GNG2101

Design Project Progress Update

Adaptive Play- Group F 2.3

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List of Acronyms

Table 1. Acronyms

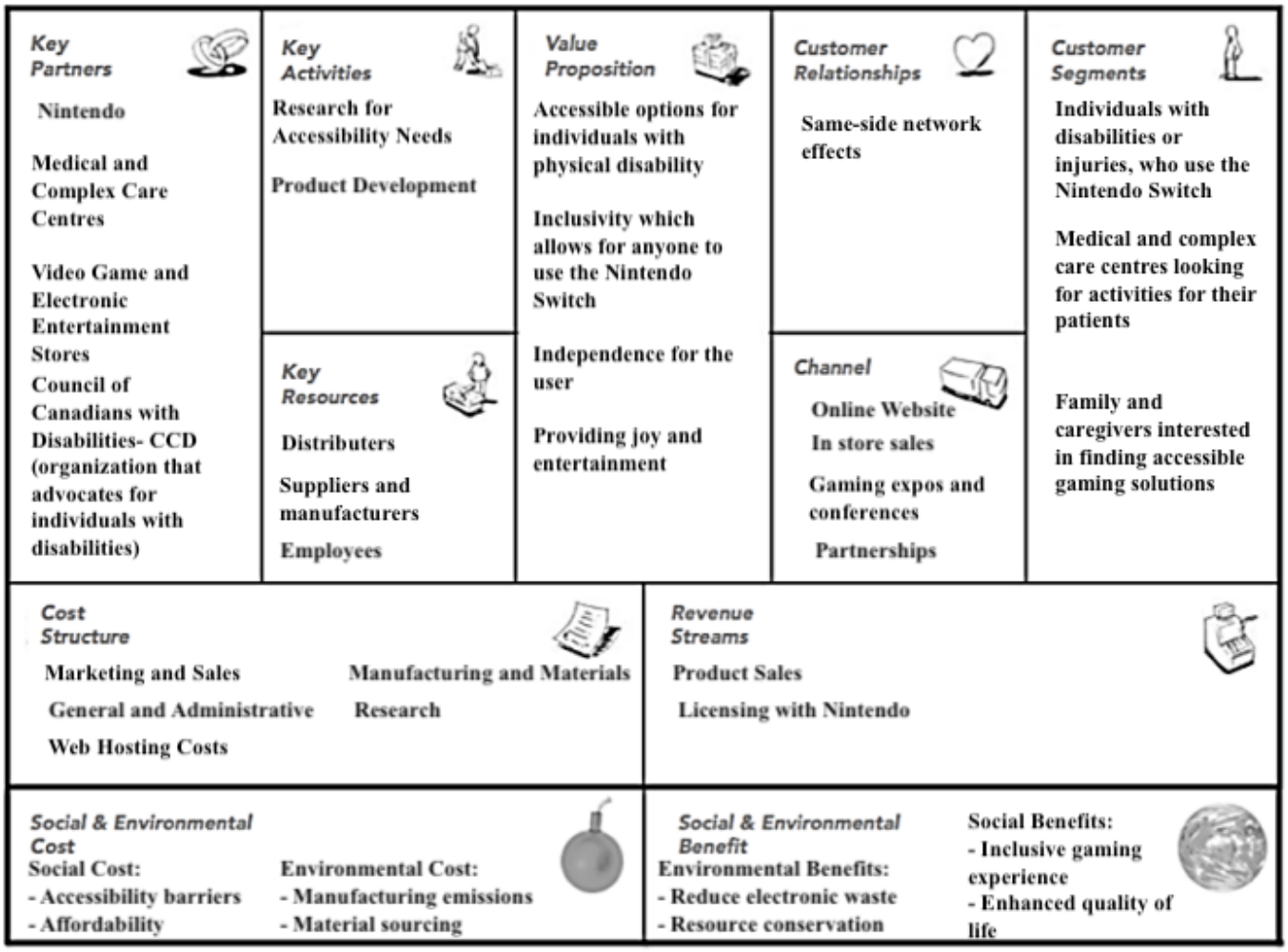
Acronym	Definition
BMC	Business Model Canvas
DFX	Design for X
BOM	Bill of Materials
MDF	Medium Density Fiberboard
ABS	Acrylonitrile butadiene styrene

1 Introduction

An adapted Nintendo Switch Controller is a remarkably interesting and unique product with the potential to make a significant positive impact on the lives of people with disabilities, physical or otherwise. This project will include hardware and software components. This document outlines each phase in the design and development process from problem identification to the final product and user manual. The activities necessary to successfully complete this project include fulfilling all business requirements, carefully identifying and fulfilling the client's needs, and the development of software and the board which will house all the controls for a Nintendo Switch. All of these tasks should take the team approximately two months to complete.

2 Business Model Canvas and DFX

2.1 Business Model and Sustainability Report



1. Environmental Impact:

Positive Impact:

- Reduced electronic waste: Some gamers may resort to purchasing additional specialized controllers or accessories to accommodate their needs. By creating an adapted controller that allows users to play games using their nose, we reduce the need for these additional devices, thereby extending the lifespan of gaming equipment. When individuals have access to a single controller that meets their needs, they are less likely to discard or replace it frequently. This reduction in electronic waste helps mitigate the environmental impact associated with the disposal of electronic devices.
- Resource Conservation: Our adapted controller is engineered to maximize resource efficiency by using recycled materials where possible and optimizing design to reduce material usage.
- Negative Impact:
- Manufacturing emissions: The production of electronic devices, including controllers, involves energy-intensive manufacturing processes that emit greenhouse gases and contribute to environmental pollution.
- Material sourcing: The extraction of raw materials for electronic components may have adverse environmental impacts.
-

2. Social Impact:

Positive Impact:

- Inclusive gaming experience: Our Adapted Nintendo Switch Controller empowers individuals with disabilities to participate in gaming activities, promoting social inclusion, and reducing stigma associated with gaming accessibility.

- Enhanced quality of life: Access to gaming can provide entertainment, socialization, and cognitive stimulation for individuals with disabilities, improving overall quality of life and mental well-being.
- Negative Impact:
- Accessibility barriers: Despite efforts to design inclusive controllers, individuals with certain disabilities may still face barriers to accessing and using gaming technology.
- Affordability: The cost of specialized gaming equipment, including adapted controllers, may pose financial challenges for individuals with disabilities, limiting access to these products and services.

3. Economic Impact:

Positive Impact:

- Market expansion: By catering to the needs of individuals with disabilities, the company taps into a previously underserved market segment, expanding the reach of the gaming industry and driving economic growth.
- Job creation: The development, manufacturing, and distribution of adapted gaming controllers generate employment opportunities across various sectors, contributing to job creation and economic prosperity.
- Negative Impact:
- Cost implications: Developing and producing specialized gaming controllers may incur higher costs due to research, design, and customization requirements, potentially impacting profitability and pricing strategies.
- Market competition: As the demand for accessible gaming solutions grows, competition among companies may intensify, leading to market saturation and pricing pressures.

2.2 Design for X

Based on the research conducted, including meetings with a real-world client and candidate for this product, the following are the aspects deemed of highest priority, to be t aken into consideration when designing the product.

Accessibility

This product is intended for people with disabilities who cannot use conventional gaming controllers so naturally, this adapted controller to be developed should facilitate gaming for people

who have limited or no use of their hands. Such is the case for our client Charlotte who will operate the controller with her nose. This, in tandem with the following aspects, make up the key design aspects which will need to be respected in designing the adapted gaming controller.

Comfort

Similarly to the previous aspect, the adapted controller should be comfortable for the user. If the product is not comfortable then the user will not use it which is why this is one of the major characteristics that our design must have. This encompasses many areas of the design such as the material of the controller, the size and dimensions of the controller, size, placement and feel of the buttons, among many other.

Quality

The product should be of high quality to ensure a pleasant experience for the user but also to allow for the product to be used for a longer period of time. Higher quality materials and construction often results in a better user experience which is why we chose to include this in our list of considerations for our controller design. It is also often the case that products of higher quality look better, which is yet another benefit that stems from designing for quality.

Compatibility

The controller should be accessible to users with different disabilities, which is why it should be compatible with different users depending on their specific needs. This perhaps means that the controller could be modular and have parts that can be interchanged, added and/or removed as needed. This also extends to making the controller compatible with a broad selection of video games including racing games, shooters, adventure games, among others. Finally, this could extend to the controller being compatible with different gaming consoles besides the Nintendo Switch such as the PlayStation and Xbox consoles.

Usability

Since the controller will be used by people with disabilities, every aspect of its design should be as user-friendly as possible. This means that the controller should be easy to set up, configure, charge, and maintain. No complicated user manual should be required for a user to understand how to operate the controller. Additionally, if the controller is made to have interchangeable components, these should also be easy to install and uninstall.

3 Problem Definition, Concept Development, and Project Plan

3.1 Problem Definition

Relevant Client Information

- Charlotte is a 23-year-old individual who uses her nose to interact with all devices, including her phone and Nintendo Switch
- Currently only uses the Nintendo Switch to play Disney Dreamland Valley
- Mainly uses the Nintendo Switch to play games with stories and quests
- The R, L, ZL, and ZR buttons are currently difficult to use because of their size
- The sunk-in buttons are more difficulty to use compared to the buttons which stick out
- Pressing multiple buttons at once is not necessary
- Prefers softer materials for the buttons
- Willing to test different prototypes
- Voice recognition is not essential, but could be useful for holding buttons

Unknown Information

- Durability/ longevity needs of the product
- **Exact measurements for size of the buttons and new remote**

List of Prioritized Needs

1. Must be compatible with the Nintendo Switch
2. Buttons must be large
3. Buttons must be spaced out on the remote so they can be pressed individually without interfering with other buttons
4. Buttons must be made of a material that is soft and will not injure the client's nose
5. Buttons on the Joy-Con remote should be sticking out, rather than sunk-in
6. Remote must be able to be mounted to the table which extends from her wheelchair
7. Remote must be able to be used for a variety of games
8. Must be affordable

Problem Statement

Current Joy-Con remotes for the Nintendo Switch are not accessible enough to accommodate the needs of individuals with disabilities. A new Joy-Con remote for the Nintendo Switch will be

designed using new materials and sizing focusing on ease of use, comfort for the user, and accessibility of all controls.

List of Need-Inspired Metrics

1. Button Size- Size of the R, L, ZR, and ZL buttons (measured in mm)
2. Button Spacing- Measurement of space between buttons so they can each be pressed individually (measured in mm)
3. Button Material Softness- Stiffness and difficulty of pressing buttons (rated by client on scale of 1-5)
4. Height of Buttons off Remote- Sticking out rather than sunk in buttons (measured in mm)
5. Ability to be Mounted- Stability and weight of remote so it does not fall (measured in kg)
6. Cost- Affordability ($)

Benchmarking

1. Logitech Adaptive Gaming Kit: https://www.logitechg.com/en-us/products/gamepads/adaptive-gaming-kit-accessories.943-000318.html

This gaming kit features 12 different adaptive controls. This feature accommodates the needs of our client for having accessible buttons and being able to use all controls for games. The buttons are also lightweight, large and can be spaced in a variety of ways on the board, which satisfies needs 2-6 on the prioritized list of needs. However, this gaming kit is not affordable and not compatible with the Nintendo Switch.

2. Xbox Adaptive Controller: https://www.xbox.com/en-CA/accessories/controllers/xbox-adaptive-controller

This adaptive controller is made my Microsoft. This product would accommodate the needs of the client relating to button spacing and material softness. This design only features two large buttons, and the rest would be too small for our client to use. The buttons also seem to be sunk into the board and the device is angled which will make it difficult to use. In addition, device is not compatible with the Nintendo Switch and not affordable, making it a poor solution for the problem defined.

3. Quadstick FPS Game Controller: https://www.quadstick.com/shop/quadstick-fps-game-controller

This quadstick controller is meant to be used by mouth and contains two mouthpieces and mounting. Although this device is compatible with the Nintendo Switch and made accessible, it does not align with the needs and metrics listed above, since it does not have any buttons and would not be able to

be used by nose. The device does satisfy the needs relating to mounting, compatibility, and versatility; however, it is also much more expensive than our budget with pricing starting at $550.

Target Specifications

Target Spec	Ideal Value	Marginally Accepted Value	Reasoning
Button Size	13mm for L and R, ZR and ZL	12-15mm	The R, L, ZL, and ZR buttons are all attached to the edges of the switch and are relatively small right now, these measurements would provide an additional 4mm of size for each button to make them easier to find and press.
Button Spacing	7mm	6-8mm	The distance between the ZL and L and ZR and R buttons is currently exceedingly small, although the measurement is unknown 7mm would be spaced enough to easily press one button without accidentally pressing the other.
Height of Button	10mm	5-12mm	The buttons need to be protruding as to be easier for controlling them with one's nose. If the buttons were too flush with the surface, their actuation may be hindered by the body of the controller itself.
Weight and Stability	0.3kg	0.28kg -0.5kg	The current Nintendo Switch controller is 0.279kg and can be easily mounted without falling, so this is the ideal value however up to 0.5kg should be suitable for mounting to the wheelchair as well.
Cost	$30	$30-$50	The budget for this project is $50; however, the lowest price possible would be best, our target value is $30 so the remote is affordable for any client.

3.2 Concept Development

Based on not only our problem statement but also on the benchmarking conducted as part of the initial phase of this project, concepts for an initial and final prototype concepts for an adapted Nintendo Switch controller have been developed and will be explored in depth in this section.

Concept 1: Housing unit with Integrated Front Paddles for existing Nintendo Switch Joy-Cons.

Seeing as how our client has the most trouble with the buttons (triggers) R, L, ZL, and ZR due to their position on the upper plane of the controller, a potential simple solution to this problem would be to design an external housing unit which could contain the standard Nintendo Switch Joy-Cons. Mounted to the exterior of this housing unit, would be a series of paddles (levers) arranged with one end of the paddles located on the front of the housing unit and the opposite end resting of the desired buttons, in this case R, L, ZL and ZR. When pressed, the paddles would transfer that motion to the opposite side, thus serving as an alternative way to press the top buttons on the existing Nintendo Switch Controller.

The use of these paddles would bring all buttons to the front plane of the controller, making the triggers much more accessible. Additionally, the larger surface of the paddles would make them easier to use.

Finally, due to the simplicity of the principles utilized in this concept, constructing a fully working and polished prototype would be viable given the time constraints of this project and limited capital available. Such a device could very well meet all the target specifications described above.

Visualization of Concept

The following images display a similar product for the PS5 controller developed by a company named EXknight, which is presently available on the market. A design such as this, and like the one proposed in this section, meets the target specifications and would be able to fulfill the needs of our client, Charlotte.

The image on the left visually demonstrates how buttons can be pressed with the use of an external paddle. The images on the right show how the paddles are mounted on an external housing unit which sits around a standard controller. The housing unit is also easy to install and uninstall and does not damage the controller in any way. These are all key elements which make this a great design, which is why they will be incorporated into our design.

Naturally, the paddles will be different in our design, both in geometry and placement to suit the needs of our client. Also, the housing unit will be different in order to accommodate the size and shape of the Nintendo Switch Joy-Cons.

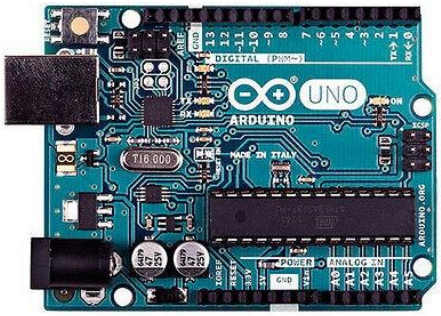
Nintendo also sells a housing unit for their Joy-Cons which give the controller the look and feel of a more traditional gaming controller (shown below). Our proposed design could be made to be mounted on this existing mould or it could be made to house the Joy-Cons directly. This decision will be made following a second meeting with the client.

Concept 2: External Arduino board with soft touch buttons

To make playing games easier for those who have trouble with pressing small or hard-to-reach buttons, an external Arduino board acting linked to 4 big buttons can be used. Each button will be able to be mapped independently to simulate different commands sent by a Joy-Con device. For example, pressing the red button once could act like pressing the ZL button, and pressing it twice in succession could send a command to the console indicating a screenshot wants to be taken.

The big buttons are made to be easy to locate and press, since they are much bigger than the regular controller buttons and may be placed freely. They will require minimum effort from the client in terms of both strength and precision, to ensure a comfortable experience. Since the buttons are simply connected to an Arduino board and able to be placed freely, they would also be able to be mounted in several ways. Such as, being attached to a vertical surface using either double-sided Velcro, or with nail holes. Moreover, they could be placed on a flat surface for a more temporary solution. This way, they can be stuck in place or moved if needed.

The aim of this design is to give the client the freedom of configuring their setup to one that is more comfortable to them, offering a wider surface to press, all the while not requiring too much force or precision to ensure comfort and effortless operation.



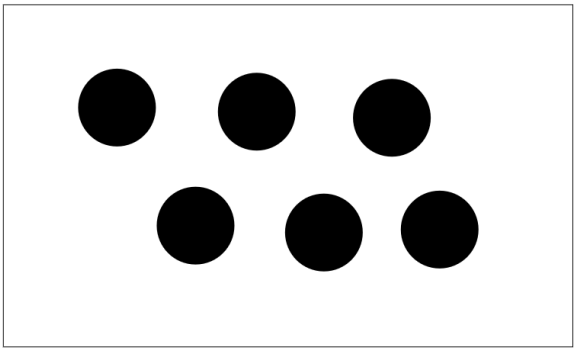
The above images depict what the buttons could look like, albeit the design is subject to change depending on the materials and manufacturing process used. These 4 tactile buttons would then be connected to the pins on the Arduino micro controller, which would be able to allow for the remapping of said buttons and handle direct communication with the Nintendo Switch console via USB, emulating the functionality of real Joy-Con controllers.

Concept 3: Flat Board Layout

The controller is designed to provide accessibility and comfort for individuals who have limited mobility in their hands and rely on their nose for interaction. It features a flat board layout with all the Nintendo Switch buttons and controls spread out for easy access. The materials used are soft and comfortable to prevent any discomfort or pressure sores during extended use.

Each button on the controller is significantly larger than the standard Nintendo Switch buttons, making them easier to locate and press. The buttons are made from soft materials to provide a pleasant experience for long durations. The board will feature a removable cover, allowing the user to remove said cover and wash it as need be. This allows for easy maintenance and ensures hygiene.

This board is made for the comfort of the user, providing a stable and supportive platform for the user's nose to navigate and interact with the buttons. The flat board eliminates the need for gripping, making it accessible to individuals with limited hand movement.



The above image visually represents a rough imagination of the flat board design. Having multiple enlarged buttons placed on top of the board for ease of locating and accessing. Overall, the flat board design emphasizes comfort, accessibility, and hygiene, providing individuals with disabilities a user-friendly gaming solution that caters to their specific needs and preferences.

3.3 Project Plan

Below is a link to this team's project plan, currently utilizing the ClickUp platform, used to coordinate and manage this project.

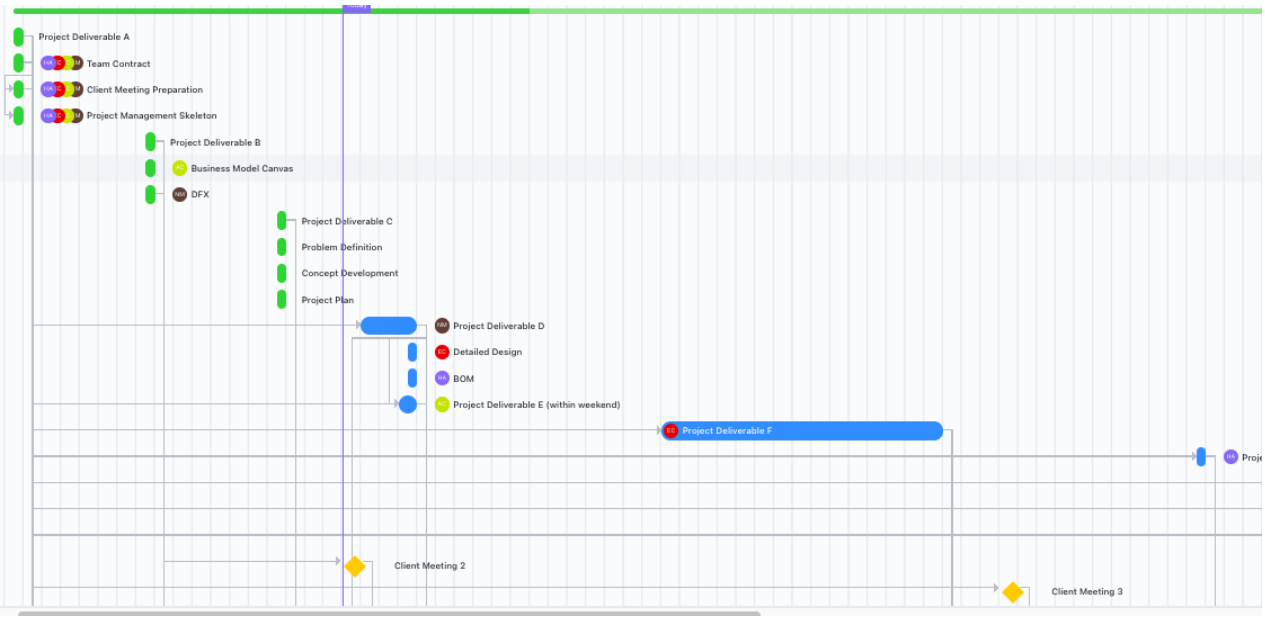
Click-Up Link: https://app.clickup.com/9017168124/v/li/901701183473

Note:

Due to the limitations of the ClickUp platform, particularly with the Gantt Chart feature, this team is currently transitioning to an alternate platform to manage our project plan. None

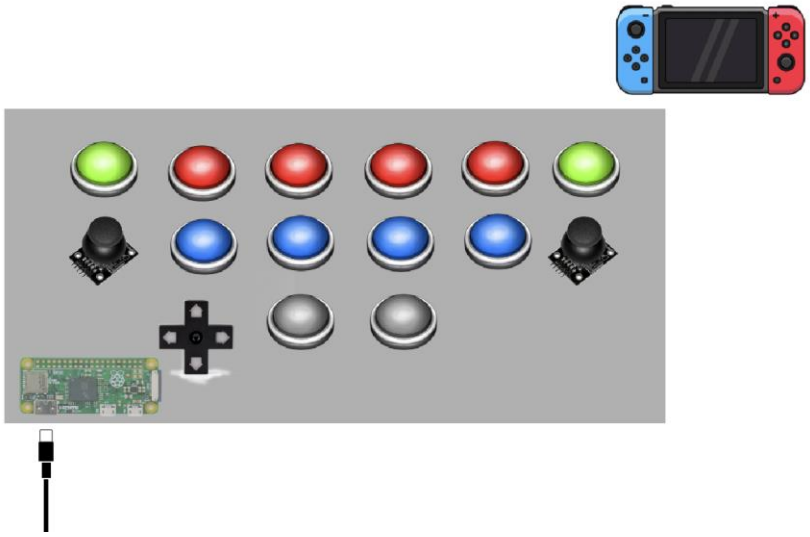
of the group members have a windows device to be able to use MS Project, so alternative options are continued to be explored.

Gantt Chart:



4 Detailed Design and BOM

4.1 Detailed Design



The main structure of the controller will be a basic 3D printed rectangle. It will be sized to comfortably accommodate all the buttons and control elements while being easily operable with the nose. The housing's material will be lightweight yet durable, and easily mountable using Velcro.

Each button will be color-coded as specified: red, green, blue, and grey. This color coding will help the user quickly identify each button's function. Further aiding in the quick identification of actions, each button could be labeled with its corresponding action, using symbols or text that are legible from a distance. The buttons will be arranged in a layout that mimics a Nintendo Switch Joy-Con for intuitive operation:

- Main Letter Buttons (Red): Four large red buttons will represent the A, B, X, and Y keys. They will be placed on the right side of the housing, spaced out to prevent accidental presses, as well as facilitating less precise ones.
- Select and Start Buttons (Green): Two large green buttons will serve as the Select and Start keys. These will be centrally located, just below the letter buttons, for easy access.
- Trigger and Bumper Buttons (Blue): Four large, blue buttons will be designated as the L, R, ZL, and ZR buttons. They will be positioned on the uppermost edge of the housing to mimic their positions as shoulder buttons on traditional controllers.
- Home and Screenshot Keys (Grey): Two large grey buttons will be used for the Home and Screenshot functions.
- Two joysticks will be integrated into the design, as well as a D-pad, positioned similarly to where they would be on a standard Nintendo Switch controller. These joysticks and D-pad will be modified to have larger, flatter tops to make them easier to control with the nose.

The Raspberry Pi Zero W will be mounted inside of the housing, along with the wires connected to each separate module. The design will include a small battery pack or a USB power supply option to power the Raspberry Pi Zero W, ensuring portability and ease of use.

The Raspberry Pi Zero W will be programmed with custom software that maps each physical button to the corresponding commands on a Nintendo Switch using the Pi's GPIO pins, controlled using the open-source NXBT library to handle the communication and emulation of a real Nintendo Joy-Con with the console. This design aims to create a functional, accessible, and user-friendly controller interface for individuals who will operate it with their nose.

4.2 BOM

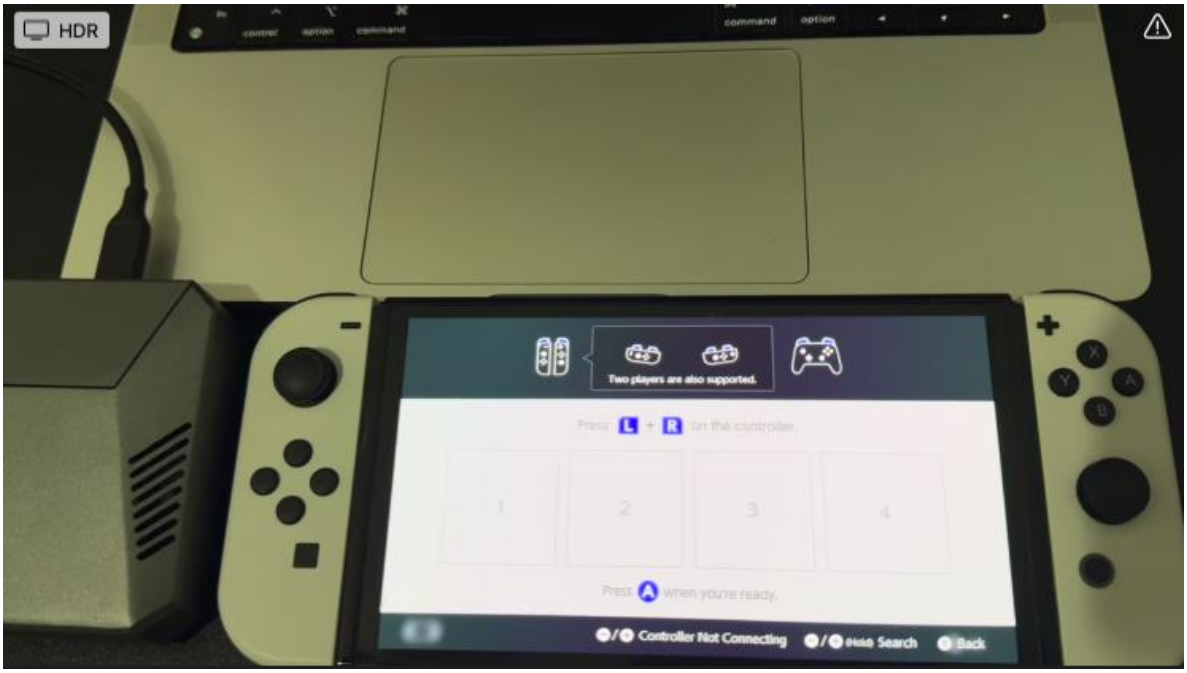
Item name	Description	Units of measure	Quantity	Unit cost	Extended cost	Link
raspberry pi zero 2 w with pre-soldered headers	Broadcom BCM2710A1, quad-core 64-bit SoC (Arm Cortex-A53 @ 1GHz) 512MB RAM Wi-Fi / Bluetooth Wireless communication technology: Wi-Fi	Unit	1	$28.95	$28.95	Raspberry PI Zero 2 W
ADC module	ADS1015 12-Bit ADC - 4 Channel with Programmable Gain Amplifier	Unit	1	$13.95	$13.95	ADC module
Buttons	arcade type buttons	Unit	1	$8.95	$8.95	Tactile Buttons
Buttons	square arcade type buttons	Unit	1	$7.95	$7.95	Tactile Buttons
analog sticks	joysticks for movement	Unit	2	$2.95	$5.90	Joystick Buttons
MDF	For laser cutting the board	12" by 24" (1/8" thickness)	1	$2.50	$2.50	MDF

Wood Glue	To hold the pieces of the board together	Unit	1	$6.48	$6.48	Wood Glue
3d printing	The main board / controller case	Inches	1	$0	$0	UOttawa 3D Printing
Wires	Male to female jumper wires	Cm	1	$2.95	$2.95	Jumper Wires
Wires	Female to female jumper wires	Cm	1	$2.95	$2.95	Jumper Wires
Total product cost (without taxes and shipping)					$80.58	
Total product cost (including taxes and shipping)					$91.01	

5 Prototype 1, Project Progress Presentation, Peer Feedback and Team Dynamics

5.1 Prototype 1

Our project's first prototype consists of a Raspberry Pi 4 connected to a laptop with custom mapped keys to emulate the Nintendo Switch Joy-Con's actions. This was done by using what we had at home as we could not obtain the specific items in our BOM, since they are not yet approved by the TA. The prototype is simple, the Raspberry Pi 4 is running a third-party library that handles remapping keys and communicating with the console. Each Joy-Con button is mapped to a specific keyboard key on the laptop and functions exactly like the original. This is the exact same concept for the final prototype, except that the keyboard keys will be actual standalone buttons connected to a 3D printed/laser cut flat board.

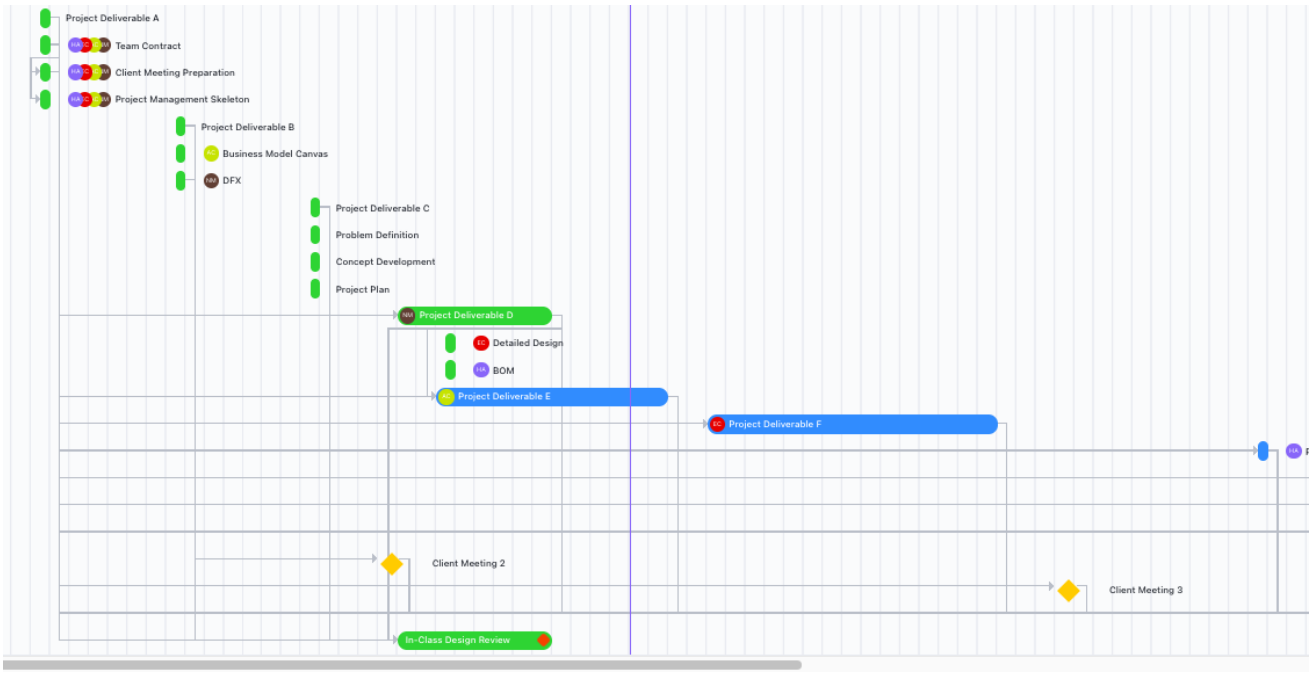


The biggest risk identified through previous deliverables was verifying that the raspberry pi and the programs created would be supported and fully functional with the Nintendo Switch. This was validated by emulating a Nintendo Switch remote, our future board though a laptop. Multiple games and functions of the Nintendo Switch were tested with this method, and each performed to the same standard as while using the controls on the Nintendo Switch. This testing verifies the compatibility and quality aspects of the DFX. The compatibility is verified since the Nintendo Switch worked using this prototype. The quality has been verified since this prototype can perform the same functions as the Nintendo Switch controller, which guarantees the same gaming quality with our final product.

5.2 Project Progress Presentation

Progress Presentation Link

5.3 Project plan update


Project Deliverable A
Team Contract
Client Meeting Preparation
Project Management Skeleton
Project Deliverable B
Business Model Canvas
DFX
Project Deliverable C
Problem Definition
Concept Development
Project Plan
Project Deliverable D
Detailed Design
BOM
Project Deliverable E
Project Deliverable F
Client Meeting 2
Client Meeting 3
In-Class Design Review

6 Design Constraints and Prototype 2

6.1 Design constraints

Two important non-functional design constraints that play an important role in the development of our prototypes include the products ergonomic and comfort features and the devices' durability. For the client to enjoy using our prototype and be able to play her games it is important that the controller contains comfort features, such as a soft enough material to not injure her nose and good spacing so she can easily move around in the game without straining her neck. The durability of the controller will also be important since it should have a long lifespan and be easy to keep clean so that this option for gaming can remain accessible and affordable.

These design constraints should be satisfied mostly through our current design. For the ergonomic and comfort features we have spoken to the client in previous meetings, and she has confirmed that the current material of the buttons, which is Acrylonitrile butadiene styrene does not affect her nose. This is a common plastic that should be easy enough for us to obtain, we all plan to make sure the buttons are not placed into the board too firmly so they can be easy to press and the ones in our current BOM meet these metrics since they are wide enough. In terms of spacing for ease of use, the Nintendo Switch spacing is not currently available online; however, we have estimated that about 7-10mm between each button should be sufficient. We also plan to show our client the main housing unit/board for our prototype during the next client meeting and use markers and pins to find the best spacing for her. For the durability and maintenance aspects of the design constraints our final prototype will be made of MDF and ABS. Since both these materials are wood or plastic, they can be easily cleaned by wiping them with a damp cloth, or for any bigger issues there are cleaning agents available. This is important to consider our client will be using her nose on this board, so it needs to be hygienic. Based on these two constraints there are no major changes that need to be made to our current design.

Since there were no previous measurements on spacing provided an iterative approach will be used to ensure that this constraint is met. During the next meeting we will obtain the client's feedback and preferences on spacing and only then begin cutting holes and inserting the final buttons into the board. It is hard to research this topic since it is a specific project for the client and to meet her accessibility needs. Many big video game controller companies use various spacing

sizes since their target audience is individuals who can easily use the controllers with their hands and do not see the spacing of the buttons as a priority when purchasing controllers.

For the durability of the prototype, we have decided to focus on its cleanliness maintenance features. Based on the research completed on the websites listed below, both materials can be easily cleaned with a cloth, water, and a cleaning agent or dish soap if needed. These are all household items which make it easy to keep up with the external maintenance of the board. Both materials can also easily be dusted to remove dust or debris. The only difference between the research done and what method we recommend is to not rinse the board entirely and rather use a cloth to not damage any of the software component, wires, and microcomputers.

How to Clean MDF Wood

How to Clean ABS plastic

6.2 Prototype 2

The client feedback received to this point has been on deciding a concept. Since the client chose the third design presented, we have chosen to create a board/ housing unit which is the box created in prototype 2 and purchase buttons and joycons which will be programmed using a raspberry pi. The client chose this design since it has the most customization options and we can

prioritize large spacing, large buttons, and placing the ZL, ZR, L, and R buttons on the front of the board along with the other buttons to make them accessible.

The testing done previously on prototype 1 was completed based on the recommendation of the TA, concerning the heating of the raspberry pi. We tested this by emulating the controller with a laptop; the raspberry pi was able to run for an hour with minimal heating. Prototype 2 was tested in terms of weight and stability. The board was able to withhold 2kg of weight without any signs of deformation, exceeding our marginally accepted value. The sides of the board need to be adjusted in terms of their height as we did not account for the fact that they would need to be placed on top of the bottom board. If the client likes this idea, we will also need to cut holes in the top of the box to mount the buttons and joysticks, as well as holes on the side of ventilation and to place the raspberry pi.

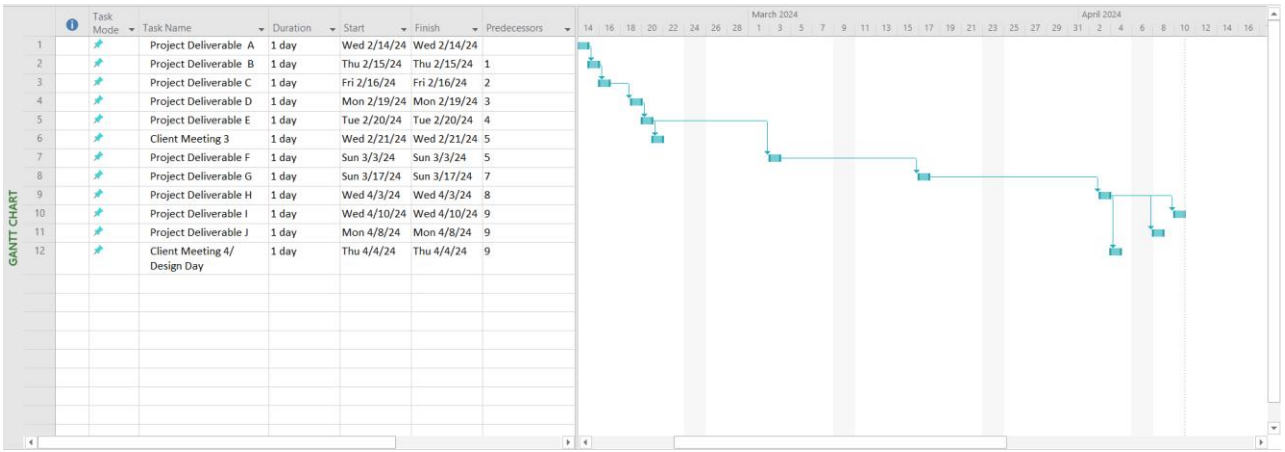
The factors we have tested so far are functionality, weight and stability, and cost these relate to the DFX factors involving usability, quality, and compatibility. The factors that still need to be tested are accessibility and comfort. These factors will be tested once the final prototype is built and during our third client meeting where we plan to obtain feedback on an ideal layout for the client. The layout requirements relate to comfort since they will determine how easily and comfortably, she can play for prolonged periods of time. Accessibility will also be validated by how easy it is for her to go in between pressing multiple buttons. All these factors will be retested when the final prototype is built to ensure we have met all the needs of the client and created a unique adapted Nintendo Switch controller.

Target Spec	**Ideal Value**	**Marginally Accepted Value**	**Method of Testing**	**Result of Testing**
Weight and Stability	0.3kg	0.28kg -0.5kg	Applying weights to the top of the box on the largest flat side.	The board withstood 2kg of weight without any signs of deformation.
Heating Factor of	Minimal to no heating	Minimal to no heating while	Emulating a controller with a laptop and	Minimal to no heating while running for 1 hour.

Raspberry Pi	while running for 1 hour.	running for 1 hour.	running the raspberry pi for 1 hour.	
Cost	$30	$30-$100	Bill of materials was created	$86.32

During client meeting 3 we plan to show the client the board we have created and obtain feedback on its size and weight. Images of the joycons and buttons will also be presented to verify the size is sufficient. We also plan to present multiple different lay out plans and spacings for the buttons, which will allow her to decide which is most accessible for her. After obtaining this we will order the materials necessary to build our final prototype and beginning making it.

6.3 Project plan update



	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		Project Deliverable A	1 day	Wed 2/14/24	Wed 2/14/24	
2		Project Deliverable B	1 day	Thu 2/15/24	Thu 2/15/24	1
3		Project Deliverable C	1 day	Fri 2/16/24	Fri 2/16/24	2
4		Project Deliverable D	1 day	Mon 2/19/24	Mon 2/19/24	3
5		Project Deliverable E	1 day	Tue 2/20/24	Tue 2/20/24	4
6		Client Meeting 3	1 day	Wed 2/21/24	Wed 2/21/24	5
7		Project Deliverable F	1 day	Sun 3/3/24	Sun 3/3/24	5
8		Project Deliverable G	1 day	Sun 3/17/24	Sun 3/17/24	7
9		Project Deliverable H	1 day	Wed 4/3/24	Wed 4/3/24	8
10		Project Deliverable I	1 day	Wed 4/10/24	Wed 4/10/24	9
11		Project Deliverable J	1 day	Mon 4/8/24	Mon 4/8/24	9
12		Client Meeting 4/ Design Day	1 day	Thu 4/4/24	Thu 4/4/24	9

7 Other Considerations

7.1 Economics report

Description of Cost	**Type**
Production Materials	Material, fixed, indirect
Salary	Labour, fixed, direct and indirect
Rent	Overhead, fixed, indirect
Electricity Bill	Overhead, semi-variable, direct and indirect
Publicity/Marketing	Overhead, fixed, indirect
General Costs	Overhead, fixed, indirect
Depreciation	Overhead, fixed, indirect
Taxes	Overhead, variable, indirect
Distribution	Overhead, fixed, indirect

First Year

Name	**Cost**
Sales ($150*300)	$45,000
Cost of Goods Sold ($93.01*300)	$27,903
Gross Profit on Sales	$17,097
Operating Expenses	

Marketing Expenses	$2,000
Salaries	$35,000
Rent and Overhead	$1,500
Electricity	$600
Depreciation	$2,000
Total Operating Expenses	$41,100
Total Net Profit	-$24,003

Second Year

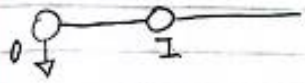
Name	**Cost**
Sales ($150*450)	$67,500
Cost of Goods Sold ($93.01*450)	$41,855
Gross Profit on Sales	$25,645
Operating Expenses	
Marketing Expenses	$2,000
Salaries	$35,000
Rent and Overhead	$1,500
Electricity	$600
Depreciation	$2,000
Total Operating Expenses	$41,100
Total Net Profit	-$15,455

Third Year

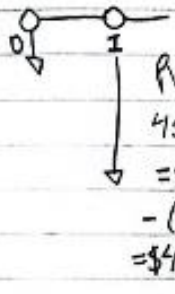
Name	**Cost**
Sales ($150*800)	$120,000
Cost of Goods Sold ($93.01*800)	$74,408
Gross Profit on Sales	$45,592
Operating Expenses	
Marketing Expenses	$3,000
Salaries	$35,000
Rent and Overhead	$1,500
Electricity	$800
Depreciation	$2,000
Total Operating Expenses	$42,300
Total Net Profit	$3,29

Assuming 4% interest rate

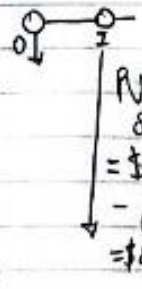
"INCOME"



PV = 300 x $150.00
= $45,000 - (300 x $93.01)
= $17,097

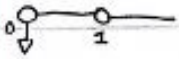


PV = $17,097 + 450 x $150.00/1.04
= $82,000.65 - (450 x $93.01)/1.04
= $41,756.14

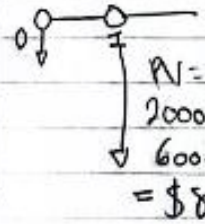


PV = $41,756.14 + 800 x $150.00/1.04
= $157,140.75 - (800 x 93.01)/1.04
= $85 594.6

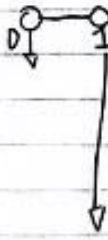
"EXPENSES"



PV = 30000 + 35000 + 1500 + 600 + 8000 = $41,100



PV = $41,100 + 2000 + 35000 + 1500 + 600 + 2000/1.04
= $80,619.23



PV = $80,619.23 + 3000 + 35000 + 1500 + 800 + 2000/1.04
= $121,292.31

"Year 1

17 097 - 41100 = -24 003

NPV = $\frac{-24\,003}{(1+0.04)^1}$

NPV = -23 079.61

Year 2

41 756.14 - 80 619.23
= -38 863.09

NPV = $\frac{-38\,863.09}{(1+0.04)^2}$

NPV = -35 931.11

Year 3

85 594.6 - 121 292.31
= -35 697.71

NPV = $\frac{-35\,697.71}{(1+0.04)^3}$

NPV = -31 735.13

Assumptions

The economics report presented above was constructed on the basis of preliminary market research conducted as part of this project, in part for the initial brainstorming phase as well as for this deliverable. In addition, the report was constructed on the basis of the following assumptions.

Supply:

The first assumption upon which the abovementioned report was based was that this team, either as an independent company or as part of a larger corporation, has a fully polished product that is ready to be taken to market. This means that all costs associated with the production and distribution of the final adapted controller have been optimized as a direct result of producing the product in large quantities, ultimately leading to reduced costs.

Demand:

Another crucial assumption is that there would be adequate interest from the consumer market for an adapted Nintendo Switch controller such as the one this team designed. It is extremely important to have enough interest from the public in order to make this business venture profitable and thus allow for the product to continue existing in the market.

These combination of these two key assumptions, along with assuming all the logistics associated with this business venture have been worked out, gives rise to the opportunity for a business to

succeed. Assuming all this has occurred, then an economics report, such as the one presented above, is very feasible.

Expected Market Share

According to the United Nations' Department of Economic and Social affairs, approximately 15% of the world's population has some form of disability which equates to roughly 1.2 billion people. Now, although that might be a very large potential proportion of users and potential customers, it would be unrealistic to assume the market for a video game controller would be that large. Other factors need to be considered such as the age demographic of these people, the severity of their disabilities, whether playing videogames is a hobby of theirs, whether the Nintendo Switch is their console of choice, among many, many more. Ultimately, it comes down to whether the user would benefit from using our controller over the alternatives available on the market. Because of this, a conservative estimate of around 5% of the total market of Nintendo Switch gamers would likely be a realistic expectation for a new product such as ours, given enough exposure and enough time to build a brand behind the product.

Unit Price

Assuming the reduction in manufacturing and distribution costs that come from mass production, it would be feasible to achieve a similar COGS as other controller manufacturers, including Nintendo. This means it would be very reasonable to for our product to retail for a similar price to official Nintendo controllers, which sit mostly in the range of $60 - $80 USD. It would also be perfectly acceptable to charge a slight premium over traditional controllers to compensate for the lower market share our product will occupy. Additionally, retailing at a higher price could help build our brand and establish our product as a more premium option when compared to alternatives. This price could be in the range of $90 - $150 USD and could be adjusted according to the demand.

7.2 Intellectual Property Report

Flex Controller for Nintendo Switch

Product: https://stores.horiusa.com/flex-controller-for-nintendo-switch/

Trademark: [1] “Government of Canada,” Canadian Trademarks Details: HORI & Design - 1906248 - Canadian Trademarks Database - Intellectual property and copyright - Canadian Intellectual Property Office - Innovation, Science and Economic Development Canada, https://ised-isde.canada.ca/cipo/trademark-search/1906248?lang=eng&payload=%7B%22domIntlFilter%22%3A%221%22%2C%22searchfield1%22%3A%22all%22%2C%22textfield1%22%3A%22hori%22%2C%22display%22%3A%22

list%22%2C%22maxReturn%22%3A%22500%22%2C%22nicetextfield1%22%3Anull%2C%22cipotextfield1%22%3Anull%7D&pageNum=0&pageLen=50 (accessed Mar. 21, 2024).

Logitech Adaptive Gaming Kit

Product:https://www.logitechg.com/en-ca/products/gamepads/adaptive-gaming-kit-for-access-controller.943-001253.html

Trademark: [2] "Government of Canada," Canadian Trademarks Details: Logitech - 2007744 - Canadian Trademarks Database - Intellectual property and copyright - Canadian Intellectual Property Office - Innovation, Science and Economic Development Canada, https://ised-isde.canada.ca/cipo/trademark-search/2007744?lang=eng&payload=%7B%22domIntlFilter%22%3A%221%22%2C%22searchfield1%22%3A%22all%22%2C%22textfield1%22%3A%22logitech%2Bgaming%22%2C%22displ

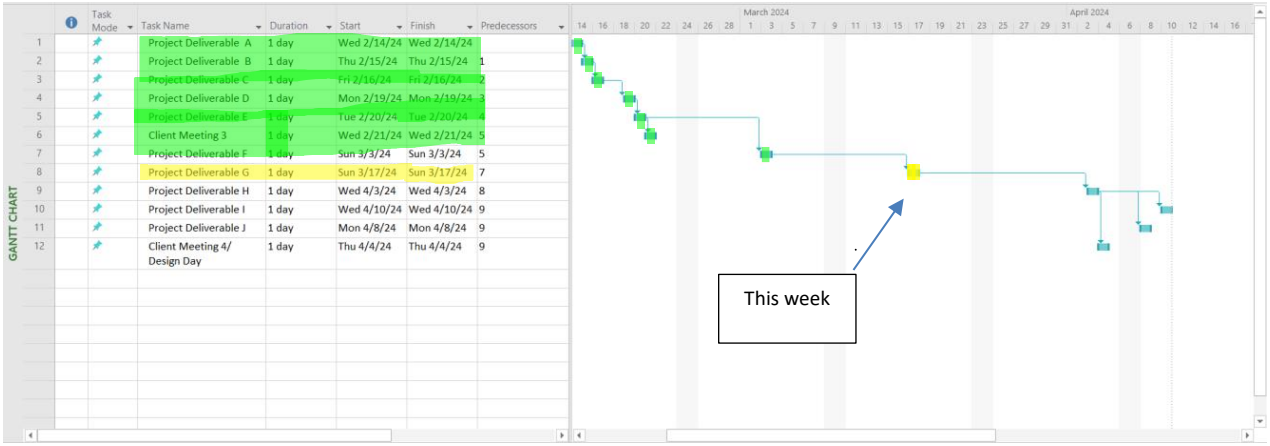
ay%22%3A%22list%22%2C%22maxReturn%22%3A%22500%22%2C%22nicetextfield1%22%3Anull%2C%22cipotextfield1%22%3Anull%7D&pageNum=0&pageLen=50 (accessed Mar. 21, 2024).

The first trademark that has been identified relevant to the development of our accessible Nintendo Switch controller is the trademark for HORI. This trademark protects the company itself and the goods associated with it, such as the flex controller. The flex controller has been specifically designed to be compatible with the Nintendo Switch. The first trademark element is the graphical design of the controller which includes the dark surface and sizing of each button on the controller. This could be applicable to our product if the same dimensions and darkened shading for buttons were chosen. The next important implication is the products created by HORI in terms of the machines, electrical wiring, cables, and batteries used in the product. This implies that any of the components used to internally wire and control the flex controller cannot be used in our product.

The next identified trademark is for Logitech. This trademark protects the logo and company itself, as well as all the products they produce, in this case the Logitech adaptive gaming kit. The adaptive gaming kit is made for the Xbox; however, the patent protects the features, mechanisms, buttons, design, and electronic components of the product. Although we are creating a controller for the Nintendo Switch, we must be cautious to not use any of the design aspects, buttons, or electrical components in this adaptive Xbox controller as they are protected individually and the product itself is protected, whether used for an adaptive Xbox controller or an adaptive Nintendo Switch controller.

In conclusion the legal constraints these trademarks place on our product prevent us from being able to use any of the components or graphical design of these two other adaptive controllers. When developing our product and business it is crucial that we take the necessary precautions to ensure we do not use these components and designs to prevent trademark infringement. If we find it necessary to use any of the components, as a business we must contact the patent owner for approval and/or create an agreement or contract with HORI or Logitech to use the elements of their trademark in our design. It would be best for our business to refrain from using any of these elements to avoid substantial expenses.

7.3 Project plan update



Additional References:

https://www.un.org/development/desa/disabilities/resources/factsheet-on-persons-with-disabilities.html

10 Conclusions

Creating an adaptable Nintendo Switch to accommodate the needs of those with any type of disability is an important project to promote inclusivity and accessibility in a variety of markets. Using design thinking strategies and careful planning this project has been successful in accommodating the needs of the client by creating a Nintendo Switch controller which is a flat board and programmed to have all the same controls as the original controller while including larger buttons, better spacing, and making the device easier to use and mount.