One Tilt - Accessible Video Game Controller

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***Abstract*—This document details the design and iterative development process of One Tilt; a one-handed accessible video game controller. Despite the rise of accessibility prevalence in video games, one-handed controllers remain quite sparse, often relying on home brew solutions from users. The One Tilt controller aims to provide a controller designed from the ground up with one-handed users in mind that maintains the portability and ease of use of modern gamepads.**

***Index Terms*—accessibility, one-handed controller, tilt controller, video game controller**

Fig. 1. One Tilt Logo

I. Project Description

A. Problem Definition

Video games are among the most popular forms of entertainment [1], yet remain inaccessible for some as standard controllers offer little support for individuals with disabilities. Those with the use of a single arm or hand struggle to use regular gamepads. Many users are forced to do what they can with a standard gamepad or engineer a custom made solution to fit their needs, often requiring compromise and retrofitting existing hardware to create a usable result.

While some customizable controllers exist, they are often not specifically designed for one-handed users, are made up of low quality components, or are add-ons to existing gamepads rather than being tailored for the use case. Additionally, many of these controllers require a flat surface to rest on in order to be usable, and lack portability. Compared to the flexibility, ease of use, portability, and comfort of standard gamepads, the current market for one-handed controllers is lacking. The One Tilt controller aims to solve these issues by providing an experience similar to standard gamepads, but designed to be fully usable and comfortable with only one hand.

This document will outline the reasoning, related works and products, iterative design process, and final takeaways from the development of the One Tilt controller.

B. Justification

Without accessible controller designs, millions of people would be unable to comfortably play video games. Intuitive controller designs also open avenues for accessible controls for vehicles, and other light or heavy equipment.

One billion people (approximately 15% of the population) experience some form of disability. Over three million people in the United States of America have some form of hand-related disability, including paralysis, arthritis, or orthopedic impairments. Hand injuries have become very common, being the most common injury in the workplace [2].

II. Ideation

A. Method

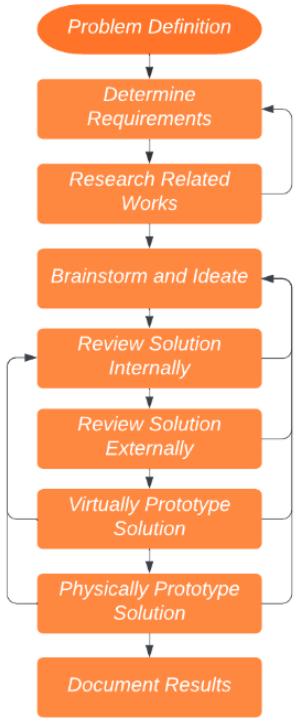

Fig. 2. Methodology Flowchart

B. Design Thinking Outcome

While there are video game controllers that are made to be accessible, many are cumbersome or have notable drawbacks for certain use cases. The Xbox Adaptive Controller, for example, is a large rectangular device meant to rest on a surface [3]. Of all the controllers designed with accessibility in mind, few deliver a nimble and mobile experience similar to a regular gamepad [4].

To solve this problem, a group of four people collaborated to design a controller that would fit these needs. The design process began by looking at existing one-handed controllers through the lens of the intended user, analyzing the benefits and drawbacks of each one. Common drawbacks included the secondary analog input method requiring that the controller be rested on a steady surface, which limits posture options and play spaces, or requiring significant arm movement, which can cause fatigue with extended use. The idea to avoid these issues was to use gyroscopic sensors to detect tilt movements of the controller, and have that act as the secondary analog input method, with the primary method being a regular gamepad joystick. Due to many one-handed players being familiar with standard gamepad layouts due to necessity, it was also suggested that the control scheme be similar to one side of a standard Xbox or PlayStation gamepad.

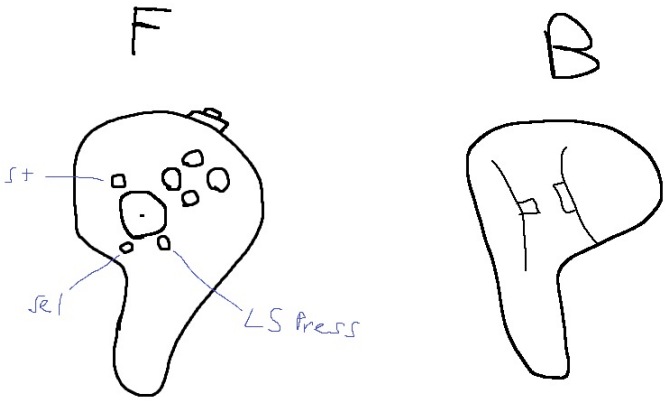

Fig. 3. Concept 1

The first controller concept is intended to be comfortable and have a layout similar to standard gamepads. The front face of the controller is laid out similar to the right half of one of these gamepads, with additional buttons for start, select, and left stick press. It is rounded off to create a more comfortable grip with one hand. The back of the controller includes a divot for the middle finger to rest, with the left trigger and bumper accessible with a slight motion.

The second controller concept was inspired by Sony's DualShock 4 controller, taking the right side of the gamepad as a base, adding extra buttons to perform some of the tasks of the missing left side, and adding more grip so the controller would be easier to hold on to with a single hand. The back of the controller uses buttons for left trigger and bumper.

The resulting controller concept is a mixture of the two previous designs. Once again taking the DualShock 4 as a base, but with this iteration incorporating the backside trigger and bumper of the first concept.

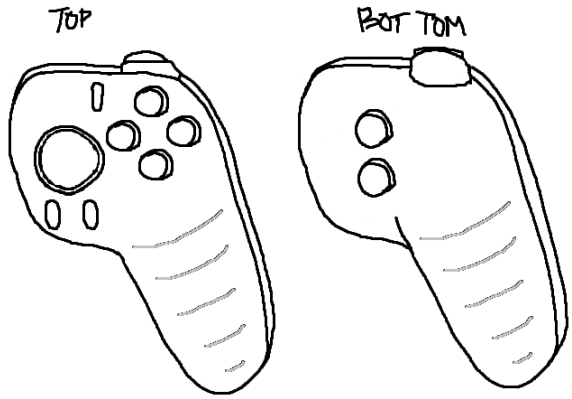

Fig. 4. Concept 2

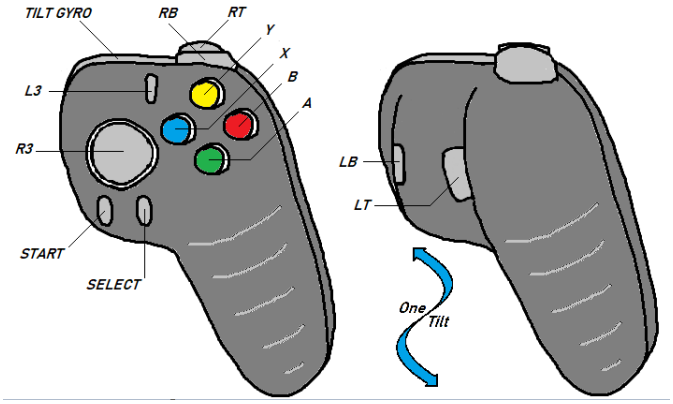

Fig. 5. Concept 3

III. Product Comparison

Single-hand controllers have existed, in one form or another, since the earliest video games. Only recently, however, have larger companies begun to identify the need for better and more accessible interfaces for players.

Fig. 6. Single-hand Controllers

A third-party controller for the PlayStation 2, PlayStation 3, and PC was made in 2010, with six circular slots to insert whichever accessory is needed (joystick, D-pad, the standard four buttons, or numerous other button combinations) [5].

Many peripherals for PC gaming have been made by individuals and large companies. Some include small keyboards with built-in analog sticks or mice with a plethora of customizable buttons and macros to accommodate almost any need.

Nintendo released a holder that allowed two Joycons to be used at once. While not being a standalone controller, this implementation shows the versatility of the Joycon design, and how smaller, compact devices potentially offer greater utility compared to larger controllers.

IV. Planning

A. Gantt Chart

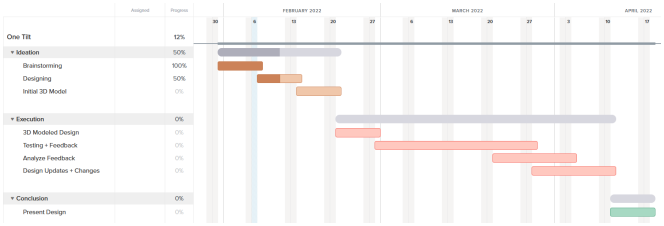

Fig. 7. Workflow process and tasks

B. Roles and Responsibilities

Both members are responsible for collaborating on the design and ideation process, as well as conducting and reviewing user tests.

Kristian Menes is responsible for creating and iterating on the 3D models of the controller.

Mathew Kostrzewa is responsible for developing the functionality of the controller.

V. Results

A. Timeline

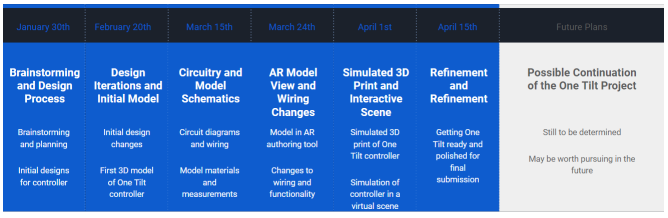

Fig. 8. Development Timeline

B. Usability Testing

To gain insights into the design of the One Tilt controller form different perspectives, a survey was created to gather feedback regarding the device. The survey included questions about the controllers usability, design, feel, and ease of use, all being rated on a scale from one to five. These responses were then put into the System Usability Score (SUS) algorithm.

Based on that feedback from the user surveys, the One Tilt controller performed well, scoring a total SUS score of 77.5 points. Taking the data and extrapolating it into an easier to read graph, the areas the One Tilt controller scored lowest in were related to design complexity and the physical controller casing.

44.4% of users found the One Tilt controller to be too complicated, and felt the may need some form of technical support to be able to use the device. 37.5% of those surveyed also felt the controller was cumbersome and would be difficult to use for extended periods of time.

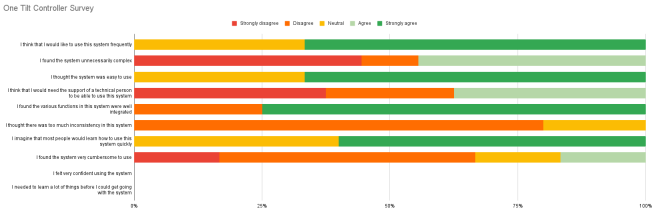

Fig. 9. One Tilt Controller Survey Results

VI. Takeaways

The complexity of the One Tilt controller is a difficult issue to address. The One Tilt is essentially a standard gamepad cut in half, while keeping the same functionality, i.e. number of inputs. This also relates to the issue of the cumbersome nature of the One Tilt controller, with the internal structure needed to support the same inputs a standard controller uses. These issues may be solved with future design iterations, nullifying redundancies, and achieving and sleeker and more streamlined design.

Despite not testing perfectly, overall the project went well and a lot of learning was done regarding the engineering process. The final design encompasses the initial vision, and theoretically fulfills the needs of those it aimed to help.

There is a possibility that the One Tilt controller project will continue, develop further, and realize the initial goal of the project to help those with disabilities, or difficulty using standard gamepads and controllers.

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