



uOttawa

PD-F: Prototype 2

GNG2101, Section A01

Team 2

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1. Introduction

This deliverable will go over the client feedback that was received in meeting number three and the improvements made to the team's first analytical prototype and the development of the first physical prototype. First of all, the client's feedback was discussed as a team and it was decided what the more crucial design features were to be and what to focus on based on the feedback as well as the team's technical skills and budget. The design features agreed upon prompted the development of the team's first 3D printed physical prototype. The physical prototype of the tablet holder mechanism as well as the client feedback will be further discussed in the deliverable. This document will also cover prototype testing and performance evaluation.

2. Main Subject Body of the Report

2.1 Summary of Client Feedback

The third client meeting was a presentation of the first analytical prototype. Overall, the client was impressed with the solution that the team had come up with. The following points are the feedback collected during the client meeting/presentation.

- The client prefers buttons attached to the table top.
- Laminating surface to protect against moisture and spillage.
- The client requires a reliable prototype over a period of time.
- The system should be able to switch which side of the table the buttons are on.
- The client requires a constant recharge of the tablet battery.

Overall, the clients were satisfied with what the team had come up with and they were very intrigued with the team's design and pleased with the team's ability to solve the problem of the stowaway tablet.

2.2 Design Details

2.2.1 Movement Prototype

Throughout the design process, there has been concern about how well the moving parts of the table will be able to move across the rails while being pulled by the motor. This prototype aimed to ensure the design allowed smooth movement along the prescribed path from a single force vector. To test this, a simplified and scaled-down version of the CAD model was 3D printed using print-in-place joints for the rails.

Print-in-place joints are a method of 3D printing in which no assembly is required and the part is usable after minimal cleanup. It is accomplished by interweaving two or more separate pieces by judicious use of gaps and bridging. It can save a massive amount of time not only in the post-print assembly but also by negating the need to design ways to fasten the various pieces together. The drawback to this method is that the joints tend to be rougher, the dimensions can be skewed from sagging during bridging, and a failed print will require re-printing the entire piece. It is also more limited in what can be made, and since many parts will end up printed in a sub-optimal orientation, the final print will be weaker than an assembled print, though these were not a concern for this print.

In the case of this model, two supports were added to the outside of the rails to allow the pins to bridge across the gap in the rails. The bridging across the pins came out fairly well, but the overhangs and bridging across the rails needed to be cleaned up. A length of fishing line was used as the string, which in hindsight was not a photogenic choice.



Figure 1: Closed Position



Figure 2: Open Position

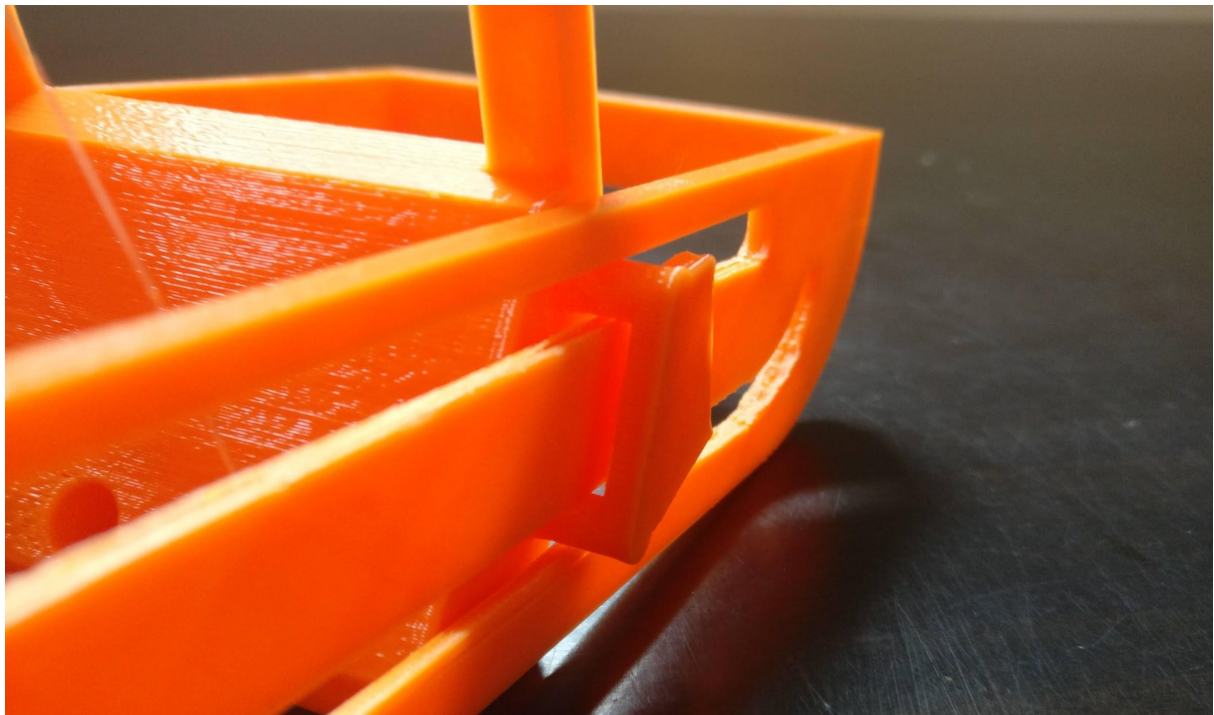


Figure 3: Rails Close-up View

2.2.2 Button Enclosure Prototype

After receiving the switches that would be used for input buttons, it was now possible to design the enclosure. The buttons and enclosure were designed in Fusion360, 3D printed and assembled. This prototype aims to test the dimensions needed to incorporate the switches and wiring needed. The switches are pressed into the orange button caps and then placed into the enclosure. A retaining bar is passed through the side of the enclosure and then bolted into place. The retaining bar provides the reaction force needed to activate the switch when pressing the button while leaving the pins accessible to have the wires soldered into place. A cutout is left in the enclosure walls for the wires.



Figure 4: Button Enclosure (Front)

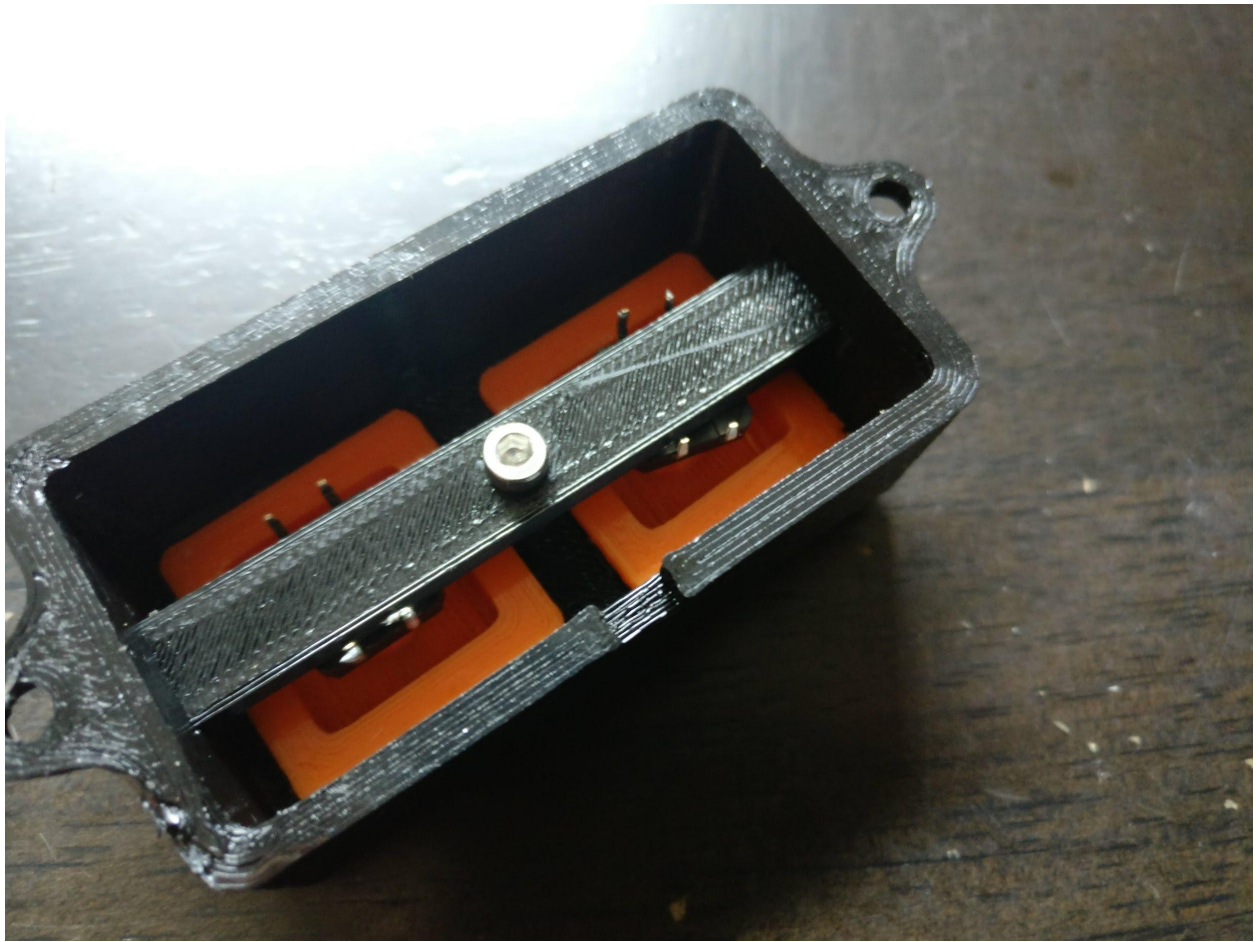


Figure 5: Button Enclosure (Back)

2.2.3 Tinkercad Circuit of Motor Control & Arduino Programming

Figure 6. Illustrate the circuit diagram of the Motor control and arduino programming. Pin 9 and 8 are connected as input pins, and pin 7 and 6 as output pins. Two buttons that act as switches are connected to the input pins. These pins are triggered by pressing the button. The signals from the buttons are processed by the arduino microcontroller. The output signals control the state and rotation of the motor. The flowchart in Figure.7 illustrated the logical flow of the arduino program.

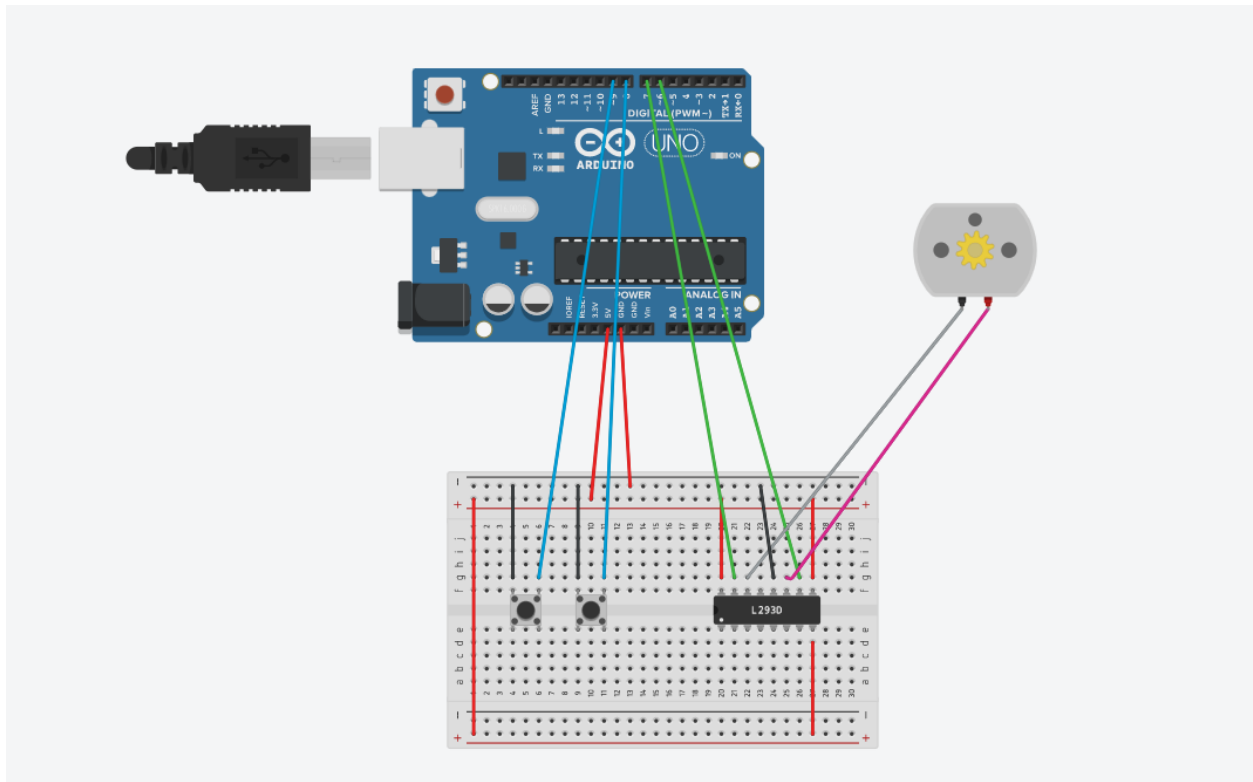


Figure 6: Screenshot of the Circuit Setup

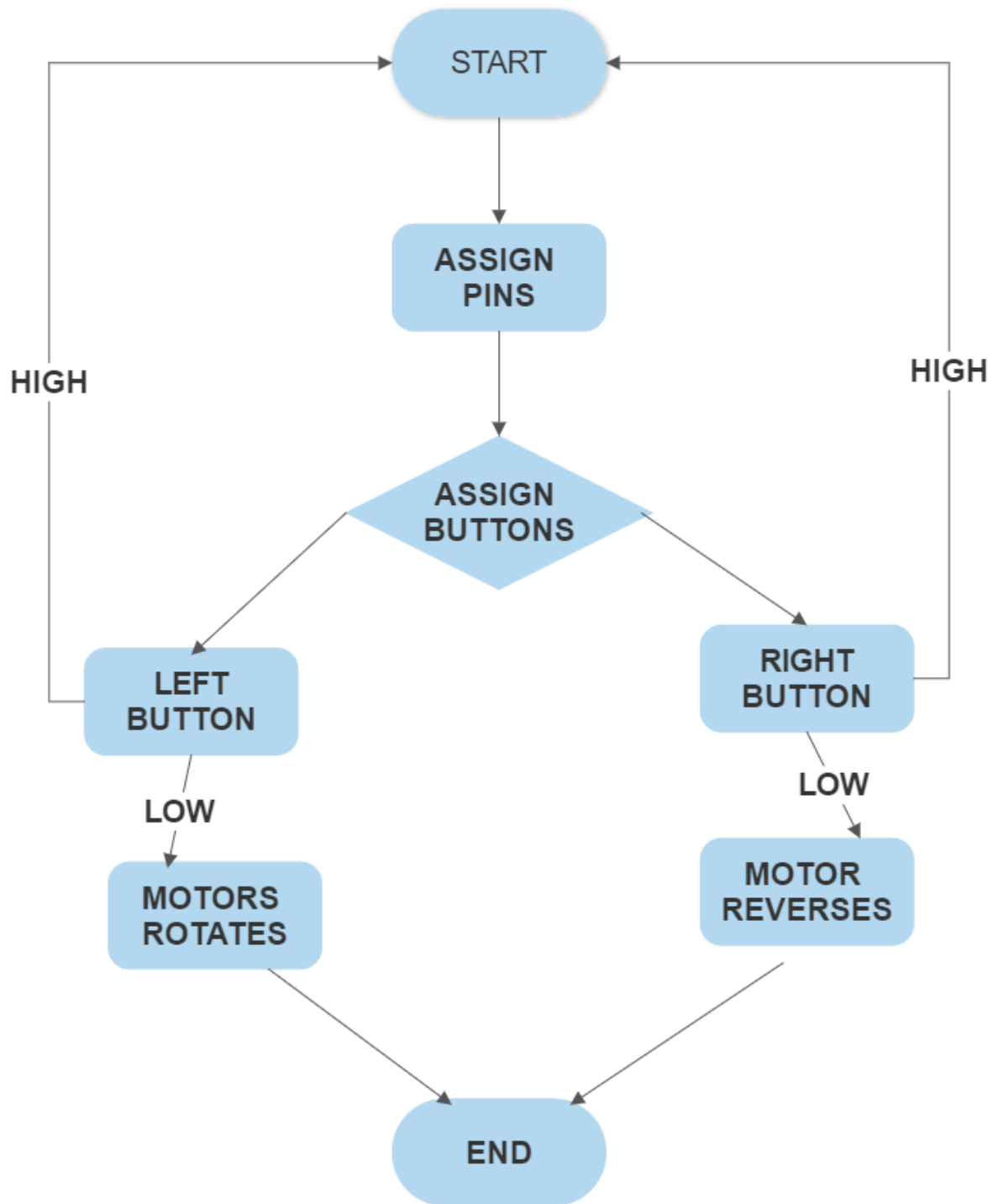


Figure 7: Flowchart of the Arduino Circuit Code

2.3 Prototype Testing & Evaluation

2.3.1 Movement Prototype

After adding the string, the printed model was held level while the string was repeatedly pulled towards the front of the print, and then towards the back of the print. The moving portion followed the rails as expected when pulled to the front, but experienced too much friction when pulled towards the back. This friction is being caused by the layer lines of the print, and is not expected to be an issue with the final product. Lubricant and bearings could be added if friction does turn out to be an issue.

Table 1: Tablet Holder Movement Testing

Test	Pass Condition	Result
Moves forward along rails when pulled by the string.	Yes	Pass
Moves backwards along rails when pulled by the string.	Yes	Fail

2.3.2 Button Enclosure Prototype

After assembling the switches into the button enclosure, it was seen that the switches fit correctly. The retaining bar held the buttons securely in place, allowing a press to activate the switch, while also leaving the pins accessible for the wires to be attached later. Using a scale, the switch activation was measured by slowly applying force until the activation occurred and noting the results.

Table 2: Button Enclosure Testing

Test	Pass Condition	Result
Switches fit in the enclosure, and pins are accessible.	Yes	Pass
Buttons can be clicked with reasonable force.	<5 N	3 N Pass

2.3.3 Tinkercad Circuit of Motor Control & Arduino Programming

Table 3: Tinkercad Circuit & Arduino Code Testing

Test	Pass Condition	Result
Motor reacted as expected.	Yes	Pass
Program ran as expected.	Yes	Pass

3. Conclusions and Recommendations for Future Work

In Conclusion, this deliverable comprises prototype 2 illustrating the final design concept, the analytical test results of the major functionalities and the bill of materials. The laser-cut model of the table surface with a recessed tablet holder illustrates the functionality of major parts. The following will be presented to the client during the next client meeting.

1. Physical Prototype II
2. Motorised arduino controlled subsystem
3. Arduino code
4. Incorporated ideas from the previous client meet
5. Updated estimated cost of the project
6. Project setbacks and challenges

In doing so, we expect to get feedback on our process, positive criticisms on the final design concept and prototype, and suggestions for a second prototype. In the future, we would like to incorporate more advanced electronic subsystems as a part of the team's automation plan.

4. Project Plan

The next step for our project is to develop a potential business model and an economics report. The economics report will help us to understand the financial and operating assumptions for our project. The business model is a way for us to understand the commercial viability of the project from a business perspective before starting to implement it.

The business model should be made to be commercialized by the final version of the Tablet Tray, which is a refined version of the second prototype that is presented in this document.

The economics report will contain the business model, the income statement, and the break-even point for our simulated company. The following link:

<https://www.wrike.com/workspace.htm?acc=4960831&wr=20#path=folder&id=755613321&c=timeline3&vid=-4&p=755613317&a=4960831&so=10&bso=10&sd=0&f=&st=space-75561331>

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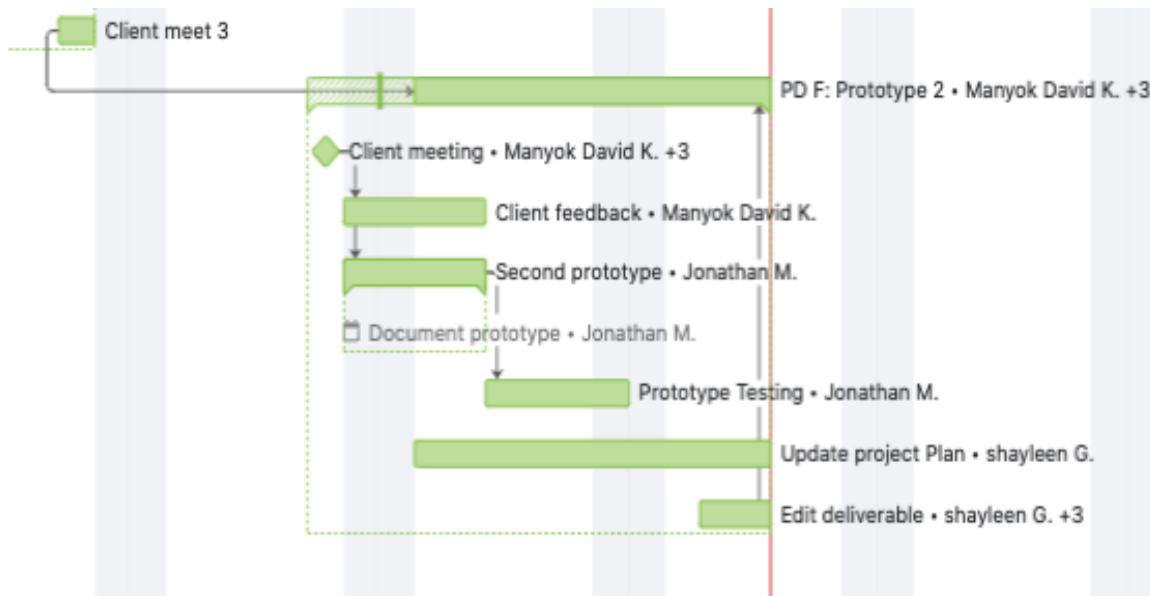


Figure 9: Screenshot of the gantt chart