

One Handed Guitar Game Controller

Controller development for individuals with limited hand mobility

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Abstract—Our controller prototype is designed to address the problem of limited hand mobility for the purposes of rhythm based games. We sought to allow for a wider audience to enjoy rhythm based games like Guitar Hero and Rockband without needing to build it around the existing and admittedly bulky controllers. Our main motivation was our shared love of music and rhythm based games, and our want to provide the same experience to people that were previously unable to experience it. Overall, our design and experimentation process was largely successful, with our working virtual prototype and a physical prototype for a tactile experience.

Index Terms—Accessibility, Rhythm Games, Controller, Design Process, Usability

I. INTRODUCTION

The accessibility issue we seek to tackle with our controller design is the issue of limited hand mobility, both due to a lack of full mobility range or because of other hand issues, such as only having a single hand. Individuals with these kinds of limitations cannot normally properly use the bulkier guitar controllers present in multiple rhythm games due to their size and shape. We want anyone to be able to experience these rhythm games, without any sort of limitations preventing them from enjoying this form of entertainment. While we would want to tackle similar issues in future projects, this is the project we decided to tackle first. This prototype's design is based heavily on a piano, since they typically have keys very closely placed together, allowing for a large amount of button inputs to be within a single hand's reach of each other. The design is intended for use with a single hand, or with a couple of fingers on each hand should that help with the individual's personal limitations. In this paper we present our experimentation and design process for creating the prototype, as well as the results from our iterative process.

II. LITERATURE REVIEW

Controllers for guitar rhythm games, such as Guitar Hero and Rock Band, require full function in both hands to use. This problem affects those with limited mobility/usage, whether that be from an injury or genetics. There has been one documented solution to this problem, the Guitar Hero pedal, which is used to replace the strumming and whammy bar functions on the guitar itself. [1] This however does not solve our problem because you have to have 2 completely separate controllers,

still holding a big guitar controller, and an extra step of using your foot. There also was an attempt with the Guitar Hero Grip for the Nintendo DS, which allowed users to easily play with one hand, as well as the Omni Controller, a one handed gaming controller. [2] There also has been the popular one handed controller for the Nintendo Wii, but this controller also utilizes an accelerometer and optical sensor technology, which we will not be using. Also, the Wii controller is not optimized for guitar rhythm games. [4] Another attempt at this problem is the Touch-based Configurable Gamepad, designed for gamers with physical disabilities. This controller however does not include the satisfaction of physical buttons, which is important when it comes to timing and rhythm games. [4] Combining features from these controllers will help create a solution for this problem.

III. METHODS

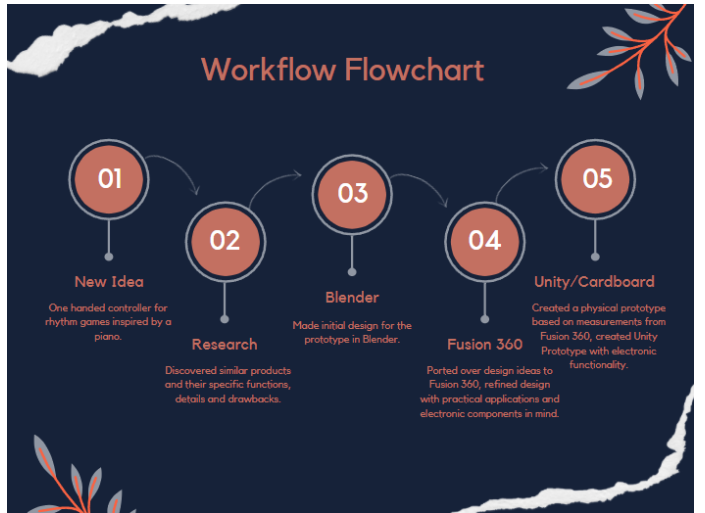


Fig. 1. Workflow Flowchart

Our initial design stemmed from some research into similar products, such as the ones mentioned in the literature review section. The first iteration of the product's design was then created within Blender based on the look of a piano and the size of other similar controllers. Then the prototype was

ported over into Fusion 360, where the design was refined in order to account for various electronic components and specific measurements for other components. Finally, the prototype has been refined further to get rid of pieces that were deemed unnecessarily complicated for the design for the physical prototype while the functionality was programmed into a Unity prototype.

IV. RESULTS



Fig. 2. Design Process Timeline

Our design process is summed up decently with our development timeline (Figure 1). Our final prototype result is partially digital for functionality purposes, and partially made out of cardboard for tactile purposes. Our cardboard prototype has been refined from the initial design to be as simple as possible while still retaining our want to have it be usable for playing the game. The buttons have been minimized to only the essential keys, as the DPad from earlier iterations was ultimately deemed unnecessary. The prototype is the proof of concept we needed to know that our idea works and fits a hand comfortably, with the size being a nice compromise between adult and child hand sizes.

Our Quality Function Deployment (QFD) chart in Figure 2 clearly shows an emphasis on the importance of the keys and casing being designed properly, as well as the LED lights on the final product being a must for both feedback and aesthetics.

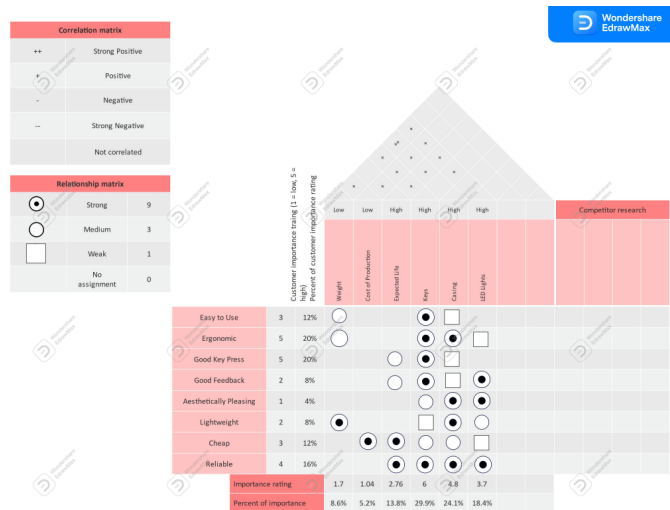


Fig. 3. Quality Function Deployment Chart

V. TAKEAWAYS

We do have a few items of note to takeaway from the entire process. First of all, making a prototype of an instrument was harder than we had initially planned, as making it work accurately required knowledge of the inner workings of the instrument, and as such more research than initially anticipated was required. In the future, we would want to account for more research time and delve further into research topics before starting the design process for other projects. We also want to prioritize having a sleeker, simpler design over something fancy or eye catching. Most of the changes between iterations was focused on simplifying the design from previous designs, improving both our ability to recreate it in a physical form and the aesthetic appeal according to some external feedback. We would also want to make future prototypes slightly larger to account for more hand sizes, as the current prototype is on the smaller side. While this is comfortable for children and adults with smaller hands, it can be awkward to use for people with larger hands. Finally, in the future we would want to add the LED lights to the designs and/or the physical prototype. They were included solely in the Unity prototype, and their exclusion before that point was an oversight that should be rectified in future projects and future iterations of this project, especially in the event that it affects the shape or size of the design.

REFERENCES

- [1] Benheck, "Guitar Hero Pedal Controllers," Web portal for Benjamin J Heckendorn, 08-May-2008. [Online]. Available: <https://www.benheck.com/guitar-hero-pedal-controllers/>. [Accessed: 02-Feb-2022].
- [2] K. Ito, R. Kuroda, M. Urata, G. Takeda, and A. Ikeda, "Video game system with wireless modular handheld controller," 20-Nov-2012.
- [3] H. Moshier, "Omni Controller: A multi-functional competitive gaming controller designed for accessible one handed use.," thesis, The Ohio State University, 2019.

- [4] D. Gadia, M. Granato, D. Maggiorini, M. Marras, and L. A. Ripamonti, "A touch-based configurable gamepad for gamers with physical disabilities," Proceedings of the International Conference on Computer-Human Interaction Research and Applications, 2017.
- [5] Barlet, C.M., Spohn, S.D.: Includification: A Practical Guide to Game Accessibility. The Able Gamers Foundation, Charles Town (2012). ISBN-13: 978-1479289356