**GNG 1103 - Engineering Design**

**Group 3.4**

**University of Ottawa**

# Deliverable F : Prototype 1 and Customer Feedback

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## Introduction

### **Why** are we doing this test?

In this deliverable, our team took the detailed drawings of our designed concept and its subsystems and designed upon it. Furthermore, after meeting with our client to discuss costs and availability of materials we found that our estimated project cost was above the threshold the client gave us by a considerable amount. For the first prototype of the project we wanted to display simple instructions on the user interface, and user movement via mouse, as well as provide a 360º view of our prototype. These initial steps are the foundation of the final project. It's important to ensure all our subsystems work effectively and within our constraints before moving on to more complicated features. The tests outlined in this document will help the team understand whether each part of the prototype works or needs refining. These will help us know which parts of our plan can be used in future prototypes, and which parts need to be modified or removed. Lastly, we had to update our BOM to include everything that you will be needing to build our prototype as well as reducing the cost of our equipment for the final product.

### Test Objective Description

- Ensure our systems work together accordingly
- Our electrical subsystem is safe, well-insulated and can produce sufficient power for our technical parts
- Thermostat reads correctly and signals THEC to turn on or off depending on the temperature of the interior.

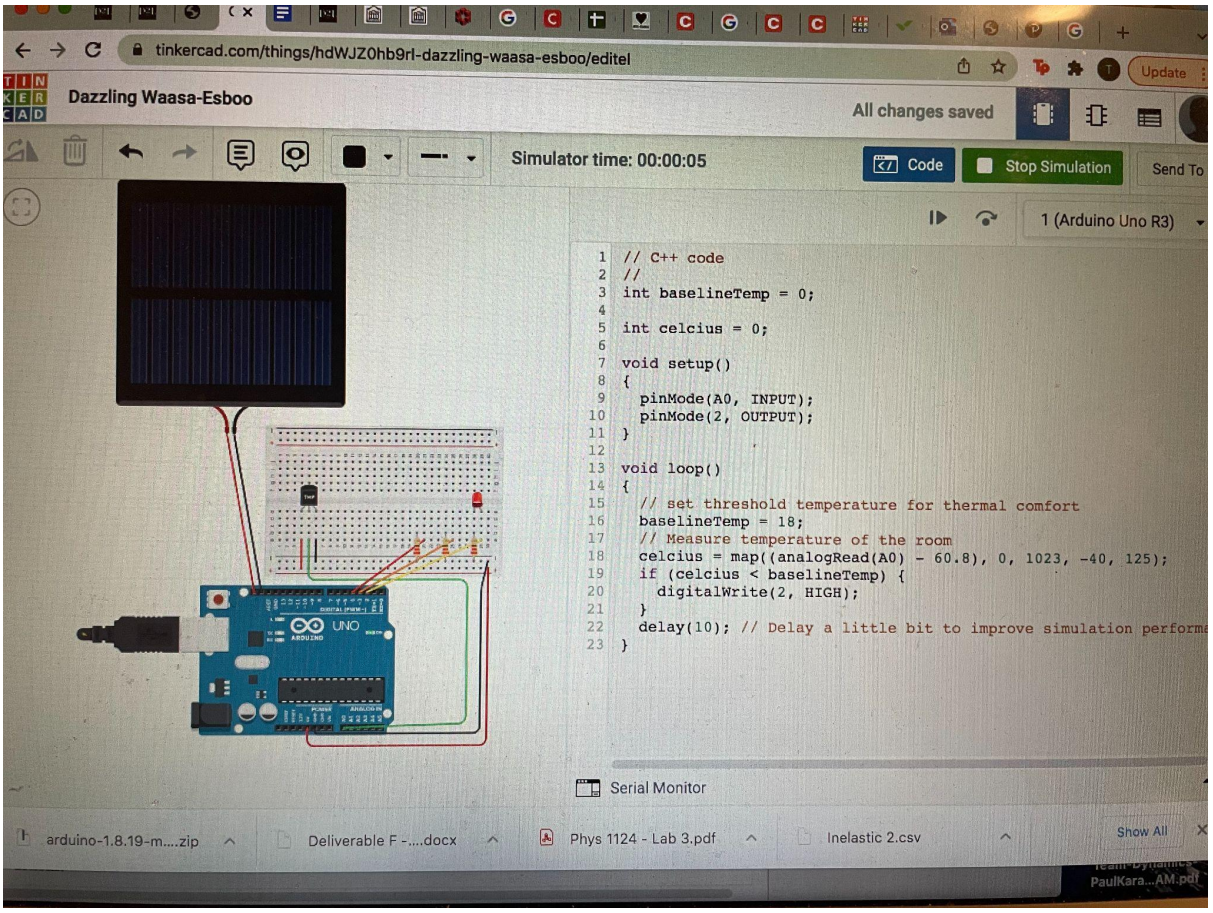
Our first prototype would provide the team with a better understanding of how our different subsystems would interact with each other as well as providing our client an initial idea of what to expect for the final product. In general, the first prototype demonstrated the building blocks of the project and what would be necessary to the overall completion of our final product.

### What is going on and how is it being done?

For prototype 1, the team has constructed a basic rendering of the electrical subsystem based on the smaller focused prototypes that each team member produced in the last two deliverables. Originally the team decided to split up the workload by having each member build a focused prototype based on the important subsystems identified in the conceptual design but this was ultimately scrapped due to being too time consuming and would delay our expected date for Design Day. We chose to focus on one subsystem at a time and lay out the basic functionality of it before moving on to the next subsystem and ultimately intertwining them together.

The electrical engineer of the team was responsible for designing as well as programming the electrical subsystem including the solar cells and all its components, and how it interacted with the other parts of the final product such as the sump pump, thermostat, fan and radiator. This aspect of the project was tested multiple times until the team was comfortable with the cost of the materials, the power output from the panel as well as the functionality and simplicity of the design.

Shown below is a rendition of how the LED light, which is meant to represent an outgoing signal, turned on or off depending on the temperature being read by the Arduino Uno Temperature Sensor.




As displayed, the chosen optimal temperature for thermal comfort is 18ºC as was determined by a survey of 22 people for a range between 16º to 20º (Appendix 1). The LED light turned on when the measured temperature of the surroundings was reading below 18ºC on the thermostat. This outgoing signal will be connected to our heating subsystem which will instruct THEC to heat the surrounding air back to 18ºC. Once the sensor reads 18ºC or above it'll turn off the LED light, representing the system turning off.

For the testing of prototype I, the results of the tests are largely qualitative and there aren't specific measurements being made. The tests are generally graded based on how comfortable and user-friendly the system feels to the tester and how easy it is to operate as well as taking into factor the cost of each step.

For testing prototype I, the only materials required are the computers and the Arduino IDE and as such there is no additional cost.

Furthermore, in a separated spreadsheet, is a more comprehensive and updated BOM list that implements the cost concerns of the client. All materials required for the concept are included and the total cost was drastically reduced from the previous version.

### **When** is it happening?

The testing of the prototype will be repetitive and often because the team makes small changes and tests each one when it is completed. Each focused prototype is tested for their own individual expectations and the comprehensive prototype is tested to ensure that the different subsections integrate well together. Testing of the separate parts can occur independently but the comprehensive tests have to wait until the prototype is combined into one. The results of the tests are necessary before the team moves on to larger milestones such as the HVAC system and the ventilation subsystem. We must ensure that the more foundational parts of prototype I, mainly the electrical subsystem, are functional and operational before implementing and testing the more complex aspects of prototype II.

Leading up to prototype II the team has to continue developing the more complex parts of the final product and making sure these fit within our size and cost restraints . By prototype II, the team hopes to have successfully assembled and completed the additional parts to the electrical subsystem as well as connecting the latter to our HVAC system.

## Client Feedback

The client was overall happy with the first concept with the only critique being; how would the house be heated when the ground isn't warm enough to warm the house. Given this problem a solution that we found was to add a radiator in the central unit where the air was entering the house to heat the air and function in a closed loop with enough heat to warm the house to a comfortable level.

The current drawback with this feature is that it will require power and if there is no solar power available it will be reliant on the power grid seeing as the application of this system would be to make a currently existing house more sustainable by lowering the amounts of gas used to generate heat. In the situation that there is no alternative power source directly connected to the house there would have to be another solution used prior such as a generator, or even other forms of sustainable energy such as hydro, wind, nuclear, etc.

The location of this feature is important because its ability to produce heat while still being in the house means that there is no power lost to heating the ground and it is readily accessible if there were to be a problem with the unit.

## Conclusion

Overall, several modifications to the design were made throughout the design of this first prototype, mostly due to budget constraints. What we have presented in this document is a starting point of our first testable subsystem which we currently have on hand, as well as a first step towards the final product on design day. We look forward to the client's feedback to help guide us in the development of the second prototype.

## Appendix 1

| Temperature (ºC) | Tally |
|---|---|
| 16º | 0 |
| 17º | 6 |
| 18º | 10 |
| 19º | 4 |
| 20º | 2 |
| | |
| Total : | 22 |
| Average : | 18.1º ≃ 18º |