Prototroller Design & Development Plan

Introduction

The Prototroller (“Prototype Controller”) is a valuable addition to the gaming domain as it makes controller modularization readily accessible for use by gamers and developers alike. It also has the potential to aid physically disabled members of the gaming community. The Prototroller provides quality of life improvements to users by allowing them to tailor their gaming experience. Developers may rapidly prototype different controller layouts for playtesting. The addition of pre-programmed configurations may be used as a template for modifications. Similar controllers in-spirit exist, such as the ByoWave Proteus Controller [1] and the Astro C40 TR Modular Controller [2]. These are modular in the sense that you can change switches and joysticks around, but they lack capability for other components and have little combinatorial value. The Xbox Adaptive Controller [3] is more developed and regarded as the go-to controller for those who have difficulty using a conventional controller. Despite its merit, it is still limited by not having programmable modules with unique functions. The Prototroller seeks to go further, providing the ultimate experience as a fully modular and highly configurable controller.

Figure: An example in-spirit from an existing commercial product, Specialwaves. It is a modular MIDI controller [4].

Statement of Work

The primary work will be implementing traditional controller input recognition (Joysticks, Push Buttons, Triggers) with modularization in mind while maintaining accuracy and minimal latency. The product base in an ergonomic form-factor is a central board (“Protogrid”) that permits swapping of components into a configuration the user desires. This is constrained by our final choices for peripheral support, which at a minimum includes the traditional inputs mentioned. Communication between the Prototroller and host device will occur through a USB 1.1+ connection, interfacing with drivers on the host Windows platform. With USB 1.1+ we ensure a bandwidth of at least 1.5 Mbps [5] which is sufficient for the Prototroller.

The firmware and host drivers we produce throughout the project will have a multitude of dependencies. Those that we currently predict are a board support package (BSP) for the chosen microcontroller and base driver libraries for Windows in a C/C++ build environment. Power for the Prototroller will be delivered through the wired USB connection. Consequently, power consumption will not be a major concern. The power drain on the host device will be minimal at 5V and below 100 mA which gives <0.5 W, typical for most microcontrollers.

Major Task	Target Completion Date	Team Member(s)
Basic Functional Hardware Firmware (Reading Modules)	December 1st 2022	Britton/Merrick
Basic Software Drivers (Register Inputs)	December 1st 2022	Caleb/Evan
Basic Hardware Breadboarding (Base functionalities)	December 1st 2022	Caleb/Yuyang
Prototyped Hardware Perfboard (All functionality)	February 2023	Britton/Yuyang
Additional Firmware Features (Detecting controller layout)	February 2023	Britton/Merrick
Advanced Software Drivers (Allow mapping of inputs)	February 2023	Caleb/Evan
Final Driver Features (Mapping updates)	March 2023	Caleb/Evan
Final Firmware Features (Low-latency input for software drivers)	March 2023	Britton/Merrick
Finalized hardware PCB (All functionality on custom PCB)	April 2023	Merrick/Yuyang

Figure: Listing of major tasks, target completion dates, and assigned team members. Not final.

Deliverable Artifacts

- ✓ **Controller hardware with added prototype builds and modules**
  - This artifact is the basis of the entire project, as the physical components enable the desired modularity. The viability of the physical components is an average of 5 years depending on the user's care and use case.
- ✓ **Software drivers (targeting Windows ecosystem)**
  - The host platform end of the controller interface. Ideally, the drivers would install the moment the Prototroller is plugged in via USB. For the remainder of its use, the drivers should function until there is a new OS update or conflict with another driver.
- ✓ **Source/Firmware for controller hardware**
  - This artifact will handle communication with the connected device and register any inputs or changes to controller configuration and communicate information with the master device.
  - Source code will be formatted in a standardized directory format utilizing header and source files, compiled into an object code binary to be flashed onto the microcontroller.
  - Firmware will be hosted on a VCS (GitHub) and modified as necessary for fixes and improvements, this way the firmware is maintained and able to be re-flashed to the microcontroller.
- ✓ **Hardware/Software manuals, installation instructions**
  - The manuals guide users through installation, usage, and troubleshooting potential issues that may be discovered.
  - Documentation will be available within the VCS repository. In addition to physical copies being distributed along with any prototype or final builds of the product.

References

[1] “Developing the Proteus Controller | Modular Accessible Video Game Controller,” *ByoWave*, 05-May-2022. [Online]. Available: https://www.youtube.com/watch?v=V0cXvv_zpqc. [Accessed: 10-Oct-2022].

[2] “Astro C40 TR Controller,” *ASTRO*. [Online]. Available: https://www.astrogaming.com/en-us/products/refurbished/refurb-c40-tr-gen-1.996-000360.html. [Accessed: 10-Oct-2022].

[3] “Xbox Adaptive Controller,” *Xbox.com*. [Online]. Available: https://www.xbox.com/en-US/accessories/controllers/xbox-adaptive-controller. [Accessed: 10-Oct-2022].

[4] R. Sethi, “Specialwaves Smart & Sexy Modular MIDI Controller Now On Kickstarter,” *MacProVideo*. [Online]. Available: https://macprovideo.com/article/news/specialwaves-smart-sexy-modular-midi-controller-now-on-kickstarter. [Accessed: 10-Oct-2022].

[5] T. Fisher, “USB 1.1: Everything you need to know,” *Lifewire*, 28-Feb-2022. [Online]. Available: https://www.lifewire.com/what-is-usb-1-1-2626036. [Accessed: 10-Oct-2022].