Project Deliverable F:
Prototype I and Customer Feedback

Submitted by: Supathira Uthayakumar

Group 10

Benjamin Hotte, 300207427

Evan Lacroix, 300194699

Alison Kamikazi, 300073548

Supathira Uthayakumar, 300167100

Gabriel Krausert, 300213672

March 7, 2021

University of Ottawa

Table of Contents

1.0 Introduction

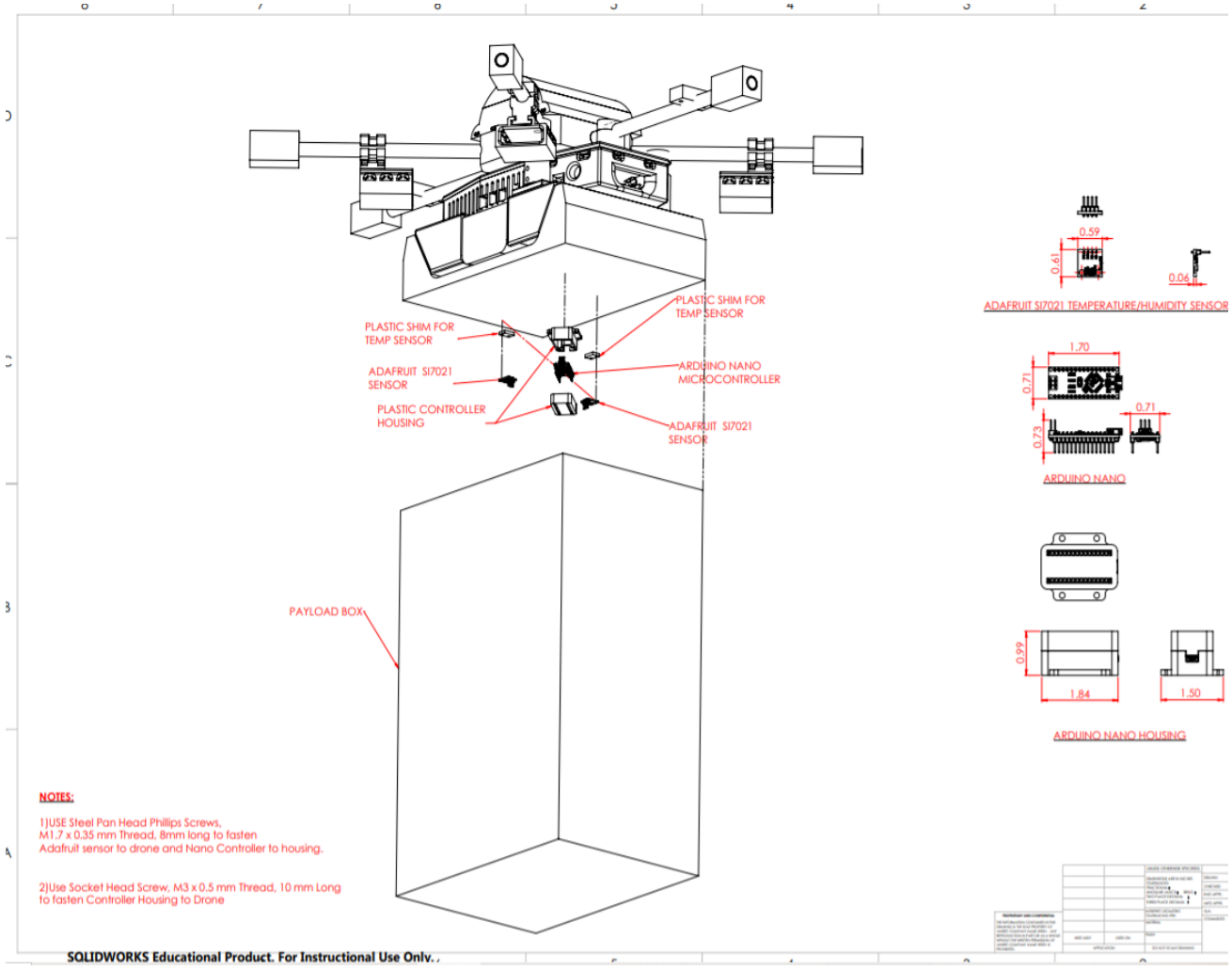
This document describes the current development of the JAMZ drone's climate sensor prototype as well as the plan for testing the prototype. This document supports the following objectives:

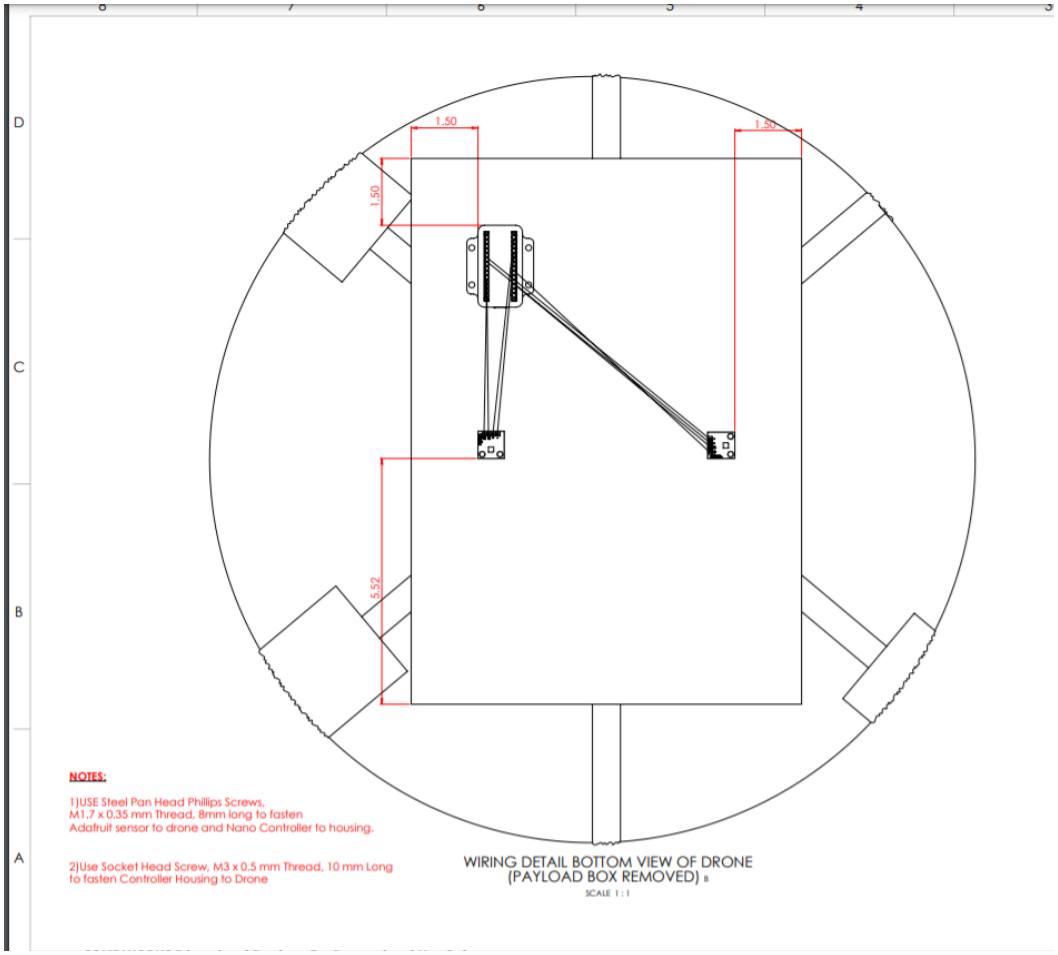
- Identify existing project information and research
- Prototype development and analysis
- List the recommended testing requirements and objectives
- Recommend and describe the testing strategies to be used
- Identify the required resources and estimates of the prototype testing efforts
- Analyze customer feedback and comments on the prototype

2.0 Prototype Development

2.1 Hardware System Analysis

This drawing shows an exploded view of our sensor system. It also shows our wire management and how the wires will be clipped to make sure they won't become loose and hang.


PLASTIC SHIM FOR TEMP SENSOR
PLASTIC SHIM FOR TEMP SENSOR
ADAFRUIT SI7021 SENSOR
ARDUINO NANO MICROCONTROLLER
PLASTIC CONTROLLER HOUSING
ADAFRUIT SI7021 SENSOR
PAYLOAD BOX
0.59
0.61
0.06
ADAFRUIT SI7021 TEMPERATURE/HUMIDITY SENSOR
1.70
0.71
0.71
0.73
ARDUINO NANO
0.99
1.84
1.50
ARDUINO NANO HOUSING
NOTES:
1)USE Steel Pan Head Phillips Screws, M1.7 x 0.35 mm Thread, 8mm long to fasten Adafruit sensor to drone and Nano Controller to housing.
2)Use Socket Head Screw, M3 x 0.5 mm Thread, 10 mm Long to fasten Controller Housing to Drone
SOLIDWORKS Educational Product. For Instructional Use Only.



*Wire layout isn't final as we do not have any physical components yet so we do not know the restraints/restrictions of what we can do.

2.2 Software System Analysis

The sensor manufacturer has made a code library freely available with easy to use functions for use with the Adafruit Si7021. The code below reads the Si7021's temperature and humidity data and outputs it as serial data to the Arduino every 1000 ms. The ability to read data from multiple sensors is not yet implemented in the code.

Error code 1:

```
In function 'void loop()':
code:27:16: error: 'sensorreadHumidity' was not declared in this scope
   Serial.print(sensorreadHumidity(), 2);
                ^~~~~~~~~~~~~~~~~~
```

code:37:16: error: 'class Adafruit_Si7021' has no member named 'HeaterEnabled'; did you mean 'isHeaterEnabled'?

```
    if (sensor.HeaterEnabled())
            ^~~~~~~~~~~~~
            isHeaterEnabled
```

exit status 1

'sensorreadHumidity' was not declared in this scope

Problem 1:

Undefined variables:

bool enableHeater; →bool enableHeater = false;

uint8_t loop Cnt; → uint8_t loopCnt = 0;

Errored delay time/ loopCnt:

Sensor relay messages must be precise. We need to wait till we receive the sensor to see exactly the transmission speed, thus an effective clock.

Sample Code

```
#include "Adafruit_Si7021.h"

bool enableHeater = false;
uint8_t loopCnt = 0;

Adafruit_Si7021 sensor = Adafruit_Si7021();

void setup() {
  Serial.begin(115200);

  // wait for serial port to open
  while (!Serial) {
    delay(10);
  }

void loop() {
  Serial.print("Humidity:    ");
  Serial.print(sensor.readHumidity(), 2);
  Serial.print("\tTemperature: ");
  Serial.println(sensor.readTemperature(), 2);
  delay(1000);

  // Toggle heater enabled state every 30 seconds
  if (++loopCnt == 30) {
    enableHeater = !enableHeater;
    sensor.heater(enableHeater);
    Serial.print("Heater Enabled State: ");
    if (sensor.isHeaterEnabled())
      Serial.println("ENABLED");
```

```
    else
      Serial.println("DISABLED");

    loopCnt = 0;
  }
}
```

The code can now be successfully compiled with the following message:
“Sketch uses 8598 bytes (27%) of program storage space. Maximum is 30720 bytes. Global variables use 542 bytes (26%) of dynamic memory, leaving 1506 bytes for local variables. Maximum is 2048 bytes.”

The code has not yet been tested with the hardware as the parts have been received from shipping as of the time of writing this deliverable.

3.0 Prototyping Testing Plan

The prototype testing plan consists of test objectives for the first prototype. The ordered parts have not yet been received so the physical sensor can not yet be tested for output functionality.

Table 1. Prototype testing plan and objectives for the first climate sensor prototype.

Test ID	Test Objective (Why)	Description of Prototype used and of Basic Test Method (What)	Description of Results to be Recorded and how these results will be used (How)	Estimated Test duration and planned start date (When)
1	**Compiler test** The objective is to see if the code successfully complies.	• Analytical • Focussing on the code’s ability to compile.	• See if the code compiles • Code will output a successfully compiled message upon completion. If not code will be reassessed for errors.	Upon completion of the code, compiling the code in the Arduino IDE will take about 10 seconds
2	**Code test 1** The objective is to see if the code can print statements.	• Analytical • Focussing on the code’s ability to print statements.	• See the result of the print statements to see variable values.	The code will be tested for statement output in TinkerCAD simulation software

			• Code will output printed statements, otherwise code will be reassessed for error.	with another temperature sensor. (Approx. 10 min)
3	**Code test 2** The objective is to see if the time delay matches the desired time of 1 second.	• Analytical • Focussing on the code's ability to regulate the 1 second time delay.	• See time delay between serial input and our count (loop) variable.	The code will be tested for statement output in TinkerCAD simulation software with another temperature sensor .(Approx. 10 min)
4	**Hardware layout design** The objective is to see if the prototype will fit on the drone.	• Analytical • Focussing on the prototype's ability to fit within the drone's dimensions.	• Complete drawing in Solidworks to make sure all the parts will fit together	The CAD drawing is estimated to take 4 days.
5	**Hardware Layout Aesthetic** The objective is to receive feedback on the design of the prototype.	• Experimental • Focussing on the overall look of the prototype.	• Verbal feedback and score concerning the aesthetics of the prototype based on CAD drawing. Score being out of 10, 0 being worst and 10 being best.	Upon completion of the Hardware layout design 3 minutes will be given to analyse drawing and 5 minutes to record feedback.

4.0 Customer Feedback

To gather feedback on the aesthetic of the prototype, each group member's parent was asked to analyse the technical drawing. After analysing the drawing for a timed 3 minutes, the team

members recorded each of their feedback over a span of 5 minutes. Lastly, the "customer" was asked to rate the prototype out of a scale of 10. The table belows shows the feedback from each customer.

Table 2. Customer feedback received on prototype one.

Customer	Feedback	Score
Supathira's Parent	"The prototype looks really nice and sleek." The **compact size** of the prototype also does not take away from the **drone's overall aesthetic** either."	9/10
Benjamin's Parent	"The prototype looks great, the concept is clear, and the wiring is good. However, how the information gets to the drone computer is still rudimentary."	7/10
Evan's Parent	"The prototype looks nice but **enclosing** it in a **case** that is black would **improve** the aesthetic, it would make the prototype look more elegant."	8/10
Alison's Parent	"The prototype looks **professional** due to wires and parts being all over the place and a mess. The **clean look** of the prototype makes the aesthetic of the prototype surreal."	10/10
Gabriel's Parent	"The prototype seems clean but **would look better** if the sensors were put together or in a position where **wires are not overlapping**."	7/10

5.0 Analysis of Feedback

Based on our customer's feedback, we were able to indicate the areas that need improvement for our next prototype. The information transfer between the arduino and the raspberry Pi is still conceptually vague. The wiring details regarding the dropping of the package aren't fool proof and will require rigorous testing. The code is not yet completed for the added multiplexer function, thus does not yet work for multiple sensors that share the same addresses. However, from testing the code tests, there is currently functionality of a single sensor.

On the other hand, this feedback has also allowed us to see that customers are looking for aesthetic appeal. We did not expect this criteria to have such a great impact on our clients perspectives of the product. As such, we are looking to add a better look to our design by putting our arduino and sensor in black-colored boxes and hiding the bunch of wires as much as possible.

The compact size and clean look of the prototype is another thing that was liked based on our feedback. The wires are easy to follow and this also helps prevent them from fastening. The sizes of the sensor and the arduino nano are small and compact enough which pleased our customers and does not cause any drastic change to the overall system.

Another feature that adds to the aesthetics of the prototype is the hardware enclosure. Enclosing the prototype in a case so that the electronic parts are not visible will increase the overall aesthetics of the module. Since the drone will be visible to JAMZ's customers, it is important that the temperature sensor system is consistent with the drone's aesthetic.

Further iterations of the temperature/humidity sensor module will take into account the feedback given on prototype one as discussed above. Ultimately the feedback given has refined the understanding of how to best fulfill the clients and customer needs when creating prototype two.

6.0 Conclusions and Recommendations for Future Work

In this deliverable, the current state of development for the first prototype was discussed. By developing a test plan for the prototype and considering future customer feedback, we will be able to gain a better understanding of how to further improve the prototype. Future work will consist of development of a second prototype with the data gathered from the prototype test plan and the analysis of customer feedback.