Deliverable C - Design Criteria

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Introduction

After analysing the specific needs from JAMZ Automated Delivery and doing an initial user benchmarking, it was possible to define design criteria for both the drone and the solution for tracking the conditions of the food during delivery. In this document, the team identifies design criteria for the drone and the climate sensor and its corresponding metrics and target specifications. The benchmarking is divided in two sections, technical and user benchmarking. The user benchmarking is updated from the last deliverable with some information based on comments from users and the technical benchmarking of the sensor has different components that we are using to make the project. For the final step, a matrix composed by the benchmarked components is used to help make a decision considering the budget and quality expected from the work.

Identified Needs and Design Criterion

Based on the need statements, the team identified the following design criteria for the drone and for the climate sensor:

Table 1.1 Design criteria for the drone

Number	Need	Design Criteria
1	The data transmitted from the device to the operator is consistent and reliable.	The data can be transmitted through an online application.
2	The drone delivery service is approved by all needed regulatory bodies.	Get the drone approved by the following companies:Transport Canada, Nascan, RCMP, National defense.
3	The route of delivery is in unpopulated areas.	Should fly through parks and rivers as those areas are least populated by pedestrians.
4	The drone operates in multiple weather conditions.	Material of the drone should be designed to repeal the rain and not have the metal to overheat when in contact with the sun.
5	The drone has a 24 hour battery life.	The battery of the drone must be efficient and durable.
6	The drone carries up to 15kg.	The drone must be able to carry a payload of up to 15kg.
7	The maximum altitude the drone can fly to is 61 meters.	The drone should have something to slow the fall if it occurs.

Table 1.2 Design criteria for the climate sensor

Number	Need	Design Criteria
1	The data transmitted from the device to the operator is consistent and reliable.	The error in the data transmitted should be as low as possible.
2	The device that tracks temperature and humidity is compact.	The device should be small in size.
3	The sensor operates within the drone's power consumption budget.	The device should not consume much power from the drone's battery.

Metrics

Table 2.1 Metrics and related units for the drone

Number	Related needs	Metric	Unit
1	4	Temperature	°C
2	5	Power Consumption	mAh
3	4	Waterproof	yes/no
4	7	Distance	m
6	6	Weight	kg

Table 2.2 Metric and related needs for the climate sensor

Number	Related needs	Metric	Unit
1	2	Dimension	m
2	1	Standard error	N/A
3	3	Power consumption	Wh

Target specifications

Table 3.1 Functional Requirements

Design specification	Relation (=,< or >)	Units	Value	Verification method
Maximum payload	<	Kg	Yes	Analysis

Power provided	<	mAh	22000mAh 2x 44.4V	Analysis, Test
Cruise Speed	=	Km/h	130	Test
Endurance	=	H	24	Tets
Altitude	<	M	61	Test

Table 3.2 Constraints

Design specification	**Relation (=,< or >)**	**Units**	**Value**	**Verification method**
Cost	<	$	Yes	Estimate, Final Check
Noise	<	Hz	0.5 Hz	Test
Weight	<	Kg	15	Analysis

Table 3.3 Non-Functional Requirement

Design specification	**Relation (=,< or >)**	**Units**	**Value**	**Verification method**
Safety	=	N/A	Yes	Test
Reliability	=	N/A	Yes	Test
Operation condition : Temperature	=	°C	Yes	Test
Functionality	<	N/A	Yes	Test
Waterproof	=	N/A	Yes	Test

Technical benchmarking

Table 4.1 Benchmarking for the sensor

Sensor Name	**Supplier name**	**Price ($)**	**Response time (s)**	**Dimensions (mm)**
CC2D25S-SIP	Amphenol	27.2	7	8.9 x 4.9
HIH8120-021-001	Honeywell	10.15	6	3.8 x 2.5
SHT31-DIS-P2.5KS	Sensirion AG	7.25	8	2.6 x 2.6
SHT31-DIS-F2.5KS	Sensirion AG	10.62	8	21.7 x 5.08

Table 4.2 Benchmarking for the housing

Housing name	Supplier name	Price ($)	Material	Dimensions (mm)	Appearance
96021114	Bopla	24.49	plastic	89 x 80	compact/block
96011115	Bopla	20.89	plastic	89 x 80	compact/block

Table 4.3 Benchmarking for the microcontroller

Microcontrollers	Supplier name	Price ($)	Dimensions (mm)
DUINO A000066 Uno	Amazon (arduino)	34.15	55.1 x 24.9
METRO ATMEGA328	Adafruit	24.21	55.1 x 24.1
NUCLEO-F401RE	STMicroelectronics	25.71	55.1 x 24.11
ARDUINO MICRO	Amazon	29.99	48 x 18
NUCLEO-L432KC	STMicroelectronics	20	48 x 19
ARDUINO MICRO	Digikey	27.39	48 x 20

User benchmarking

The user benchmarking was updated from PD B with client feedback and new needs that arose with this new information

Table 5 User benchmarking

	Drone Delivery Canada	Wingcopter	Amazon Prime Air
Drone model	Robin XL	Wingcopter 178	Amazon MK27 UAS
Maximum range	60 Km	40 Km	24 Km
Maximum speed	105 km/h	130 km/h	80.5 km/h
Max payload	11.3 kg	6 kg	2.26 kg
Safety features	Wing's unmanned traffic management (UTM) tools and flight planning software	Computer software is capable of complex flight planning.	Combination of thermal cameras, depth cameras, and sonar to detect hazards.

Direct Quotes	"Will have touchless cargo drop functionality"	"Especially high humidity, the spool material was compromised. "A misunderstanding of this aim led in some cases to large orders of vaccines and heavier than expected cargo weights"	"Operations may not be conducted at night until such time as the MK27 UA is equipped with appropriate lighting" "Max payload is relatively small "
New Needs	1. Complex cargo handling	1. Not durable in high humidity 2. The interaction is too dependent on the user's mobile phone location 3. Max payload is small	1. Do not equip appropriate lighting 2. Upper limit of the flight 3. Upper limit of the flight

Matrix

Table 6 Matrix of needs for the sensor

Sensor	accuracy(+ - % RH)	Price ($)	weight (grams)	Dimensions (mm)	Score
CC2D25S-SIP	5	1	N/A	5	11
HIH8120-021-001	2	5	N/A	7	14
SHT31-DIHIH8120-021 -001S-P2.5KS	5	7	N/A	8	20
SHT31-DIS-F2.5KS	5	5	N/A	1	11
Note: weight specifications were unavailable on all data sheets, could not evaluate this design criterion					

Conclusion

We used the design criteria gathered from the user needs identification to help evaluate possible solutions to the problem statement and establish potential options for a prototype. We then organized these options and ranked them based on the client's needs in a matrix.The benchmarking can be further updated with new user needs and designed criteria gained from our next client meeting.In the next week, all team members will deliver at least three concepts each for the climate sensor. We should decide on the best idea for the project at the end of the week and present that on a document for deliverable D.