Increasing Tactile Sensations for Virtual Card Games by Creating a Controller that Simulates Immersion

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I. Introduction

THe goal of this project is to create a controller that accurately mimics the tactile and interactive experience of playing a physical card game. By integrating the physicality of cards and the engagement of digital interaction, we aim to deliver a more immersive and authentic gameplay experience for users. To achieve this, we will document the progression of our project, including the materials used and the methods used to create each controller component.

As part of our iterative design process, we will present the feedback gathered through multiple rounds of user testing. By distributing questionnaires to participants after each test session, we can gather insights into user preferences, challenges, and overall satisfaction. These findings will guide us in refining our controller's design to ensure it delivers a seamless and enjoyable experience.

In the final section, we will reflect on the lessons learned throughout the project. This will include a discussion of what went well, what could have been improved, and whether there are additional enhancements we could explore to elevate the user experience further. Ultimately, this project seeks to bridge the gap between the digital and physical worlds, creating a new type of controller that enhances the card-playing experience.

II. Materials and Methods

IN materials and methods, we would go through our project progression from planning, to component, to technical drawing, and at last combining everything.

First of all, we started with the planning stage and we started by figuring out what a virtual card game player needs to experience the tactile feeling of playing a physical card game. The design slowly comes into shape with more feedback and improvement received for the iterative designs.

Then we start working on building the component by programming the controller functions on Wokwii and purchasing electronic components for the controller. The electronic components include 1 Arduino, 1 RFID sensor, 1 joystick, 1 slider potentiometer, 1 large breadboard, 2 nano-sized breadboards, 4 buttons, and 4 LEDs.

Next up is the technical drawing, which consists of creating separate pieces needed to build the outside cases of the controller. The pieces include the lid, body, bridge, and buttons. The lid is used to seal the box and has holes on top to access the buttons, slider, and LEDs. The body is where all the components are stored, and contains blocks that would hold the bridge above the main component, and a hole on the side to plug in by the power source. The bridge is to hold the RFID sensor as close as possible to the lid to maximize the distance to sense cards. The buttons are simply cylinders to extend the buttons on the component for the player to access.

Finally, after finishing designing each piece for the controller case we 3D printed it out and started combining it with the components. The controller case uses filament as material to 3D print and when combined uses cardboard and tapes to fill in gaps and secure components in place.

III. Results

Timeline with comments for major milestones can be found in E

Slicer video links can be found in D

The QFD and Usability Assessment shows us that the controller is working as intended. They can be found in D alongside the total print time and material amount.

Fabrication Process Video can be found here: https://www.youtube.com/watch?v=wxifi8fT8Cc

Prototype Demo Video can be found here: https://www.youtube.com/watch?v=1Hc-Lim6AQ0

Electronic Simulation Video can be Found: https://www.youtube.com/watch?v=9TmpfCNKFD4

Assembly Simulation Video can be found at: https://www.youtube.com/watch?v=VmjWsArN9i4

Bill of materials, 3D part blueprints, electronics schematics, 3D assembly, exploded view can be found in C

Improvements made: We shrunk down the Bridge's pegs since the old bridge's pegs were too big to fit in their holes.

The lid was modified so that the left side is raised by 1cm then slopes down towards the middle. This was done because the components on the left side were slightly too tall but we needed to keep the right side at the end height so sloping it allowed us to raise it while also letting it flow down naturally.

To make sure that each component and wire was properly secured into place we used tape to secure these parts to the case.

IV. Takeaways and recommendations

THe takeaways we had in this assignment are getting user results through QFD methods, and the importance of precise measurement in similar projects. Using QFD methods, we could better translate customers' needs to technical requirements giving us a better idea of where to adjust. We learned the importance of precise measurement when we encountered 3 issues while assembling the physical component. First, half of our controller lid is stuck, then the other half couldn't close due to the wire poking up, and lastly, the bridge's peg is wider than the hole making it unable to plug in. We have to resolve the problems by iterating the design on fusion and 3D printing it again. We would recommend those who want to create similar projects to check each step they took multiple times as it would help polish the iterations of the design, find potential bugs in code, and make sure each piece has enough space to fit through.

V. REFLECTION

THroughout the project, we learned how to plan a game hardware project and make the hardware and software of a controller. We plan the hardware design through the use of a design thinking process to iterate on designs and solutions properly. Then we learned how to use fusion and CAD software to draw out the iterated design and then 3D print it out. For the software we learn how to use Wokwii to simulate the ideal functions we need for the controller.

If we start over, what we would do differently is better time management since we often run out of time and have to push or cut certain functions out. We also need to create a more detailed paper prototype since the one we created doesn't have a detailed measurement making it difficult to reference in fusion. Speaking of fusion, we would want to create a more precise drawing on fusion as the first 3D printed product has size issues causing the lid hard to close.

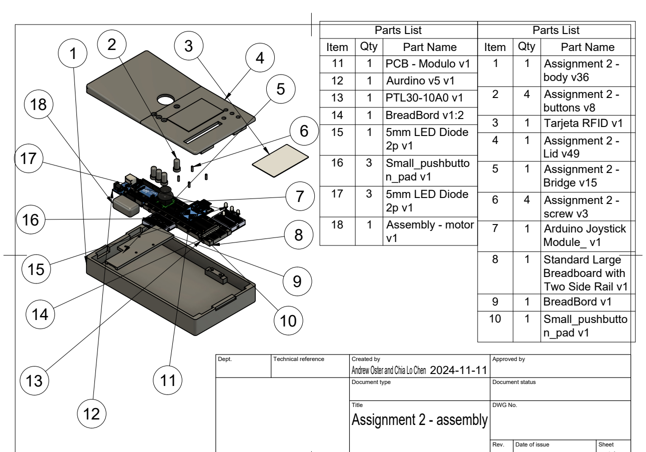
APPENDIX A
CONTRIBUTIONS

Chia Lo Chen's Contributions:
Design and Iterations,
Base and Bridge of Case Fusion Models,
Lid of Case Fusion Model,
Assembly Animation,
Technical Drawing Touchups,
Video Report.
Andrew Oster's Contributions:
Design and Iterations,
Fusion Model Improvements,
Fabrication Highlight Video,
Unity Project Programming/Design,
Electronic Component Programming,
Questionnaires,
QFD,
Video Report.

APPENDIX B
SLICER VIDEOS

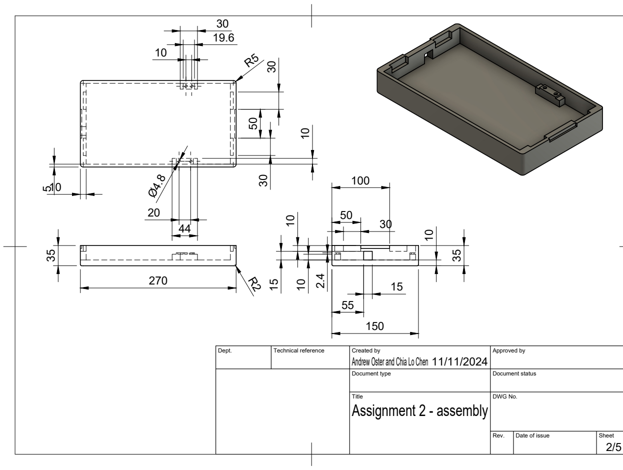
All of the slicer videos:
https://www.youtube.com/watch?v=U9rV0YPV-oc
https://www.youtube.com/watch?v=oVa4BcqmQxs
https://www.youtube.com/watch?v=bPwI8$_{g}tZUY$
https://www.youtube.com/watch?v=ezQYgLVif$_{8}$

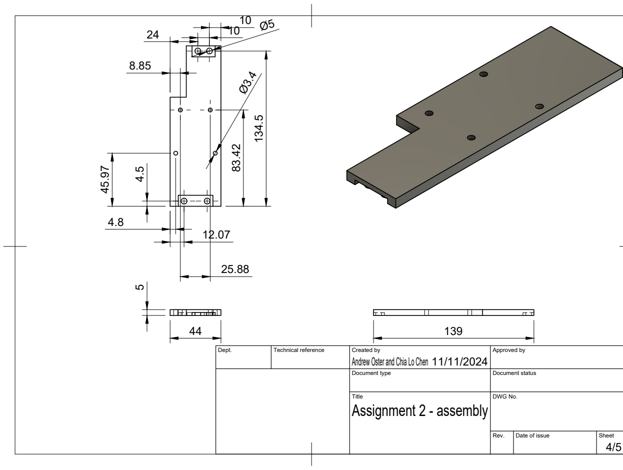
APPENDIX C
ASSEMBLY AND TECHNICAL DRAWINGS

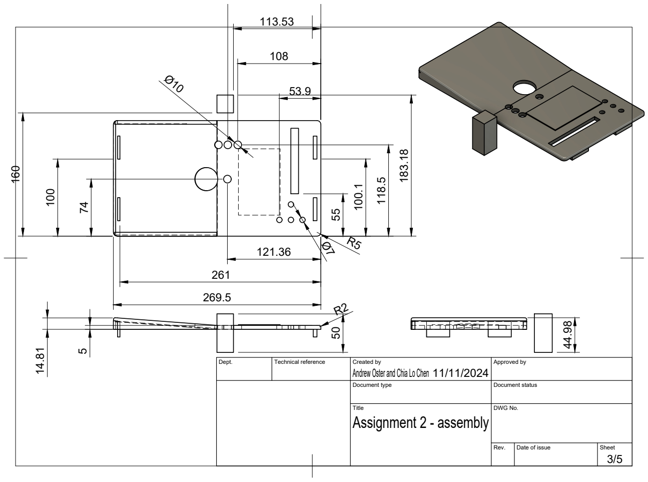


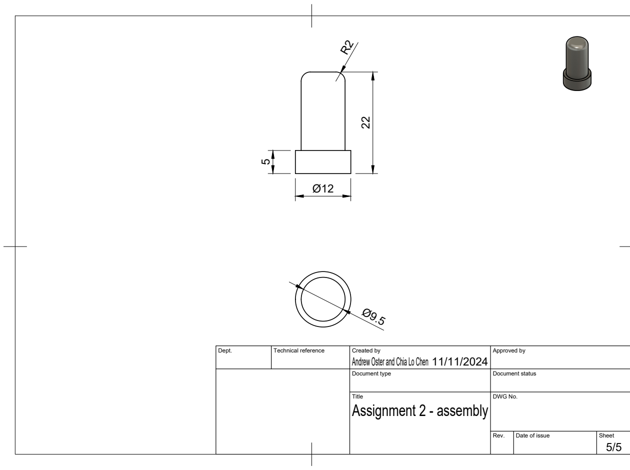
Item	Qty	Part Name
11	1	PCB - Modulo v1
12	1	Aurdino v5 v1
13	1	PTL30-10A0 v1
14	1	BreadBord v1:2
15	1	5mm LED Diode 2p v1
16	3	Small_pushbutton_pad v1
17	3	5mm LED Diode 2p v1
18	1	Assembly - motor v1

Item	Qty	Part Name
1	1	Assignment 2 - body v36
2	4	Assignment 2 - buttons v8
3	1	Tarjeta RFID v1
4	1	Assignment 2 - Lid v49
5	1	Assignment 2 - Bridge v15
6	4	Assignment 2 - screw v3
7	1	Arduino Joystick Module_ v1
8	1	Standard Large Breadboard with Two Side Rail v1
9	1	BreadBord v1
10	1	Small_pushbutton_pad v1







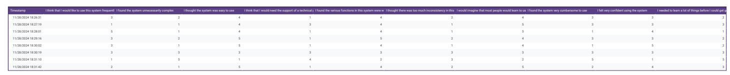


Filament	Model	Support	Total
1	118.48 m 353.37 g	5.93 m 17.69 g	124.41 m 371.06 g

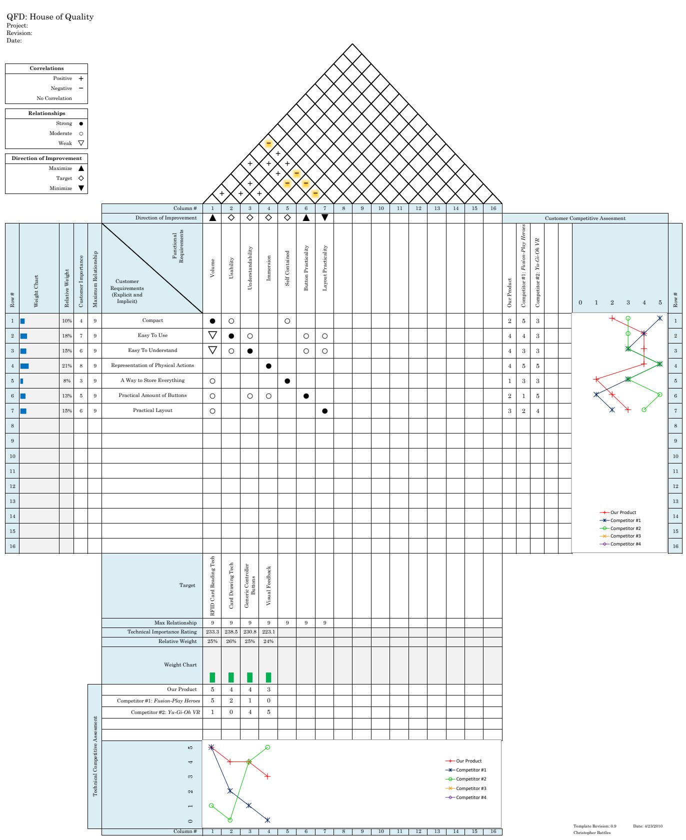
Total cost: 7.42

Time Estimation

Plate 1	4h34m
Plate 2	2h44m
Plate 3	2h39m
Total	9h58m



Appendix D
Prototype Fabrication



APPENDIX E
TIMELINE