benchmarking data for four common temperature sensors. See references for origin of data.

<u>Additional information:</u>

- Location and size of the hole for sensors?
- Weight restriction for the module?
- How would sensors be placed in the hole? Could the restaurants do this when loading the container?

- How far would the hole be from where the module is placed?
- Do they want the temperature regulated as well as measured?
- Should there be an alert if the temperature is out of range? Should there be different temperature settings for different food types?
- What would be above and beyond additional sensors to include?

References:

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- S. Madhusoodhanan, S. K. (2016). Highly linear temperature sensor using GaN-on-SiC heterojunction diode for Harsh environment applications, Table 1. doi:10.1109/WiPDA.2016.7799932