Project Group A14 - Max Goehrum - Brittanny Belanger - Miguel Sousa - Rishi Khubchandani - Jun Qian

Project Deliverable F: Prototype I and Customer Feedback

GNG 1103 – Engineering Design Faculty of Engineering – University of Ottawa

A prototype is being designed to ensure adequate methods will be used for the final product. This prototype will be useful in order to understand our product's needs better and to gain constructive feedback from our client. By accomplishing three prototype steps, there will be a reduced risk along the way so that changes can be accomplished earlier than later. The prototype will allow us to view the realistic overall functionality of our product. The general objective of this prototype is to learn what works and what does not work. As a team, it can be established what can be done better towards Bowie's final product.

Recall, Problem Statement:

Alternative means for environmental restoration implemented to Erin on the existing Bowie robot during its mission will be evaluated upon its current abilities with an attachment that is lightweight, affordable, and uses materials that are environmentally friendly, to more effectively reduce the amount of litter and pollution on parks and beaches.

During the conceptual design process, many ideas had been presented to Erin. It had been established that a Secure Portable Storage method will be our final product. Our team has based this design on a combination of two conceptual design ideas, as listed below:

Secure storage method

When or if Bowie becomes a fully autonomous robot, it will need to be stored in a shelter. The shelter will protect Bowie from natural weather impacts and provide security for Bowie so there is no direct damage done by humans or animals. Considering natural weather impacts, the storage shelter will need to be durable enough to protect Bowie from wind, heavy rain, and very cold (and/or very hot) temperatures. The storage shelter will need to be big enough to hold Bowie, any non-permanent attachments, and a charging station to reach Bowie's battery. The amount of durable material will need to be determined by triple bottom line.

Carrying Case

A carrying case designed specifically for Bowie that has a foam cut out for the robot and any other supplies needed. This will resemble cases for drones or cameras. The case could be made of a hard plastic, sheet metal or plywood. Handels will be placed at multiple locations for ease of carrying in

numerous situations. A customized foam placement will be added to the box to support Bowie during transport. Sections for the remote, extra battery will be added to the foam cut out.

Test Objectives Description

Specific tests are rigorous examinations prepared in order to determine if the module will work as intended. This includes testing to find out if the attachment is suitable for the weather conditions that Bowie is capable of operating in, if the electronic components will function properly, and if Bowie will be able to interact with the attachment as desired. Weather resistance can be tested by placing the prototype outside at different times throughout the day, in extreme weather conditions, and even controlled environments. For example, a parameter would be how water-resistant the material is. The effectiveness of the electronics can be achieved by viewing how the camera can handle various lighting conditions by recording at different times of the day. Additionally for the camera, testing the effectiveness of the motion detector will also be required. This can be realized by moving objects in front of the camera at various velocities to see if it records that movement. Lastly, testing how Bowie will interact with the shelter includes a wide variety of necessary tests that determine the overall functionality of the product. Some examples for testing overall functionality include: observing if Bowie is able to fit in the door frame, if Bowie may get damaged during transport, and how many people are needed to move/set up the shelter.

Designing Prototype I will allow the team to learn and communicate whether to keep an idea or not based on the testing elements applied. The point of creating stages of prototypes is to test different steps to prevent creating a final product that needs to be changed completely. Changing a finalized product rather than modifying different stages of a product can cause additional costs as well as additional time. The communication from this test will be whether each test passes or fails on the given parameter. Prototype I will be a basis of communication to teach the team what is done well and what needs improvement.

The possible types of results will be damaged within the storage unit, theft of the camera, and dropping the unit. Various methods will be used to protect Bowie while inside the unit as Bowie will be moving freely. Currently, the test will be done based off of velcro straps. Movement of the unit could have Bowie bumping the sides, therefore, causing damage to both the unit and Bowie. The camera will be placed on the inside of the storage unit but the possibility of it being tampered with from a bystander is a possibility. The camera lens could get damaged should someone decide to vandalize the unit. It is always a possibility for the user to drop the Secure Portable Storage unit and having it become damaged from the ground or bumping into other obstacles. Materials will become a concern to observe what will not allow the unit to fall apart (e.g., the connection of the corner is opened, a hinge has broken apart, etc.).

The results from the tests applied will impact the decisions of what will need to be used for the next prototype. During the first prototype, the main objective will be to determine if the unit is structural

sound. The decisions that will be impacted are the materials used and the framework of the entire storage unit.

The criteria for test success or test failure would include structural elements, camera visibility, accessibility for entrance and exit, and weight constraints. To test for structural integrity, application of pressure to the top and sides of the storage unit would be applied. The pressure would range from pulling the unit by hand to the weight of a human (like sitting on the box). A fail would be considered as anything that breaks cracks or damages that storage unit. A pass would be considered as the structure surviving multiple stress tests without and damage obtained. We will determine whether the applied weight is applicable in a real world situation. A test for camera visibility would confirm if it can be tampered with too easily. A pass for this would be to show the storage unit to a test group and allow for them inspect it. If majority of them notice the placement of the camera, that location might not be the optimal place to put the camera. A test for whether or not Bowie can easily enter and exit the box due to its size will establish if Bowie has trouble entering the storage unit that entrance may need to be larger. A test will be completed to determine if the weight of the storage unit is too heavy. Testing would include multiple people moving and transporting the box and recording their feedback. If people say the unit is too heavy, an alternative material may have to be considered. The general criteria for a success and failure for tests on the prototype would be no failure in terms of anything structural and having various people try to operate the storage unit with no complaints or weight or noticeability of the camera.

Accomplishing Testing

The prototype type will be comprehensive. A reason for this is that the prototype we are constructing will include multiple stages of testing for which we can improve on each prototypes previous failures. The first prototype will determine the structural layout of the secure, portable storage method for Bowie. The second prototype will determine whether the storage method is functional for Bowie. The final prototype will be the most complex and will be the final manufactured product for the client.

The testing process will be based on structural ability, electronic components, and weather impacts. The prototype will require certain materials and stability to withstand the tests applied. The testing process is previously mentioned in the criteria for test success and test failure. An individual can base their tests on the specifications mentioned.

The information being measured is the effectiveness of the shelter until failure occurs. The structural stability is the most crucial parameter, therefore, materials will be the top priority for a sound structure. The camera visibility is also measured based on observation from third parties. Feedback from the observers will give the team information on changes that can be applied for the next prototype. Weather impacts will be measured by damage that has occurred or has not occurred. These impacts will display if materials or structure need to be changed moving forward.

The raw data will be recorded by notes during third-party observations and during the application of various weights applied to the structure. The data will then be computed in excel to graph the ranges of pass and failure constraints. All data collected will be accomplished in a group setting in case one individual missed a parameter that another individual can incorporate.

The approximate cost of the materials are:

Popsicle sticks - $2.50
Wooden dowels - $3.75
Fabric - $1.25
Platform (cardboard, wood platform) - $3
Rope - $1.25

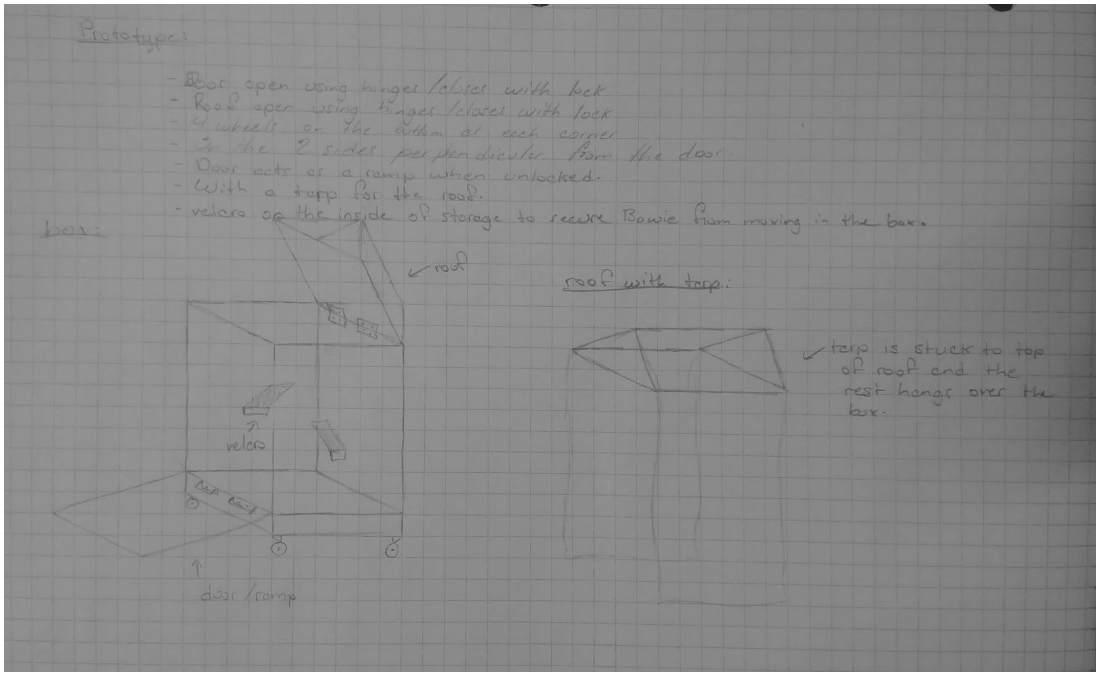
*Note: The duct tape and hot glue are not included in the price because they were refurbished materials.

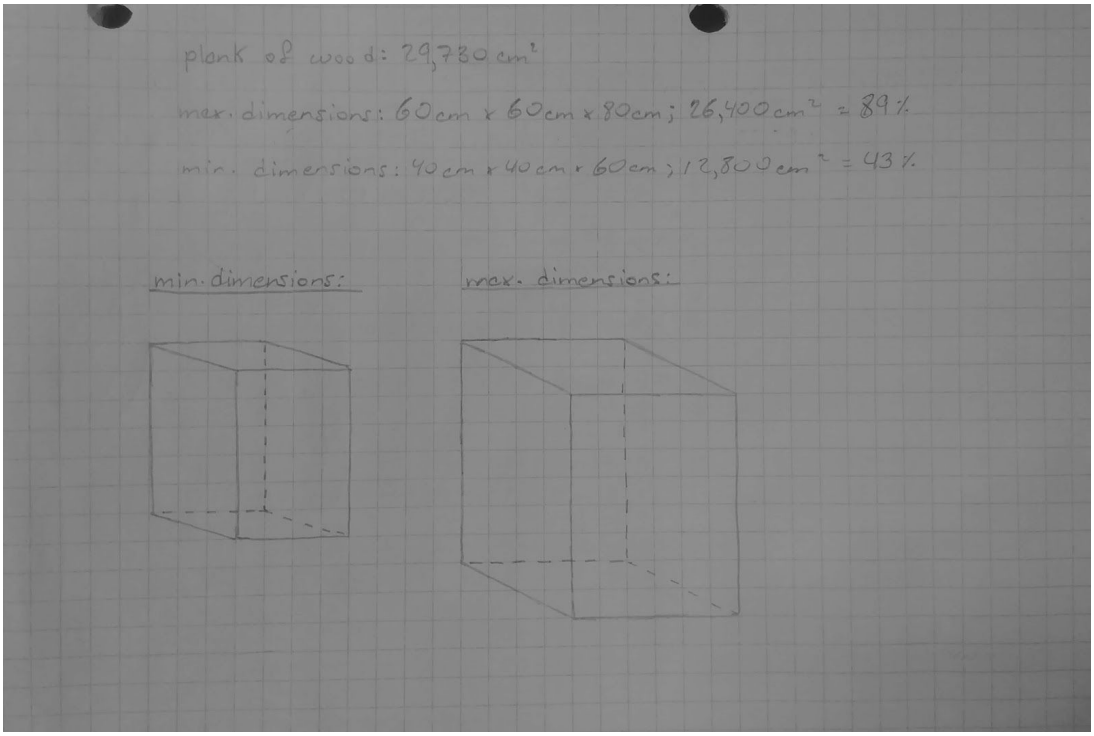
Total = $11.75

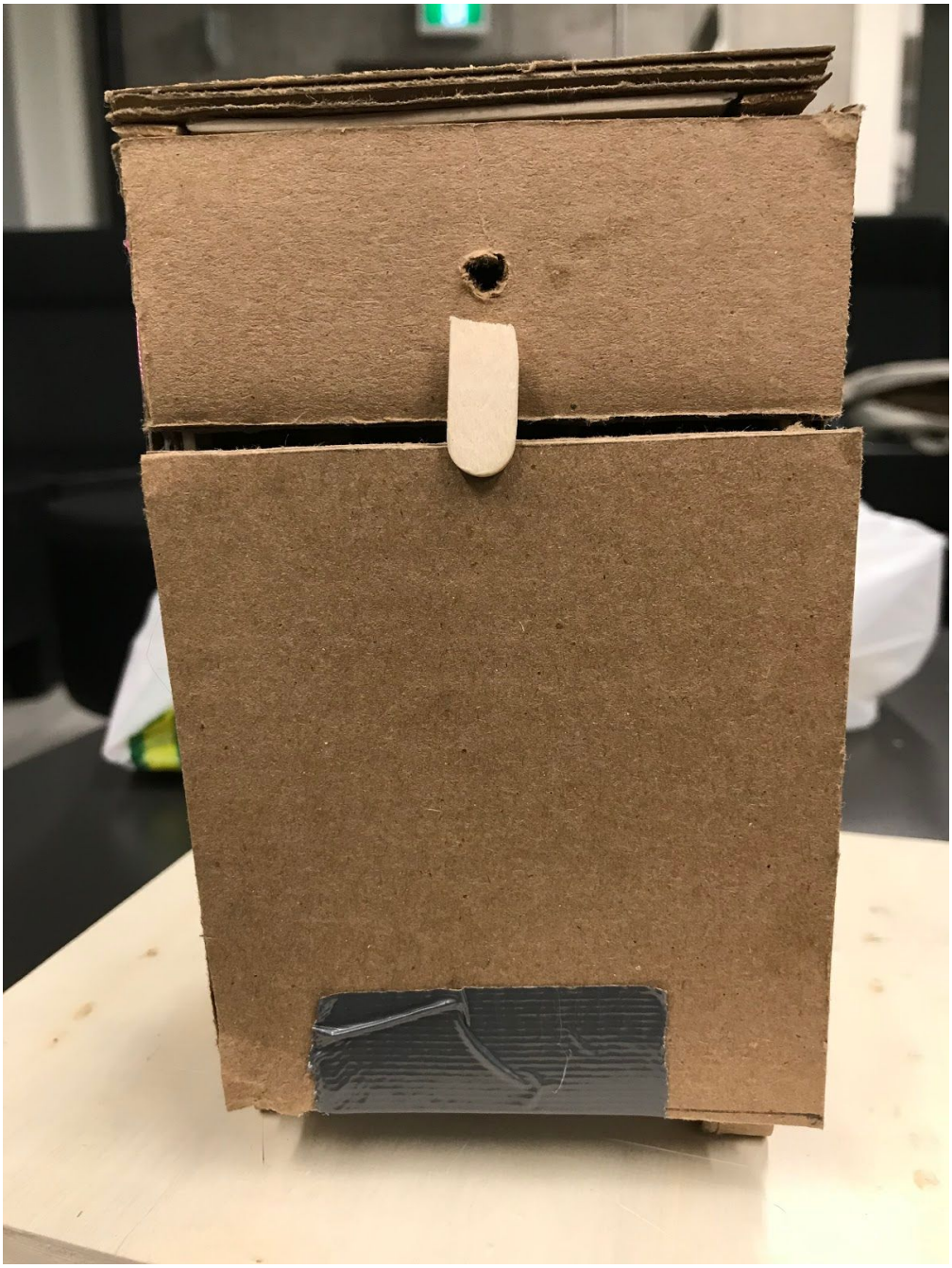
Schedule

The work that needs to be done during Prototype I is to model the structural framework of the Secure Portable Storage method. The tests that should be done to prototype I are: the analysis of the structure (where is it most likely to fail, are there any weak points, should there be cross member to support the structure, brackets in the corners?), where would water enter the prototype (are we going to waterproof or water-resistant or neither, and how will that be attained), and can the wheels on the bottom of the storage unit handle the surfaces that the storage unit will encounter (do we need larger wheels, softer rubber or harder rubber?). The tests will be required next week to submit observations to the client. Once feedback is received, the group will think about the usability of the product in the eyes of the client and imagine what other conveniences will be useful to Bowie. Brainstorming will follow to add ideas to the next prototype.

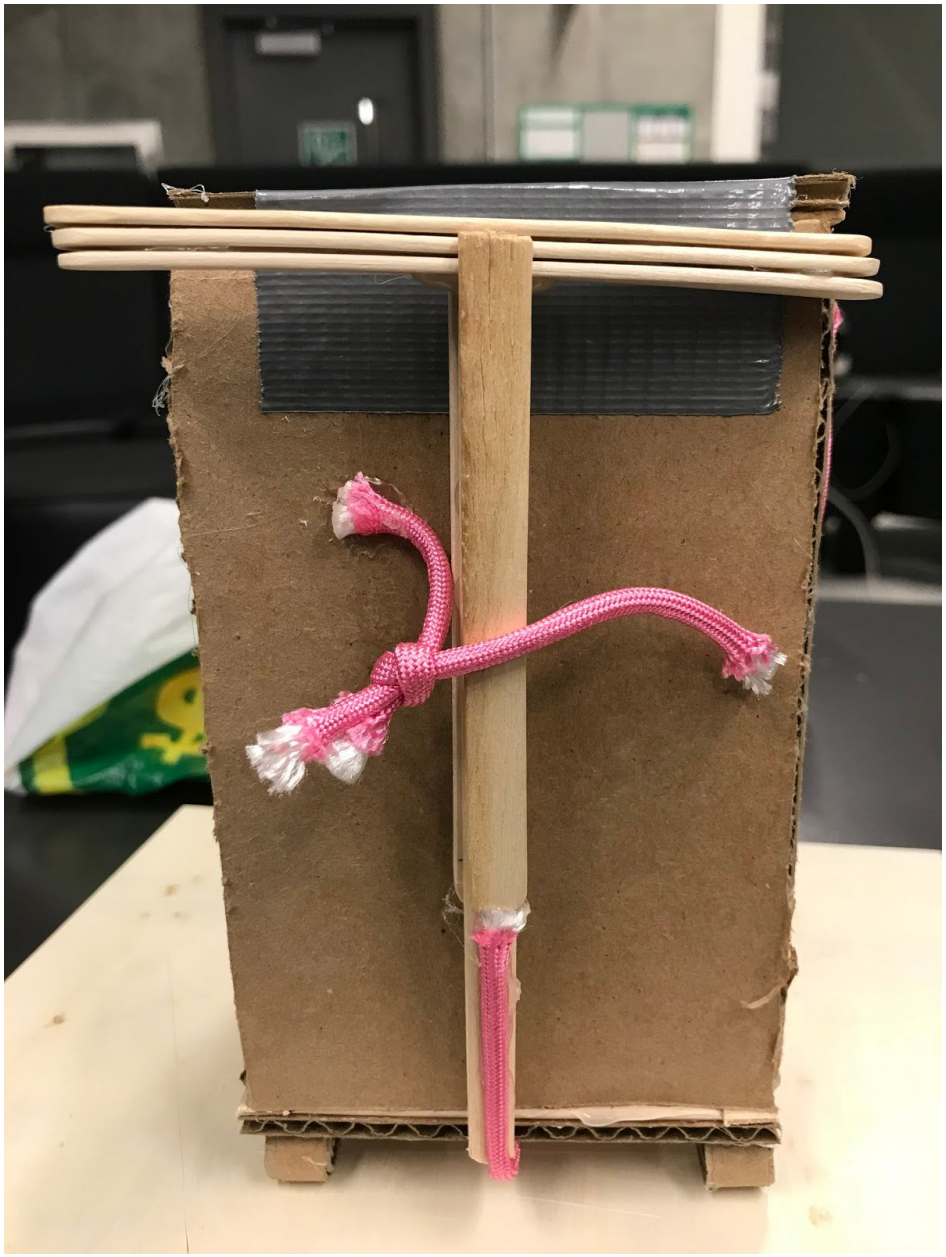
Sketches and Pictures



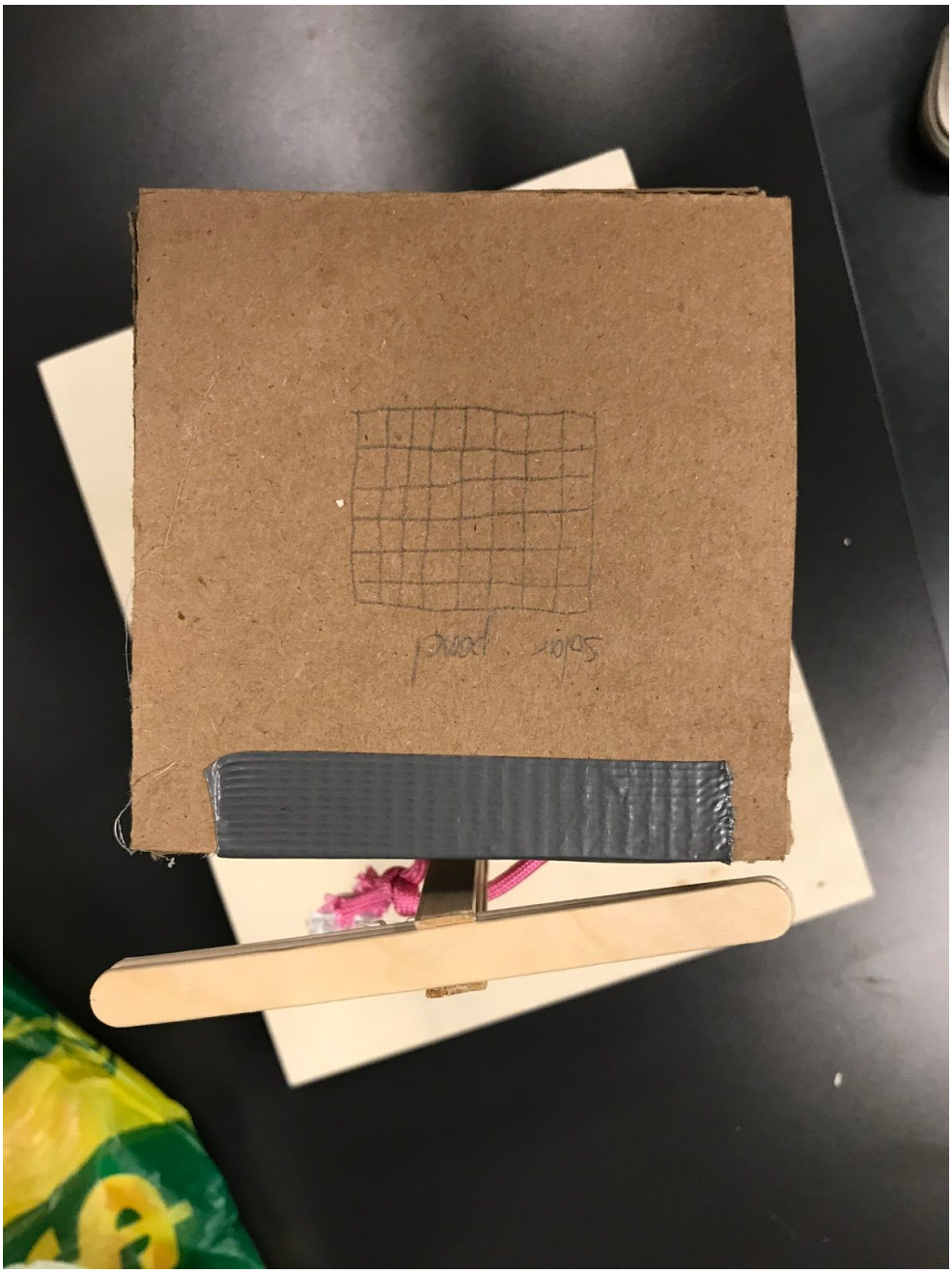




Front view



Rear view



Top view

Side view

Isometric view