GNG1103[D] – Engineering Design
Course Project
Group C7

Project Deliverable E:

Project Schedule and Cost Estimate

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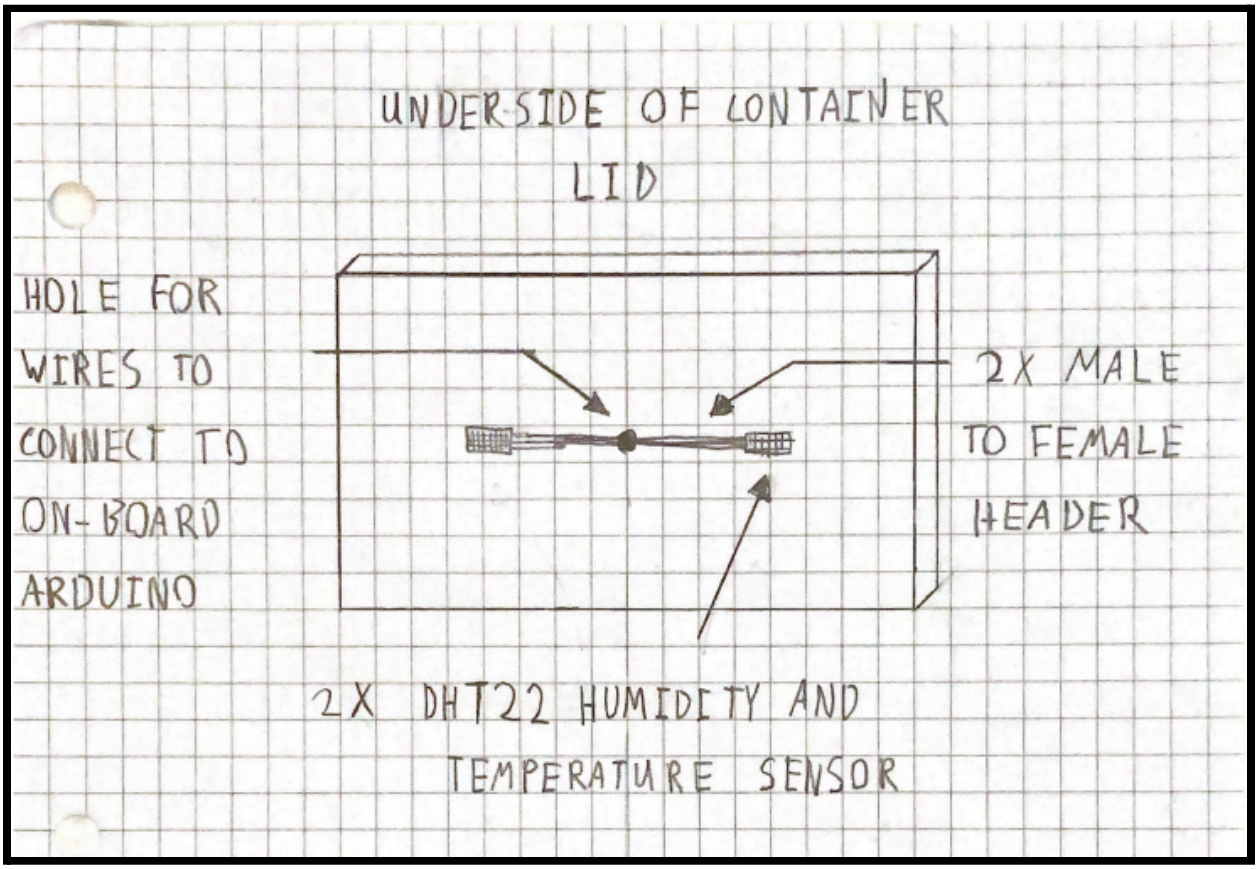
Introduction

After our second client meeting on February 22, our team reflected on the feedback we received from the client and refined our three chosen prototypes. Below, you will find a comprehensive bill of materials, and an outline of our project schedule for the next three weeks, including the first three prototypes. This document will also be accompanied by a gantt chart showing a visual representation of our predicted schedule.

Changes to Global Concepts

Prior to the client our team had developed subsystems that fed into three separate global concepts for adding a climate sensor to the JAMZ drone.. However, after the meeting, we realized that we did not need a subsystem dedicated to the placement of the Arduino Uno board as well as the Arduino Uno casing since the JAMZ team is going to provide the board that will be used. In addition, the JAMZ team member we spoke to suggested that we utilize more than one climate sensor placed in strategic areas of the package's container to ensure an accurate reading of the ambient temperature by using a combination of the sensors' information. Moreover, we received more information in regards to the protocol that leads us to the assumption that we do not need to worry too much about transferring information to other onboard MCU.



Cost of Materials

To better organize the process of prototyping for our project, we have created a list of materials that displays their individual costs, function, and vendor to ensure that we do not go over this project's set budget of $50.00. These materials must be approved by TA's prior to the addition to this document.

Table 1: Bill of Materials

Item Name	Purpose	Vendor Link	Quantity	Unit Price $	Total Price $
Arduino Uno	For testing and verifying the temperature collection process.	https://makerstore.ca/shop/ols/products/arduino-uno-r3	1 (Already have)	17	0
DHT11 Sensor	Temperature and humidity sensing	https://www.adafruit.com/product/386	0 (Canceled)	6.5	0
DHT22 Sensor	Temperature and humidity sensing	https://www.adafruit.com/product/385	2	12.50	25
Male to Female wire	For connecting the arduino and sensors	https://makerstore.ca/shop/ols/products/jumper-cables-per-10	1	1	1
Breadboard	For testing and verifying the temperature collection process.	https://www.ebay.ca/itm/Solderless-Bread-Board-830-400-270-170-25-Contacts-Power-Supply-CanHobby-Kit/113610874921?hash=item1a73bc6029:g:~ssAAOSwuCdbl~3O	1 (Already have)	3.5	0
Rubber Sheet	For flapped through hole, weather proofing and fixing the sensor wire in place	https://www.amazon.ca/Styrene-Butadiene-Rubber-Backing-Thickness/dp/B00L8NRV2S/ref=sr_1_5?dchild=1&keywords=rubber+flap&qid=1614357623&sr=8-5	1	10	10
Cardboard/ Styrofoam Box	For testing and verifying the temperature collection process.	-	1	0	0
				Total:	**36**

Prototype 1: Proof of Concept and Feasibility

Our first prototype will be focused on demonstrating the feasibility of our design through various proof of concept tests. We will start by building a demo box and performing a rough analysis on the optimal sensor placement. This demo box is to be combined with prototype 2 (Sensor-Arduino Subsystem) to become the final design and testing platform. It will include some of our design features such as a flapped rubber through hole. In addition, we may also perform basic proof of concept tests on the sensors, such as basic reading of ambient temperature and humidity using a single sensor. In order to complete those objectives, we will delegate separate tasks related to analyzing and recording information as well as building and testing. This preliminary delegation of tasks and associated dependencies of prototype 1 are presented in the following table.

Table 2: Prototype-1 Delegation of Tasks

Members	Task #	Tasks To Do	Min (Days)	Max (Days)	Dependency
Sammy Fakhouri	1	Collecting demo box prototype components	1	2	David-1
	2	Building a Basic prototype for Sensor Placement. (Building the Demo-Box)	0.5	1	David-1
	3	Taking and Uploading Images	1	1	Sammy-2
Kevin Jia	1	Building a Basic Prototype of Arduino-Sensor Module. Contriving and Performing Basic Proof of Concept Testing on Sensors	2	3	Ben-1
	2	Continued Arduino Code Development	1	5	Kevin-1
	3	Formatting/Relaying/Integrating Design and Collected Data into Deliverables and Prototype	1	1	Kevin-2
David Marion	1	Preliminary Analysis of Optimal Sensor Placement and Develop the Prototype Model for Sensor Placement (Demo-Box)	1	2	-
	2	Analysis of Critical Components	0.5	1	-
	3	Formatting/Relaying/Integrating Results into Deliverables and Prototype	1	1	David-2

Benjamin Millan	1	Develop Test Plan Outline	1	2	-
	2	Coordinate Project Progression	-	-	-
	3	Formatting/Relaying/Integrating Results into Deliverables and Prototype	1	1	Ben-1
Shiyu Yuan	1	Building a Basic Prototype of Arduino-Sensor Module. Contriving and Performing Basic Proof of Concept Testing on Sensors	2	3	Ben-1
	2	Continued Arduino Code Development	1	5	Shiyu-1
	3	Formatting/Relaying/Integrating Design and Results into Deliverables and Prototype	1	1	Shiyu2

Prototype 2: Sensor-Data Collection Sub-System

Prototype 2 will be primarily focused on the sensor-arduino data collection subsystem. It will utilise the results from the analysis of optimal placement in prototype 1 to physically test the impacts of different sensor placements in an open environment. The main objective is to show that the data from two (or more) sensors can be analyzed using software and will be more precise and perhaps more accurate. Additionally, this prototype will serve to demonstrate that the sensory subsystem is ready to be combined with the demo-box and tested in a closed environment.

The delegation of tasks here will not include dependencies as the specifics of this prototype is to be further refined as more information is collected on the exact requirements. The following delegation table will provide a rough outline of the general tasks associated with the construction and testing of prototype 2.

Table 3: Prototype-2 Delegation of Tasks

Members	Will do	Minimum Duration Estimation (Days)	Maximum Duration Estimation (Days)
Sammy Fakhouri	Further Refine Prototype Drawing(s)	1	2
	Gather Continuous Feedback	2	3
	Formatting/Relaying/Integrating Results into Deliverables and Prototype	1	1

Kevin Jia	Develop Test Plan For The Prototype (Testing Sensor Placement Obtained from Previous Prototype, and Other Isolated Tests)	2	3
	Continued Arduino Code Development	1	5
	Formatting/Relaying/Integrating Results into Deliverables and Prototype	1	1
David Marion	Develop Test Plan For The Prototype (Testing Sensor Placement Obtained from Previous Prototype, and Other Isolated Tests)	2	3
	Critical Analysis of Sub-System	0.5	1
	Formatting/Relaying/Integrating Results into Deliverables and Prototype	1	1
Benjamin Millan	Integrate Feedback From Previous Prototype	1	1
	Coordinate Project Progression	-	-
	Formatting/Relaying/Integrating Results into Deliverables and Prototype	1	1
Shiyu Yuan	Continued Arduino Code Development	1	5
	Build, Test, and Collect Feedback from Test Plan	1	2
	Formatting/Relaying/Integrating Results into Deliverables and Prototype	1	1

Prototype 3: Finalized Model - Full System

Our current plans for prototype 3 is to combine the final results from the first and second prototype into one fully functional prototype modeling the real world environment that the sensor module is meant to operate in. Placing the sensor module in a closed system, we will perform various tests to demonstrate its ability to respond to different temperatures and humidities. Error and uncertainty analysis will also be conducted, especially against localized temperature/humidity differences to further emphasize the benefit of having two (or more) sensors on board. This prototype will be the final platform to which existing features are tested and potential problems are addressed. Moving forward, this design will become the final design to be showcased on design day.

Similar to prototype 2, the delegation of tasks here will not include dependencies as the specifics of this prototype is to be further refined as more information is collected on the exact requirements. The following delegation table will provide a rough outline of the general tasks associated with the construction and testing of prototype 2.

Table 4: Prototype-3 Delegation of Tasks

Members	Will do	Minimum Duration Estimation (Days)	Maximum Duration Estimation (Days)
Sammy Fakhouri	Further Refine Prototype Drawing(s)	1	2
	Gather Continuous Feedback	2	3
	Formatting/Relaying/Integrating Results into Deliverables and Prototype	1	1
Kevin Jia	Develop Test Plan For Final Prototype (Sensor Accuracy In Closed Box and Other Full System Tests)	2	3
	Continued Development of Arduino Code	1	5
	Formatting/Relaying/Integrating Results into Deliverables and Prototype	1	1
David Marion	Develop Test Plan For Final Prototype (Sensor Accuracy In Closed Box and Other Full System Tests)	2	3
	Error and Uncertainty Analysis	0.5	1
	Formatting/Relaying/Integrating Results into Deliverables and Prototype	1	1
Benjamin Millan	Integrate Feedback From Previous Prototype	1	1
	Coordinate Project Progression	-	-
	Formatting/Relaying/Integrating Results into Deliverables and Prototype	1	1

Shiyu Yuan	Continued Arduino Code Development	1	5
	Combine Demo Box and Sensor Prototype, Test and Collect Data for Test Plan	2	3
	Formatting/Relaying/Integrating Results into Deliverables and Prototype	1	1

Project Risks and Contingency Plan

Due to the global pandemic and the restrictions currently in place, we are limited to relying on one member of the team to build the prototypes that will be used for this project. This member will be Shiyu, as he has the most pre-existing knowledge on the subject and currently has an Arduino Uno board already in his possession. However, if problems arise, we may need to send the materials to another team member for them to build the prototypes. Moreover, with most of the materials being delivered through the mail as a response to the orders issued by the province, we may run into the issue of delayed package arrivals which will impact our scheduling of tasks. Likewise, if equipment for the prototypes does unfortunately break, we may need to order replacement parts which may increase our current projected budget and scheduling. In the event that these occur, we will most likely resort to creating an analytical prototype using a software such as Tinkercad in place of a physical prototype. Hopefully, any issues like these will only impact the first prototype since we are heavily relying on information from physical prototypes to ensure our final model is successful.

Conclusion

This deliverable serves as a good way of planning out our next steps as a team to get a successful final product. Mapping out our list of materials alongside the specific tasks of each member for each prototype ensures that we are being efficient in creating the climate sensor add-on for the JAMZ team's drone. We will continue with this plan to create our prototypes in the coming weeks to gain insight on how we should approach our final model.