Team Ate

Deliverable G – Prototype II and Customer Feedback

GNG1103 C – Introduction to Engineering Design

Lab Section CO2 – Group 8

10 November 2024

Group Members

Ryley Dunn (300405314)

Makia Bernard (300436325)

Coulton Wong (300426191)

Haneen Barghouti (300414387)

Mujibullah Naziri (300430492)

Mani Nazari (300435894)

Abstract

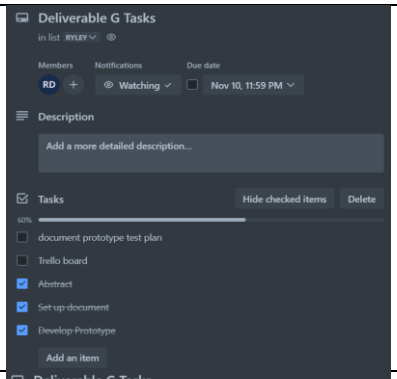
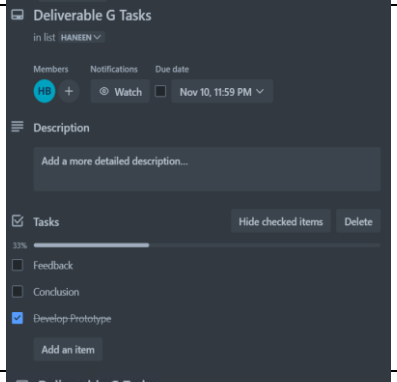
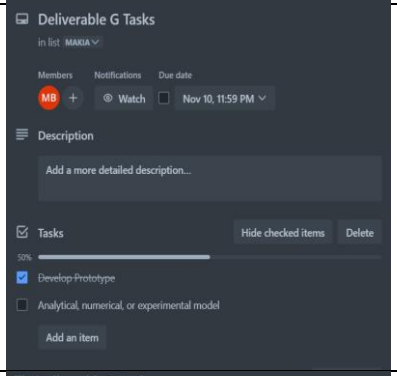
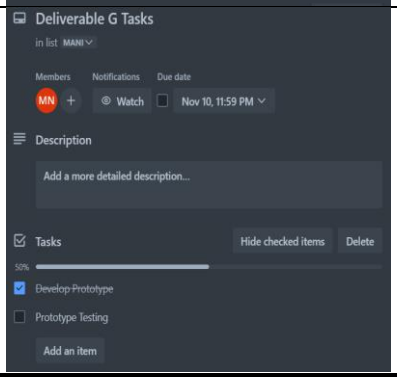
Using feedback to develop a second prototype and a test plan for the third prototype. Additionally, feedback from the client on the prototype will be acquired.

Table of Contents

Abstract.....2
Table of Contents.....3
Trello Board Updates.....4
Updates to the Code Flow Chart.....6
Prototype II Analysis.....7
Prototype II Testing Plan Results.....7
Feedback.....9
Updated Target Specifications and BOM.....9
Prototype III Test Plan (Mounting).....10
Conclusion.....12
References.....13

Trello Board Updates

Individual tasks have been updated to reflect the tasks for each team member. Additionally, a team meeting section has been added for both in-person and online meetings.

Person	Task	Trello Board
Ryley	- Document prototype test plan - Trello Board - Abstract - Set up Document - Develop prototype	
Haneen	- Client Feedback - Conclusion - Develop prototype	
Makia	- Develop prototype - Analytical, numerical, or experimental model	
Mani	- Develop prototype - Prototype testing	

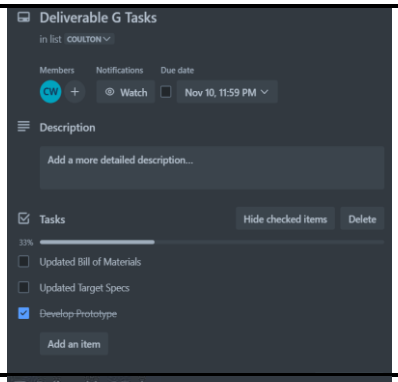
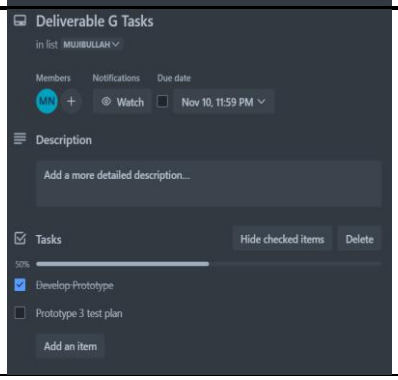
Coulton	- Updated Bill of Materials - Updated target specifications - Develop prototype	
Mujibullah	- Develop prototype - Prototype 3 test plan	

Table 1: Individual tasks for each team member as displayed on Trello.

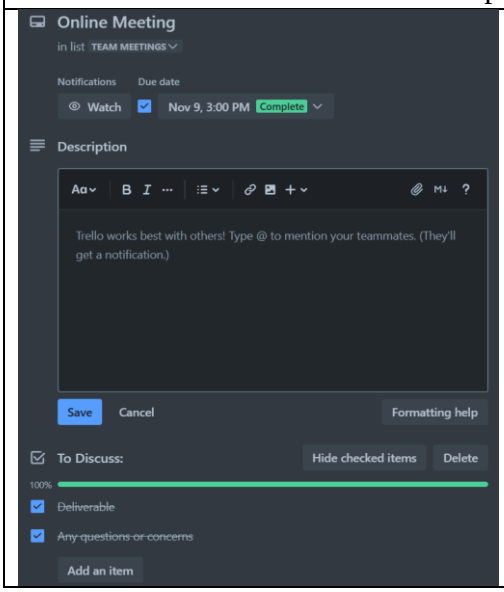
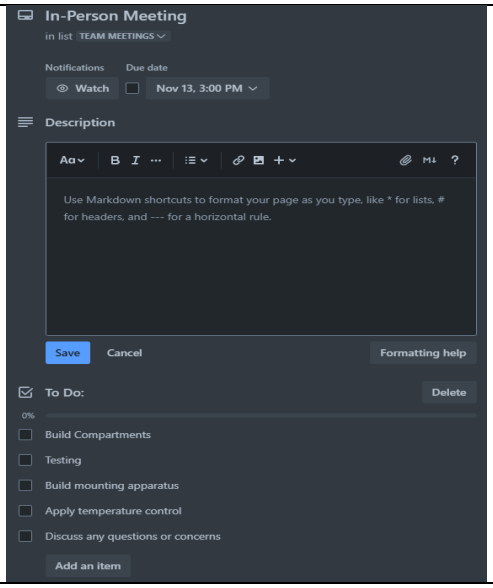
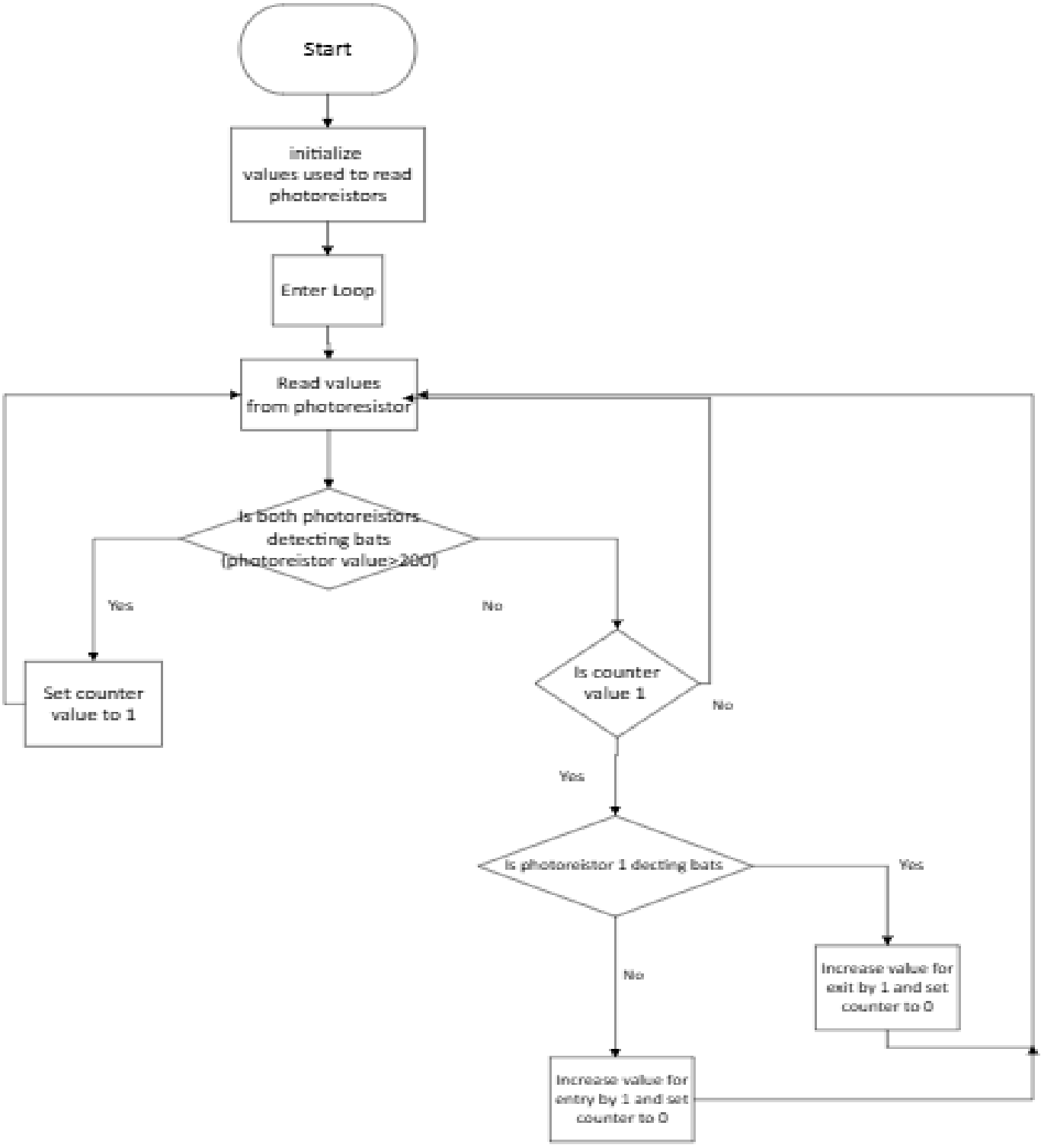
Upcoming Team Meetings	
	

Table 2: Upcoming team meetings both in-person and virtual as displayed on Trello.

Updates to the Code Flow Chart

The flow chart has been improved to be clearer and more concise.



Prototype II Analysis

For the second prototype, we purchased a wooden bat box and made some adjustments to it. The open spaces of the bat box were caulked to prevent any cold air from entering the bat box and making it colder. A sheet of metal that was placed on the roof of the bat box was also removed as it was not in our original design plan. For this deliverable, we tested the waterproofing of the bat box by pouring some water on top of it. Three trials were made and for each one, more water was poured on to the bat box to simulate a light and heavy rainfall. Overall, the light rainfall trials had no water entering the bat box while the heavy rainfall trials had 0.05% of the water entering the bat box. All three trials had the outside walls of the bat box absorbing the water with no visible damage.

Bat Box Prototype:

Prototype II Testing Plan Results

Water proofing

This test is to ensure that the bat box can withstand water from the environment in any given situation. In this test water was poured on the box in increasing increments and the leakage inside the box was measured.

Trial	Amount of water poured	Initial photo	Results photo	Results

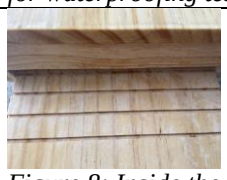
One	In the first trial 150mL of water was poured onto the box to simulate light rainfall.	 *Figure 1: Dry and untested bat box.*	 *Figure 2: Inside the bat box after the first trial for waterproofing test.*  *Figure 3: Outside the bat box after the first trial for waterproofing test.*	This test resulted in no water inside the box, however the outside had minimal water absorbed.
Two	In the second trial 300mL of water was poured onto the box to ensure it can withstand heavier rainfall.	 *Figure 4: Outside the bat box after the first trial and before the second for the waterproofing test.*	 *Figure 5: Inside the bat box after the second trial for waterproofing test.*  *Figure 6: Outside the bat box after the second trial for waterproofing test.*	The observed result for this test was that slightly more water entered the box, having approximately 0.05% of the water poured entering. However, the outside of the box absorbed more water with no visible damage.
Three	In the third trial, 450mL of water was poured onto the box to ensure it can be used without damage for a long time.	 *Figure 7: Outside the bat box after the second trial and before the third for the waterproofing test.*	 *Figure 8: Inside the bat box after the third trial for waterproofing test.* 	The observed result for the third trial had similar results to the second trial, with approximately 0.05% of the water leaking through with no visible damage, however, some absorption from the walls of the box occurred.

			Figure 9: Outside the bat box after the second trial for waterproofing test.	

Feedback

Feedback on this bat box prototype highlighted a few areas for improvement. For ventilation, the feedback pointed out that the ventilation holes we are planning to implement may need to be adjusted in size to ensure there is still airflow without letting in too much light or cold air. This feedback will be implemented by testing the effect of the air vents on the temperature inside the box. Another piece of feedback we received and implemented for this prototype was to have a compartment to house the electronics for the sensor. This aspect was overlooked in the original design and, in response to this feedback, we added a separate compartment that will be attached to the side of the box for the Arduino and sensors and wire management to keep the cables protected from rain or the bats. It was also mentioned that easy access to the electronics should be considered when designing the compartment. Feedback was given on mounting stability which will be tested in the next prototype.

Updated Target Specifications and BOM

Bill of Materials

Items Added	Cost	Source
Large Bat Box	$25.99	amazon
Items Removed		
Two 2 inches by 10 inches by 10 ft wood material	$43.80	Homedepot
Original Estimate	$141.36	
Updated Estimate	$123.55	

Target Specifications

	Design Specification	Relation	Value	Units
1	Capacity	>	50 (Original: 100)	Bats
2	Dimensions	=	10.5x 28 x 47 (Original: 47x104.1x17.8)	cm
3	Multiple chambers	=	1 (Original: 2)	Chambers

Prototype III Test Plan (Mounting)

Calculations for the maximum vertical load expected x 2.5 safety factor:

-The capacity of our bat box is 50 bats.

-Big brown bats are at most 25 grams. (Nature Conservancy Canada)

25 grams x 50 bats x2.5= 3.125kg

Calculations for the maximum vertical load expected x 2.5 safety factor:

-Highest average wind speeds in Ontario: 70 km/h (Government of Canada)

- Front panel dimensions 0.2286m X 0.2286m

-Wind load 39.62kg/m^2 (University of Sussex)

-Weight equivalent for the wind load x 2.5 safety factor: 39.62kg x (0.2286m x 0.2286m) x2.5 =5.18

Test ID	**Test Objective**	**Description of Prototype used and of Basic Test Method**	**Description of Results to Be Recorded and How They Will Be Used**	**Estimated Duration and Planned Start Date**

1	Find vertical load capacity, to ensure that the bat box does not fall off trees when mounted.	Two 5-inch nails will be used on the top and one on the bottom to nail the bat box to a tree. Then increasing amounts of weights/water will be added to bat box using a string to attach it to the box.	The final weight in kg with no visible damage will be recorded as the maximum vertical load of bat box. This will be compared to the maximum weight of bats expected in the bat box 3.125kg, adjustments to bat box will be made like adding more nails if this metric cannot be met.	The test will be performed on Friday Nov. 15. Weights added will keep increasing until there is visible damage and instability, or when more than 3.125 kg are added. (~20min)
2	Find horizontal load capacity of front panel, to ensure bat box does not get torn apart by weather conditions like strong wind.	The front side of the box will be held downwards, and increasing increments of weights/water will attach to bat box via string to the front panel of the bat box.	The final weight in kg with no visible damage will be recorded and converted to newtons as the maximum horizonal load of bat box. This will be compared to the maximum force expected of the bat box. Adjustments to bat box will be made like adding more nails and adhesive between to the front panel connect if this metric cannot be met.	The test will be performed on Friday Nov. 15. Weights added will keep increasing until there is visible damage and instability, or when more than 5.18 kg are added. (~20min)
3	Evaluate temperature stability of bat box.	The prototype will include ventilation holes on the box's sides, a small slit in the front and be made from timber to regulate the internal temperature.	The internal temperature data will be monitored every 30 minutes and compared to the maximum and minimum required	The test will last for a week to ensure enough data is collected or when the

		The box will be placed in direct sunlight for a prolonged period with a thermometer. Temperature readings will then be taken, ensuring they do not exceed 40°C and remains greater than >2°C.	temperatures. The results will indicate if any modifications need to be made in the ventilation systems.	temperature greatly deviates from desired range, in which case adjustments like increasing thickness of box will be made and test will continue. Test will begin on Monday Nov.11 and last till Sunday Nov. 17

Conclusion

In this deliverable, we have documented the development of our second prototype which focuses on the physical bat box. The deliverable includes documentation of the testing process, feedback from users/peers, and an update to the target specifications and BOM based on this prototype. Feedback on our design was considered for this prototype and iterations that will be made. The testing process results were analyzed and will also be considered for our next prototype. Also included is the outline of the test plan for our third and final prototype. Prototype 3 will have details of the original design, and any modifications or additions made, such as a compartment for electronics.

References

(1) Government of Canada. *Historical Climate* Data. https://climate.weather.gc.ca/ (accessed 2024-11-09).
(2) Nature Conservancy Canada. *Big Brown Bats.* https://www.natureconservancy.ca/en/what-we-do/resource-centre/featured-species/mammals/big-brown-bat.html#:~:text=The%20big%20brown%20bat%2C%20one,membranes%20and%20ears%20are%20black. (accessed 2024-11-09).
(3) University of Sussex. *WindForce.* http://www.sussex.ac.uk/weatherstation/technical/Windforce.html (Accessed 2024-11-09)