Deliverable C: Design Criteria

GNG1103D – Engineering Design University of Ottawa Group 12

Introduction

Our Group is planning to design a climate sensor that relays the temperature and humidity of the drone's contents. In order to design this system a list of criteria and client needs were created to help develop possible solutions to our project. We also bench marked several sensors to compare their capabilities and determine which sensor would be most beneficial for our module. Lastly, we created a table of requirements and constraints to ensure that our system design meets the interpreted needs from JAMZ. This information will aid us in thinking and designing possible solutions and provide design goals that will lead us to our final module.

Design Criteria

Table 1. List of Client Needs and Design Criteria

#	Need	Design Criteria	Type of Design Criteria/ Constraint
1	A climate sensor that relays the temperature and humidity status of the contents of the drone.	Measures Temperature and Humidity of a Space	Functional
2	Data collected is precise and accurate.	Accurate/Consistent Output	Functional
3	Data from the module/sensors are going to be communicating with the computer onboard by serial communication. Data is transferred in serial through UART.	Outputs Serial Data	Functional
4	The drone (its modular systems) and the operator need to be in constant communication.	Connects to Drone's onboard Computer	Functional
5	Modules/Sensors need a power source to operate. The drone's main battery power source can supply energy required by the module/sensor.	Connects to Main Power Source	Functional
6	The module/sensor can communicate with other systems onboard and receive messages sent from the operator.	Communicates with other Systems Connects to Drone's onboard Computer	Functional Functional
7	Visual feedback to convey if the food is going bad.	Visual Feedback for Food Conditions	Functional
8	Project budget provided. Err on the side of the more expensive that does not tend to break.	Cost Reliable Failsafe	Constraint Non-Functional Non-Functional

9	Keep the module/sensor as light as possible	Weight	Constraint
	and make it easy to manipulate or change its	Can be placed	Non-Functional
	location.	anywhere on drone	
10	Sensor can handle the range of temperatures	Operating Conditions:	Constraint
	it is exposed to both inside the container or	Temperature	
	from outside conditions (when package is		
	not onboard).		
11	Sensor can handle the range of humidity it is	Operating Conditions:	Constraint
	exposed to both inside the container or from	Humidity	
	outside conditions (when package is not		
10	onboard).	A d d	N 7 1
12	"Professional looking."	Aesthetics	Non-Functional
	Seamless. Sensor does not catch your eye.		
13	Sensor is close to/inside the box during	Safety: Sensor Retracts	Non-Functional
	flight.	from Box	
	Retracts from the box before drone		
	completes delivery so the drone and its		
1.4	systems remain intact.	Duete etc d has Common	Non-Functional
14	Module/Sensor should be protected by weather elements the drone will be exposed	Protected by Common Weather Conditions	Non-Functional
	to during flight or when stationary.	(UV light, rain, snow,	
	to during riight of when stationary.	wind)	
15	JAMZ will consider the trade-off of how	Compact	Non-Functional
13	useful the product is versus how compact it	(minimal area)	TVOII-T UIICUOIIAI
	is.	(IIIIIIIIIIII arca)	
16	Module/Sensor is always available for	Availability	Non-Functional
10	operation when the drone is in use.	11 variability	11011 I uncuonai
	operation when the drone is in use.	l	

Benchmarking

 Table 2. List of Climate Sensor for Benchmarking

Name	Tempe rature Sensor	Humidi ty Sensor	Accuracy	Tempe rature range	Humidity range	Output type (analog/ digital)	Price	Weight
DHT11 (old)	у	у	±2C, ±5%,	0 to 50	25-90%	D	3.60 (+15.50 shipping)	2.4g
DHT11 (new) Unavail	у	у	±2C, ±5%,	-20 to 60	5-95%	D	NA	2.4g
DHT22	у	у	±0.5°C, ±2%	-40 to 80	0 -100%	D	7.83 (+ 5.28 shipping)	2.4g

AHT20	у	у	±0.3, ±2%	-40 to	0-100%	D	6.99 (+9	9g
				85			shipping)	
2857	у	у	±0.3C,	-40 to	0-100%	D	19.30(+	0.8g
			±3%	125			20	
							shipping)	
AM232	у	у	±0.5C,	-40 to	0-100%	D	3.95(+20	1.1g
0			±3%	80			shipping)	

 Table 3. Product benchmark comparisons

	Weight	DHT11	DHT22	AHT20	2857	AM2320
Accuracy:	5	1	5	5	4	4
Humidity						
Accuracy:	5	1	4	5	5	4
Temperature						
Weight	2	3	3	1	5	4
Price	2	2	5	4	1	2
Temperature	5	1	3	4	5	3
range						
Humidity	5	1	5	5	5	5
range						
Total		30	101	105	107	92

For the climate sensors, the different available temperature/humidity sensors were compared against each other. The overall best sensor was determined to be the 2857 sensor module, meeting all the design specification requirements. Ideally, the specification of other delivery drones and their climate monitoring systems would help to better estimate what our design specification to be, but this information was unable to be found either due to these drones not having climate monitoring or it not being public.

Design Specifications

Table 4. Design specifications

	Design Specifications	Relation (=, < or >)	Value	Units	Verification Method
F	unctional Requirements				
1	Measures Temperature and Humidity of a Space	=	Yes	°C / %	Test
2	Accurate/Consistent Output	<	+/- 2 +/- 5	°C %	Test
3	Outputs Serial Data	=	Yes	N/A	Test

4	Connects to Drone's onboard Computer	=	Yes	N/A	Up to JAMZ to test
5	Connects to Main Power Source	=	Yes	N/A	Up to JAMZ to test
6	Communicates with other Systems	=	Yes	N/A	Up to JAMZ to test
7	Visual feedback for food condition	=	Yes	N/A	Test
	Constraints				
1	Cost	<	50	\$	Test
2	2 Weight	<	500	g	Test
3	Operating Conditions: Temperature	=	-5 to 40	°C	Analysis
4	Operating Conditions:	=	0 to 100	%	Analysis
	Relative Humidity				
ľ	Non-Functional Requirements				
1	Product Life	>	2	Years	Up to JAMZ to test
2	Aesthetics	=	yes	N/A	Test
3	Safety: Sensor Retracts from Box	=	yes	N/A	Up to JAMZ to test
4	Reliability	=	yes	N/A	Test
5	Protected by Common Weather Elements	=	yes	N/A	Test
	(UV light, rain, snow, wind)				
6	Fail-Safe	=	yes	N/A	Test
7	Availability	=	yes	N/A	Test
8	Compact (minimal area)	<	100x100	mm	Test

9	Can be Placed Anywhere on Drone	=	yes	N/A	Test

As we begin the design process and consider requirements such as the safety of a retractable sensor, we have run into underlying requirements like the necessity to communicate with other systems. Concerns like how the drone knows it has picked up or dropped off a package and the accessibility of that signal will need to be addressed in the next client meeting to ensure our module can work in parallel with other systems on the JAMZ drones.

They have indicated that visual feedback for the food condition, and accurate/reliable data output is their main focus. In order to achieve this we have formed the design specification as shown in table 3. The current plan, based on the client meeting, is to find a method to protect the climate sensor from the contents of the delivery and the outside environment.

Client Meeting Reflection

Before the meeting, the team did not have a preference on a specific system or a plan on the systems and it was determined that we would wait for the clients input before deciding. With the client meeting, the details for the operating conditions and the customer needs were defined more clearly and the team chose to design the climate sensor system for JAMZ. Some question remain as to how the sensor will access the container, and where the module will be placed since the locking mechanism stands between the box and the drone.

Conclusion

Once our group identified that we would build a climate sensor for JAMZs' drones, we developed design criteria and benchmarked different sensors that we could use in our module. The criteria and requirements are based on the interpreted needs from our client meeting with JAMZ. Benchmarking different possible sensors concluded that the 2857 sensor is the best overall. The sensor meets all the necessary requirements and design specifications. We tried to benchmark current climate sensors on drones to help us in our design process but were unable to find any specifications online. The information from this deliverable will prove beneficial as we develop ideas for our climate sensor. It also allowed us to determine other questions that we will ask JAMZ in our next meeting, such as where the module will be placed in relation to the locking system.