Prototyping an Immersive Gun Controller for Splatoon

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***Abstract*—This document details the process taken to create an immersive gun controller. The controller was meant to solve problems with immersion to help keep retention in games. This was an interesting idea and allowed the creation of a prototype that while not fully functional, was an enjoyable creation.**

***Index Terms*—immersion, controller, electronics, feedback**

I. Introduction

Going into this project, we had two major problems in mind, both in regards to the game *Splatoon 3* [1].The first is looking for an alternative to the Nintendo Switch Joy-Con [2] that fix the problem with its size and gyro controls. The second is the looking for a more immersive alternative to the controllers on the market for the Nintendo Switch.

Rory Mcgloin, Kirstie Farrar, and Marina Krcmar found that "The more natural participants believed the gaming controller to be, the more realistic the game itself was perceived to be" [1, p.78]. If this perceived realism as found in Mcgloin's [3] work can be maintained, it may be able to keep traffic for the game high, allowing people to play the game with short wait times and continued support. The chance of a Nintendo Switch Joy-Con [2] breaking [4] could lead people to try and find other controllers without drifting problems, which opens up a wide market of possible choices for consumers.

With the above justifications in mind, we came up with a solution: create a controller that emulated the Switch controllers while shaped like a gun from *Splatoon 3* [1]. This would allow us to make a bigger, easier to use controller with an accelerometer in the main part of the controller instead of split off.

This document will go over the comparisons made to other controllers that are similar or would be seen as competitors for our prototype, the process and iterations went through to make our final prototype, the results of said prototype, and what our key takeaways were from completing this project.

II. Literature Review

In Paul Cairns article [5], it was found that the closer the controls of a game are to how the game is played the more immersed the player would tend to be. This, along with the perceived realism found in Mcgloin's article [3] told us that the use of a gun as a controller should help increase immersion as long as the controllers are mapped to positions one would find similar to the controls on a real gun.

A. Competitors

When first making our controller, we compared it to the Nintendo Entertainment System Zapper [6]. The NES Zapper [6] is a controller in the shape of a gun, much like ours, that uses light to communicate with the system and fire when the trigger is pulled. The light basis of the Zapper [6] was not something we were heavily interested in, but the shaping of the controller helped inform how our prototype could be shaped and the important use of a trigger as the main control for our controller, especially something like shooting.

When finally looking to compare what works about our system and what does not, it was decided that a better comparison would be controllers used today specifically for games on the Nintendo Switch. Comparing to something that not everyone would have handled and that is not relevant to the problems we were trying to solve would be counter productive. Instead, we used the Nintendo Switch Joy-Con [2] and the Nintendo Switch Pro Controller [7] within our QFD. We found that when being compared to the Joy-Con [2], the prototype was either equal to, or just slightly worse in most customer requirements. It can be reasoned that the Joy-Con [2] has many problems on its own, like sizing, and so that kept the controllers on an equal footing when people compared the two. This was not the case when compared to the pro controller [7], which was regarded as much better than the prototype in most aspects. This could be due to the fact that pro controller [7] is close to the average controller, and requires less learning from average players to use. See Appendix A for the QFD in question.

III. Methods

When we first created our paper prototype, we found the gun to be unwieldy and large, especially around the handle. People we talked to and received feedback from felt much the same, which lead to the first iteration of changing the handle to be smaller. We also received feedback that the button placement around the front and back handles were off and hard to reach. This was consistent with our second iteration, leading to the final iteration where we changed the button placement on the back handle. It was easier to reach the joystick when placed further down the handle. Our main reason and sources for iteration was receiving feedback from those around us, as shown in Appendix B.

A. Out of Scope Iterations

We found from feedback, that the front handle had buttons that were hard to use due to their placement. This led us to want to try and iterate on the front design. In the end, we decided that an iteration we wanted to make was to change the front handle to be vertical in a similar function to the back handle. This would have allowed the buttons to be easier to use as there would have been more room for them and the joystick. Due to time constraints, this iteration was not possible.

IV. Results

Our final prototype, while not fully functional, is much better than the designs we originally had. The iterations we went through can be found below in Appendix C. The main source of iteration was the handle, which went through three major parts from paper prototype to final prototype. The first change was making the handle not as big and square. The handle was hard to hold and uncomfortable, which many people shared with us. So, we changed the handle to be smaller. It was still partially square, which once again was not liked, but suffered less from being too big to hold. An issue that arose from this change, however, was difficulty reaching the buttons. This lead to the second change which became our final prototype. The handle was much smaller than the previous two iterations, and nice to grip. This was much better received by those who tried it than the last iterations.

A. Feedback

When receiving opinions about our prototype through the QFD, we found that the prototype was outclassed by our competitors. This can be seen in Appendix A. From a customer standpoint, the prototype was just a little bit worse. This was especially true with portability, which was not something we had considered much in the creation of the prototype. The prototype did appear to be better received from an emotional standpoint compared to our competitors, which was good to hear from an immersion stand point. Functionally, the prototype was also behind, only matching up in terms of size, which was found to be the poorest part for Joy-Con [2].

As shown in Appendix D, our prototype received a SUS score of 67.9 out of 100. This would put the prototype very close to okay, but still in poor standings. This was done before the final iteration, and so the system was found cumbersome by most. It was also found that most people believed the prototype to be a little inconsistent. Most people said they would not be against trying the prototype out and that they found it fairly simple to use. We hope that with the final changes made to the prototype, people may find the system less cumbersome.

V. Takeaways

Going into this project, we were unsure of what to expect and what our final outcome would be. While we thoroughly enjoyed the process, the final product did not function correctly. We believe this was mainly caused by over-scoping, if we had went for a project with less buttons, we likely would have had an easier, and less costly, implementing the electronics correctly. It also would have freed up more time to work on the unity demo scene. That is not to say that it did not teach us valuable lessons on the placement of buttons and joysticks. We went through a few iterations on button placements and received a lot of feedback on the subject. We learned that we had to keep in mind how the player would perceive the controls and what may be hard for them to reach or exhaust them.

Another thing we learned was the need for proper holders to keep our electronics inside. Without those, when creating our electronics we had to utilize a lot of tape, which may have been a factor in why our buttons did not function correctly. If given the chance to redo the prototype, we would have taken more time to research and create special holders that could be implemented into our project. This also would have helped with our joystick having better control as well.

Our electronics were lack luster. While we did know, and try, to keep our wires together and not have them sticking out, it did not work out that way, leaving the inside of our design unappealing. Investing in some Velcro straps and parts dedicated to holding wires would have saved us some headaches in that regard and if we were to try a project like this in the future, we would pay more attention to it early on.

While our work did have problems, we did like the final prototype from a design perspective. Our final handle was a pleasant grip and the front grip being used as a button is something we still like the idea of. While we do recognize this as over-scoping, if we were to scope down, we would likely add less buttons rather than changing the design in other ways. Overall, this project was fulfilling and we are proud of our prototype.

Appendix A
QFD

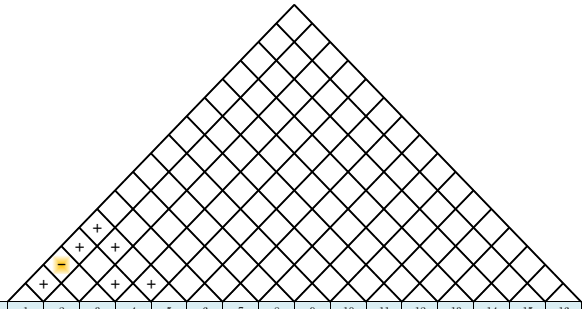
QFD: House of Quality

Project:
Revision:
Date:

Correlations	
Positive	+
Negative	−
No Correlation	

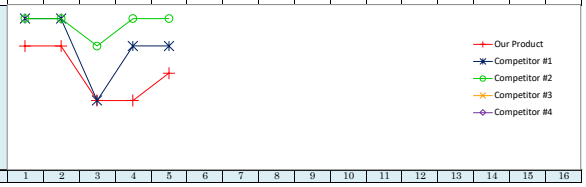
Relationships	
Strong	●
Moderate	○
Weak	

Direction of Improvement	
Maximize	▲
Target	
Minimize	▼

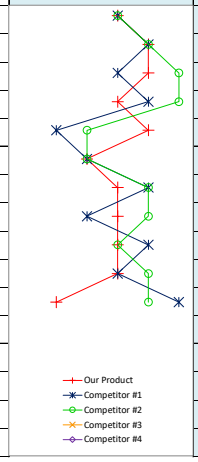


Row #	Weight Chart	Relative Weight	Customer Importance	Maximum Relationship	Customer Requirements (Explicit and Implicit) \ Functional Requirements	Buttons	Duration of Input/Output	Size	Feel	Resistance	Our Product	Competitor #1: Nintendo Joycon	Competitor #2: Nintendo Switch P	Competitor #3: *Product Name*	Competitor #4: *Product Name*	Row #
Column #						1	2	3	4	5						
Direction of Improvement								▼	▼	▲						
1		7%	3	9	Haptics	●	●	○	●	●	3	3	3			1
2		7%	3	9	Weight			●	○	○	4	4	4			2
3		20%	9	9	Button Placement	●	○	●	●	●	4	3	5			3
4			9	9	Usability	●	●	●	●	●	3	4	5			4
5			3	9	Emotional Response	●	●		○	○	4	1	2			5
6			1	9	Aesthetics	●		●	●		2	2	2			6
7			3	9	Calibration	●	●			●	3	4	4			7
8			3	9	Build Quality	●		●	●	●	3	2	4			8
9			1	9	Ease of Use	●	○	●		●	3	4	3			9
10			9	9	Ergonomic	●	○	●	●	●	3	3	4			10
11			1	9	Portable	○		●	○		1	5	4			11
12																12
13																13
14																14
15																15
16																16
					Target	Target for Functional Requirement #1	Target for Functional Requirement #2	Target for Functional Requirement #3	Target for Functional Requirement #4	Target for Functional Requirement #5						
					Max Relationship	9	9	9	9	9						
					Technical Importance Rating	246.7	126.7	260								
					Relative Weight	39%	20%	41%								
					Weight Chart											
					Our Product	4	4	2	2	3						
					Competitor #1: Nintendo Joycon	5	5	2	4	4						
					Competitor #2: Nintendo Switch Pro Controller	5	5	4	5	5						
					Competitor #3: *Product Name*											
					Competitor #4: *Product Name*											
					Column #	1	2	3	4	5						

Technical Competitive Assessment

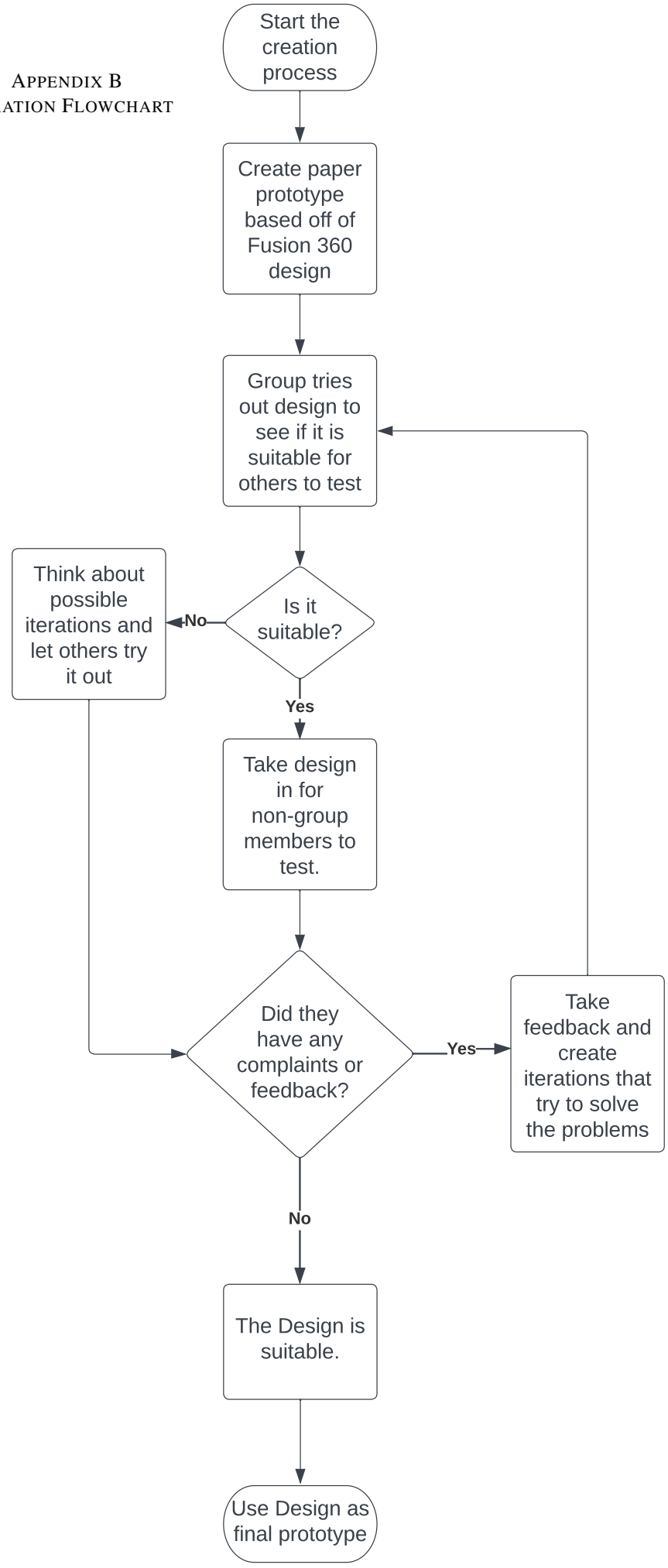


Customer Competitive Assesment



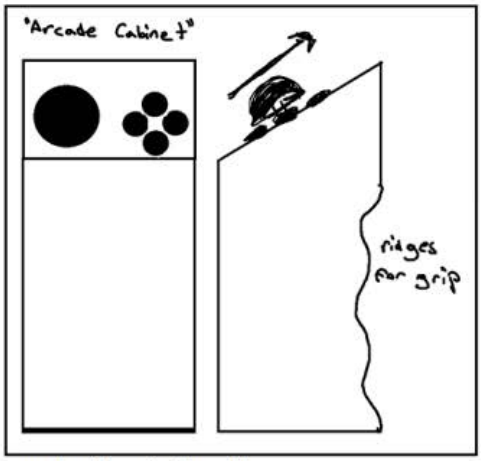
Template Revision: 0.9 Date: 4/23/2010
Christopher Battles

Appendix B
Iteration Flowchart



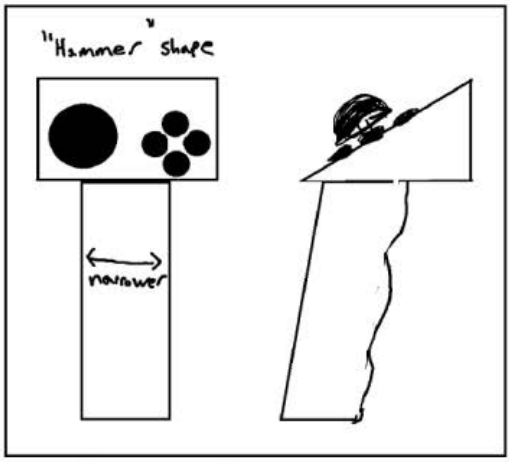
APPENDIX C
ITERATION TIMELINE

Paper Prototype

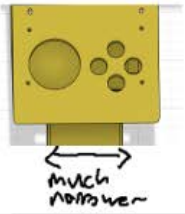


very hard to grip, too wide
very difficult to use buttons and joystick with one hand

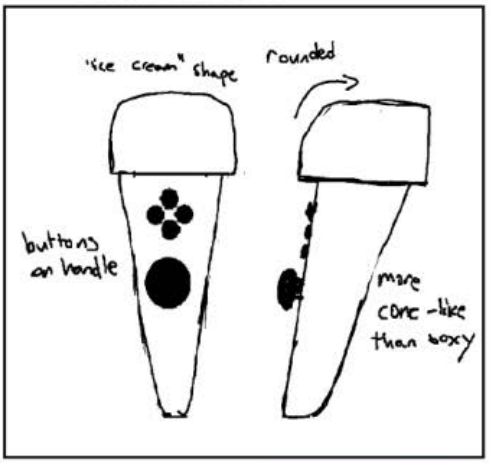
Adjusted Print

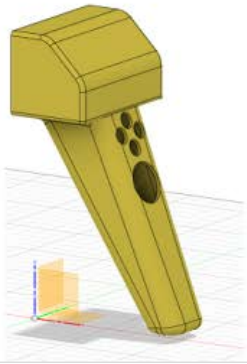


easier for several people to grip
still awkward to use buttons and joystick with one hand
(forced to grip very high up)



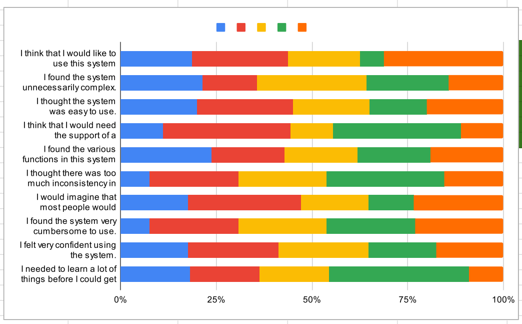
Final Version





Appendix D
SUS Survey Answers, Score, and Chart

Timestamp	I think that I would like to u	I found the system unnece	I thought the system was	I think that I would need th	I found the various functio	I thought there was too m	I would imagine that most	I found the system very cu	I felt very confident using	I needed to learn a lot of things before I could get going with this system.
	4	2	4	1	4	2	4	2	4	1
	3	3	4	1	5	1	3	1	3	2
	4	2	5	3	4	3	5	3	4	2
	3	4	4	1	4	3	3	3	4	2
	1	3	3	3	4	4	2	3	3	4
	5	2	4	1	4	2	4	3	3	1



15	17	80
13	17	75
17	12	72.5
13	12	62.5
8	8	40
15	16	77.5
		67.91666667

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