

XBOX ADAPTED Controller

Progress Presentation
Group Z11



1. INTRO

What are the goals of the controller?





Agenda

1. Customer needs and problem statement
2. Concept ideas
3. Detailed design
4. BOM and assumptions
5. Client feedback
6. Project plan
7. Testing metrics
8. Prototyping and testing
9. Results and analysis
10. Trials and tribulations
11. Next client meeting
12. Live demo

2.

COSTUMER NEEDS AND PROBLEM DEFINITION

What are our costumers needs?



Client needs statements

No.	Client needs statements	Priority
1	A remote adapted to any kind of video game	5
2	The remote controller is compatible with the Xbox and PC	5
3	The remote controller is inspired by the Axis controller model	3
4	The remote integrates an interface to configure each button	5
5	The remote software has a macro that allows action to be made by clicking one button	5
6	The remote is easy to use	4
7	Buttons can be spaced in any way	2
8	The remote is simple/doesn't have lot of buttons	3
9	The remote can be made in a short amount of time	4
10	The remote is inexpensive	4

11	The remote is custom made	3
12	The remote is robust/The remote is made of high quality products but as low-cost as possible	5
13	The remote includes a sticky trigger	5
14	The remote's sticky trigger has an on and off toggle	5
15	Remote is comfortable	5
16	The software's user interface is accessible	5
17	The remote's design is ergonomic	5
18	The remote has a reasonable weight	4
19	The controller is portable	1
20	Sensitivity of buttons and joysticks can be configured	3
21	The controller have is adapted to the tremors	2



Problem Definition

“ Design a robust, programmable and accessible remote controller that is compatible with both Xbox and PC for disabled gamers. ”

Market Research



Axis 1 Pro

Out of production and expensive accessible controller.



Xbox adaptive controller

Xbox's proprietary solution to adaptive controllers

Target specifications



Portability

of the remote



Modularity

of the button
implementation



Modularity

of the sticky trigger
implementation



Cost

Manufacturing and
Design

Target specifications cont'd



Shape

Controller shape
and dimensions



Accessibility

of the interface and
setup



Compatibility

with other devices



Low lag

Low delay input

6. Concept Ideas

Our 4 different concepts of the controller.



IDEAS

1. Taking apart regular controller



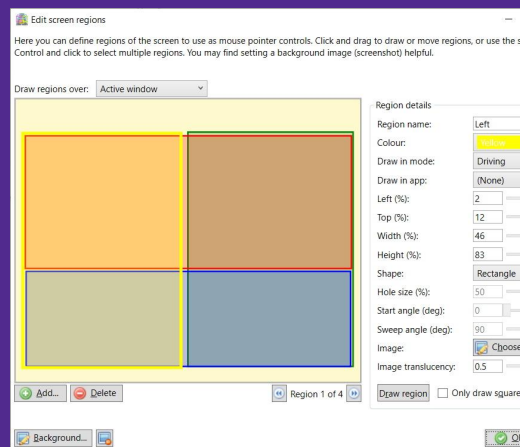
2. Use arduino with Xinput firmware



3. Reverse engineer GIP protocol + use Xbox controller to send signals



4. Use external open-source platform (Alt Controller)



7.

Detailed Design : Physical Aspect

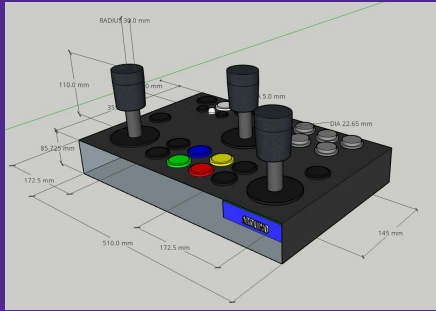
What are the goals of the controller?



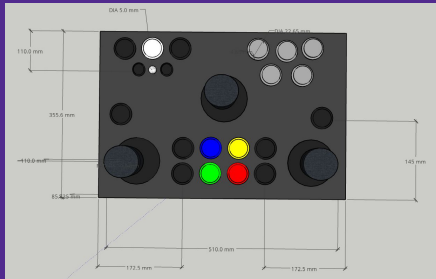
Appearance

Materials and assembly

Side View



Top View



MDF



PLA

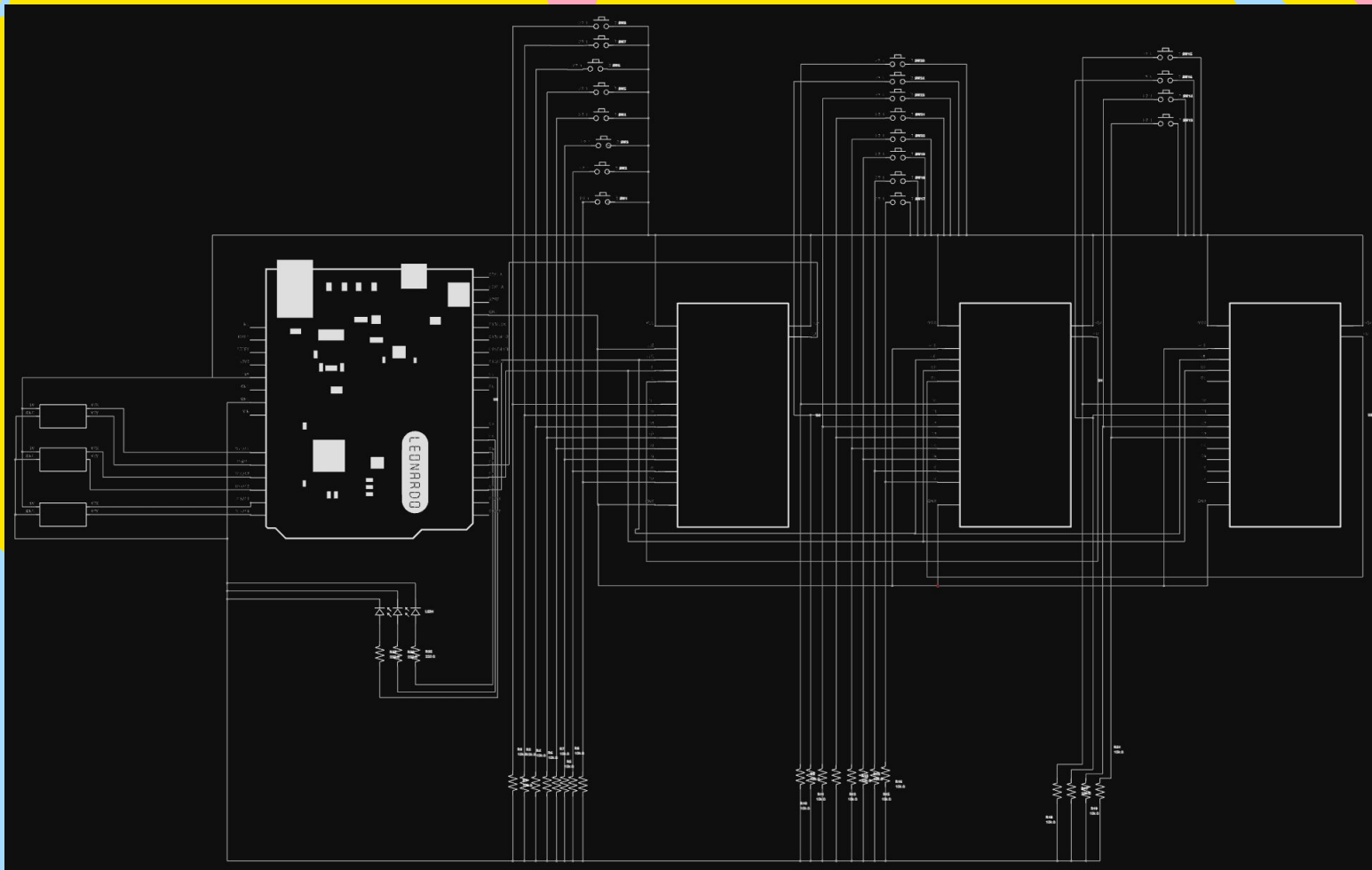


Wood Joints

8. CIRCUIT DESIGN



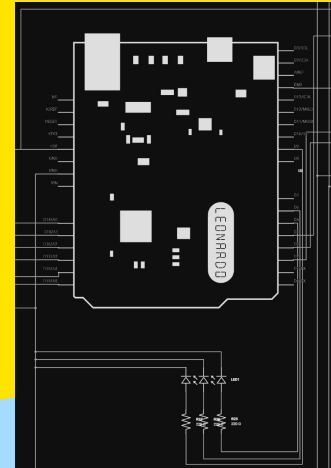
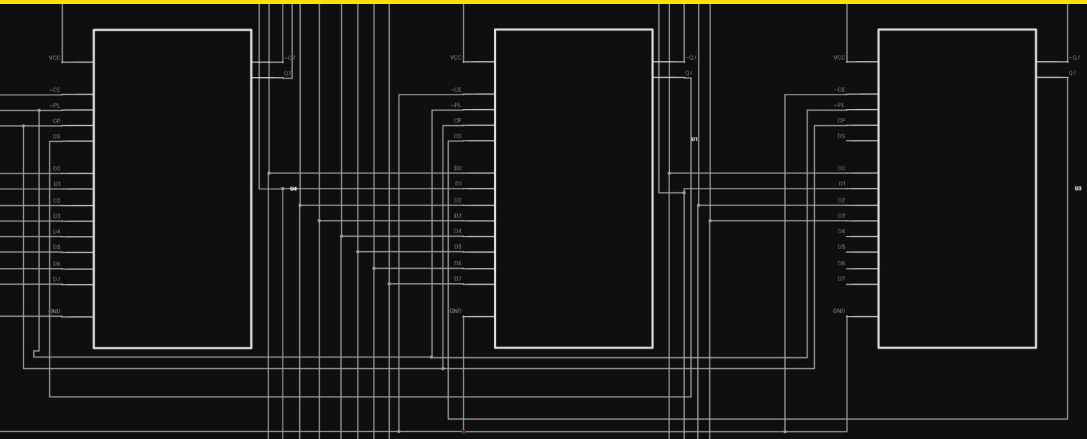
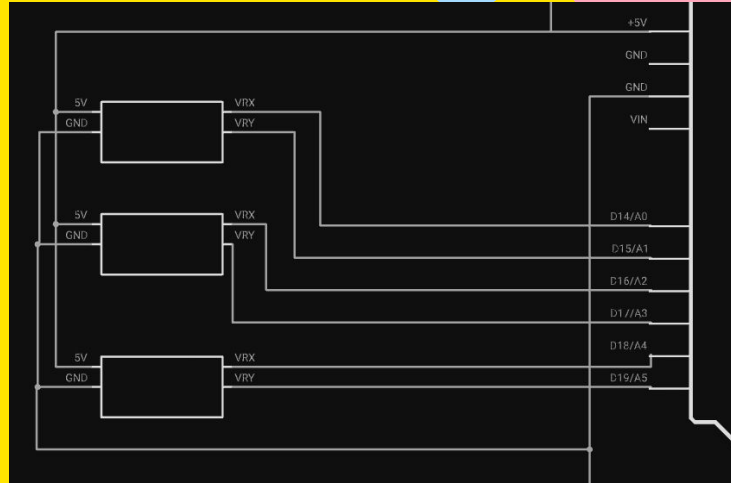
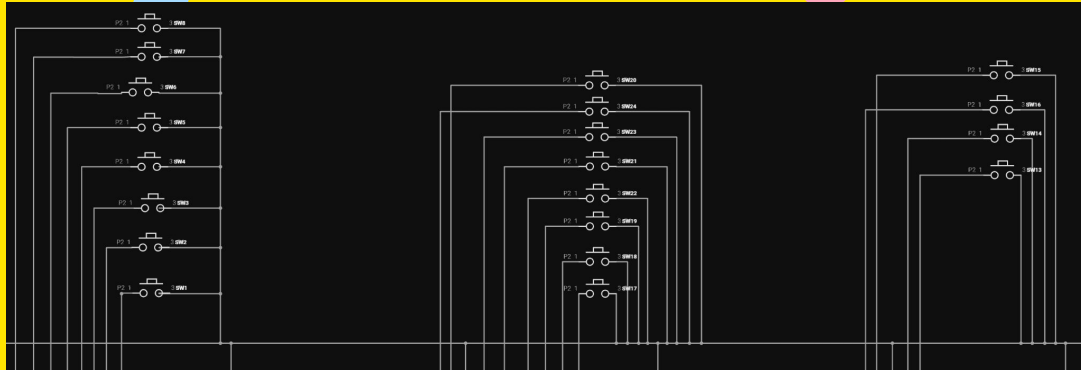
FULL CIRCUIT DESIGN



CIRCUIT DESIGN

Buttons

JOYSTICKS



ARDUINO/
RGB LED

PISO SHIFT REGISTERS

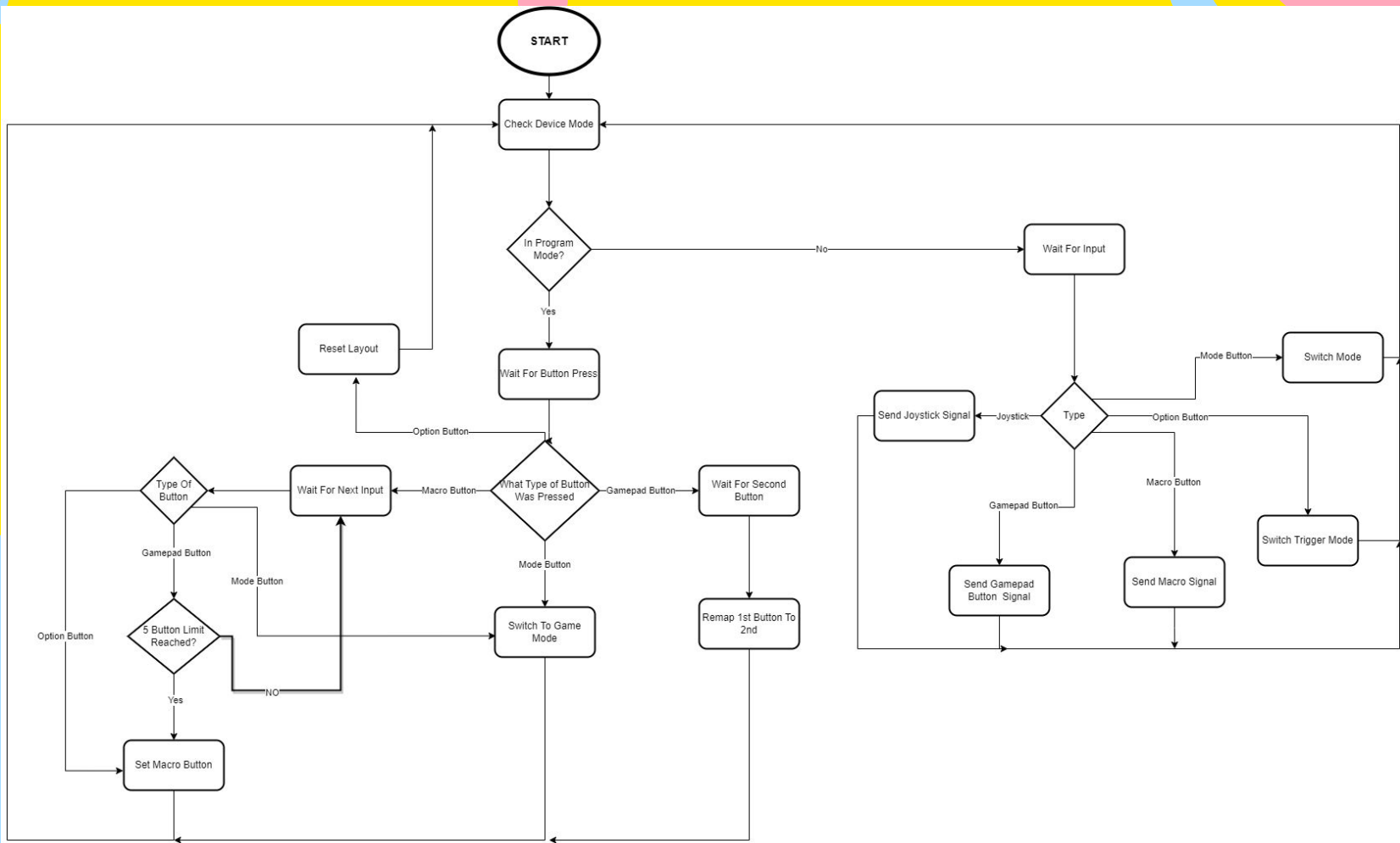
9.

SOFTWARE

What are the goals of the controller?



SOFTWARE DESIGN



10. Bill of Materials

Detailed list of materials required



Other Materials

ID #	Name	Description	Unit	Quantity	Unit Cost	Extended Cost
4	Arcade Button Type 2	Arcade settings button	Unit	10	\$0.00	\$0.00
5	Joystick	analog joystick potentiometer	Unit	3	\$0.00	\$0.00
6	Single Coil Wires	electrical wire to connect components	Meters	10	\$0.00	\$0.00
8	SN74HC166N	parallel-in/serial-out shift register to extend inputs	Unit	0	\$0.00	\$0.00
9	USB Male Micro B To Female A	inner USB wire. Arduino to box wall	Unit	1	\$0.00	\$0.00
10	USB Male A To Male A	outer USB wire. Controller to game device	Unit	1	\$0.00	\$0.00
12	Solder	lead free solder	Unit	1	\$0.00	\$0.00
15	Wood Glue	glue to hold box together	Unit	1	\$0.00	\$0.00
16	Arduino XInput Library/Firmware	To let Arduino be used as a controller	Unit	1	\$0.00	\$0.00
19	USB Convertor	to allow the controller to work on Xbox	Unit	1	\$0.00	\$0.00

Purchased Materials

ID #	Name	Description	Unit	Quantity	Unit Cost	Extended Cost
1	Arduino Leonardo	Main logic board	Unit	1	\$15.00	\$15.00
2	LED	RGB light to display mode info	Unit	1	\$2.00	\$2.00
3	Arcade Button Type 1	Arcade game pad button	Unit	10	\$3.83	\$38.30
7	Joystick Cover	3d-printed cover for accessibility	g	30	\$0.15	\$4.50
11	PCB	PCB to connect electronics to	Unit	1	\$5.00	\$5.00
13	Header pins	Pins to connect to the PCB	Unit	3	\$0.30	\$0.90
14	MDF Wood	wood panels to be laser cut for box	m ²	0.56	\$17.85	\$10.00
17	Resistors 10K	Resistors for buttons	Unit	20	\$0.01	\$0.20
18	Resistors 220	resistors for RGB LED	Unit	3	\$0.01	\$0.03
Total product cost (without taxes or shipping)						\$75.93
Total product cost (including taxes and shipping)						\$93.80 Includes \$8 Shipping

12. Critical Product Assumption

Important assumptions we make during the
design process



Properties of the device



External factors

Input lag

We assume buttons will not have input lag

Length of Wire

We assume 3m of wire length is enough for the purposes of our client

MakerLAB hours

Enough to successfully 3D print all our parts in time

Clock rate

Clock rate is currently unknown and will be determined by testing

Current Delivery

Strong enough to power the circuit and for shift registers to work

Component availability

We assume we can obtain all needed parts from the MakerStore

Time Assessment

Basis of the calculations

Average estimation =
 $(\text{optimistic estimation} + \text{pessimistic estimation})/2$

Time assessment =
 $(\text{pessimistic estimation} - \text{average estimation})/2 + \text{average estimation}$

Physical
2 days

Pessimistic estimation: 2 days
Optimistic estimation: 1 day

Circuit
8h

Pessimistic estimation: 9h
Optimistic estimation: 5h

Software
6h

Pessimistic estimation: 7h
Optimistic estimation: 2h

13. Client Feedback



- He would like us to add rapid fires
- configure buttons before start play
- The main features we want to add is more buttons to do subsequent actions only by pressing it once.



14. PROJECT PLAN



Overall

- Physical, circuit and software designs
- Time and skills needed to complete
- Critical assumptions
- Cost and procurement of materials

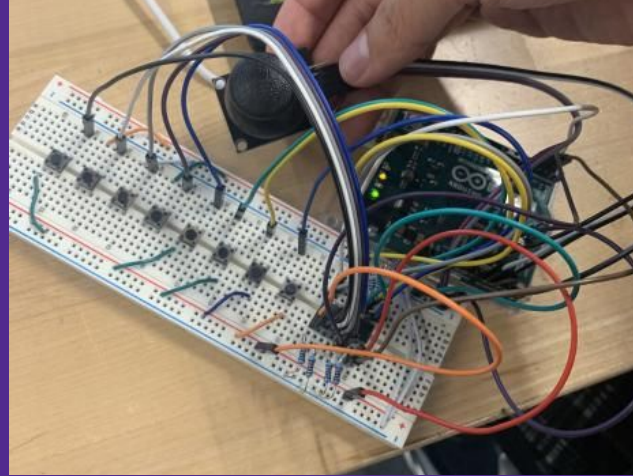
Next steps

- Prototyping and testing
 - Prototype 1
 - Prototype 2
 - Prototype 3
- Progress presentation
- Final presentation and design day pitch

Testing metrics

- Input lag \Rightarrow $< 12\text{ms}$
- Clock rate \Rightarrow fully working
- Power delivery \Rightarrow works for shift registers
- Shift register functionality \Rightarrow all pins work
- 3D Print time \Rightarrow enough time to print during a makerspace session (< 6 hours)

Prototype choice



15. Planned Tests



Planned Tests



Input Lag

Xinput lag test



Buttons

Gamepad Tester



Gameplay

Super Mario Bros

16. Results and Analysis



RESULTS

	Expected Value	Actual Value
Input Lag Test	<12 milliseconds	9.3086 milliseconds
Gamepad Tester	All 13 Buttons Working	All 13 Buttons Working
SMB Play Test	No Perceived Lag	No Perceived Lag

Analysis

Xbox 360 Controller (XInput) Polling Rate Checker

```
Outliers: 3 / 1000  
Top 3 Outliers: 748.64 ms, 70.85 ms, 64.89 ms  
  
Min 0.514300 ms - Max 748.640600 ms - Jitter 8.597398 ms  
Average 9.308595 ms - Polling Rate 107.427599 Hz  
  
Write Report To File? Y/[N]:
```

XBOX Elite 2

15.2

ms

Bluetooth

8.27

ms

USB

9.11

ms

USB With Converter



9.11 VS 9.3

XBOX Elite Controller ms VS Our Controller ms

19.

Trials and Tribulations

What challenges did we encounter during our journey?





Lack of information

Very few similar projects in the market

Testing issues

Arduino port, soldering, etc



Learning new skills

3D printing and 3D modeling



Libraries

Finding resources online for our purposes



20. Upcoming Client Feedback



Client Feedback



Button
Choices



Joystick
Styles



Design
Feedback



Case
Feedback



LIVE DEMO