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RetroPie Arcade Game System

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Introduction

The Retro Arcade Game System is a portable wooden box with a clear acrylic top, meticulously designed for retro gaming on-the-go. This system is powered by a Raspberry Pi single-board computer running the RetroPi operating system, which allows players to enjoy classic games like Mario, Pokémon, and Atari classics. The system features two player controllers, each with a joystick, eight game buttons (red for player 1, blue for player 2), a coin/start button, and an exit button. Additionally, all 20 buttons feature LEDs, providing an exciting and unique gaming experience. An LCD screen is also included for displaying game info and button mappings, which is controlled by an Arduino Mega, providing customizable lighting patterns and message displays.

The Arduino Mega played a crucial role in our Retro Arcade Game System, as it controlled the LED lights on the buttons and LCD screen. With enough input/output pins, the Arduino allowed us to control all the LEDs and the LCD screen. We used a simple code to control the LEDs, allowing us to turn them on and off in different patterns, such as flashing or fading, and added a potentiometer for adjusting the speed of the lighting patterns. Another code controlled the LCD screen, allowing us to display different messages and images. The Arduino code underwent several revisions to fine-tune the timing and functionality of the different components, resulting in a powerful and versatile tool that added unique features to our Retro Arcade Game System.

How to Play

Using the Retro Arcade Game System is easy - players simply plug it into a power source and connect it to a TV or monitor using an HDMI cable. Games can be loaded onto the system by uploading them to an SD card that goes in the Raspberry Pi. Once a game is loaded, players use the joystick and game buttons to play, with the LED lights adding an extra level of excitement to the gaming experience.

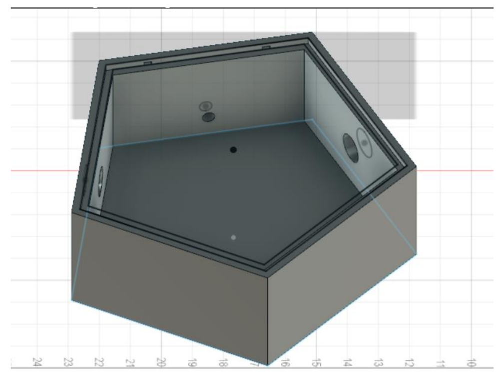
Components

Structure
- Plywood
- Acrylic
- Adjustable Legs
- Vinyl
- Assorted Screws
- Cable Ties
- Cable Clips

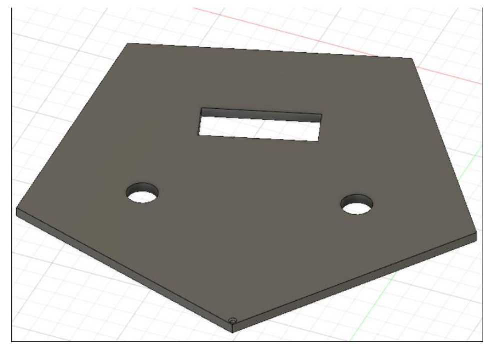
Hardware
- Raspberry Pi Model B, 8Gb
- Arduino Mega 2560 Rev3
- EG STARTS USB Encoders
- 20 Arcade Buttons w/ LEDs
- 2 Joysticks
- 2 Buttons w/o LEDs
- Potentiometer
- LCD Display

Controller Housing: CAD design/Fabrication Process

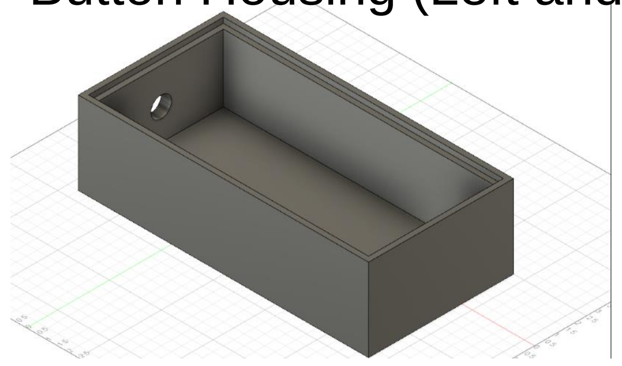
Pentagon CPU and Controller Housing



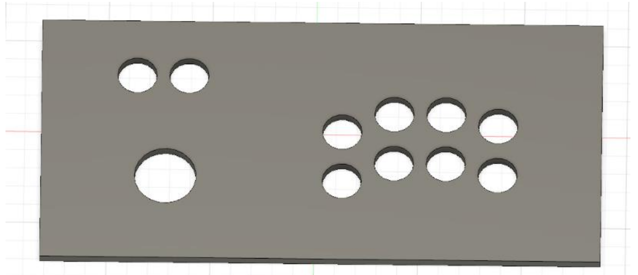
Middle Faceplate



Button Housing (Left and Right)



Controller Faceplates

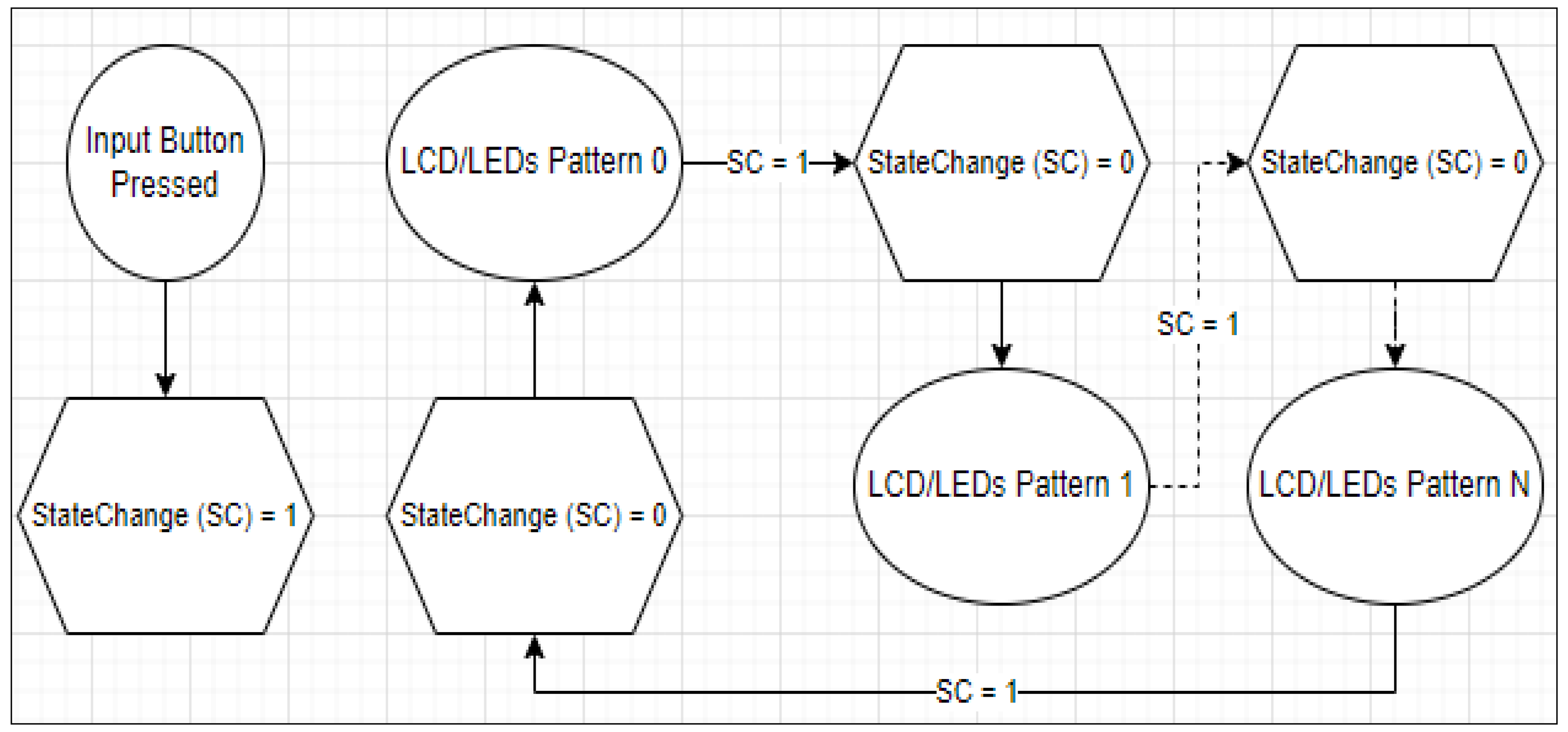


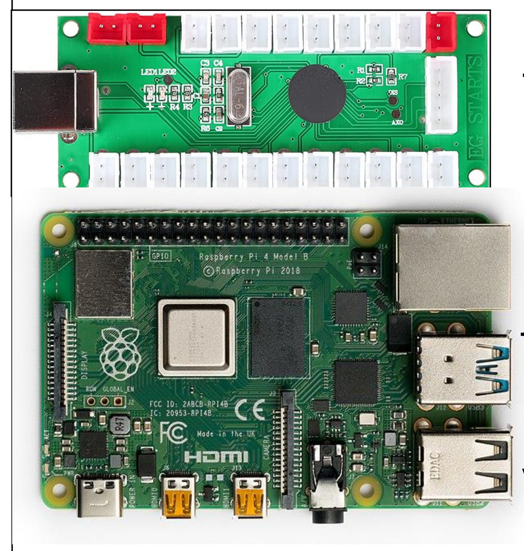
In our senior project, we utilized both Fusion 360 and ShopBot software to create and machine the components required for our project. Fusion 360 is a computer-aided design (CAD) software developed by Autodesk, which is widely used in industries such as engineering, architecture, and product design to develop and prototype new products. On the other hand, ShopBot is a brand of computer numerical control (CNC) routers used to machine various materials such as wood, plastic, and aluminum. ShopBot routers are controlled using ShopBot software, which allows users to design and control the cutting path of the machine. Using Fusion 360 software, in design mode we sketched and extruded each individual side face of the respective components using .668 inch plywood for the box sides and .25 inch acrylic for the box faces. In manufacturing mode, we used a combination of 2D and 3D milling operations, specifically adaptive clearing and contouring, to create toolpaths for the ShopBot to produce our specific design. After design creation is finalized we ensure there are no errors in the process that inhibit process completion or sacrifice design integrity by 3d simulation of the cut process within the Fusion360 software. After simulation is complete and no errors were listed we exported the design setup which is essentially a list of all operations needed from start to finish categorized into respective operations by the type of bit that will be used for each operation. To cut out the components, we utilized three distinct types of bits on the ShopBot, which included: 1/4" single flute acrylic flat end bit (acrylic) 1/8" dual flute ball end bit (wood) 1/8" dual flute flat end bit (wood) It is worth noting that the 1/4" bit was used exclusively for the acrylic material, and it was the smallest bit size available for the material at the school's fab lab, which made it impossible to create smallest .12 inch diameter holes with it. The 1/8" flat bit, on the other hand, was used for all cuts and holes in the plywood sides and bottom pieces, while the 1/8" ball drillbit was used for the diagonal 54-degree edges of the pentagon sides. Additionally, the 1/8" ball drill bit used to fabricate the pentagon's edges utilized in combination with the 3D adaptive clearing, was the most time-consuming and complex operation of both materials, plywood or acrylic.

Hardware and Software

We implemented an Arduino to control both the LCD and LEDs. It's crucial that the Arduino code doesn't contain any delays to ensure effective control of these features. Instead of using delays, we utilized the millis() function, which retrieves the current system time in milliseconds. By storing this information and comparing it with new calls, we can trigger functions if enough time has elapsed. This method allows us to avoid pausing the program while checking if an action is needed. We developed state machines to control the output of the LEDs and LCD. The input buttons trigger an interrupt, which\ sets a flag variable to update the button's corresponding state. As the code loops around, the state is updated, and other key variables are reset. The other input is the potentiometer, which updates the delay between LED updates. This allows user control over the speed of the lighting patterns! This approach ensures a smooth transition between states and reduces bouncing in the button's signal. Overall, this method allows for efficient and effective control of the system, making it popular for various applications.

State Machine Diagram for Both LED Patterns and LCD:





To the left are pictures of the EG STARTS USB Encoder (TOP) and the Raspberry Pi Model B (BOTTOM). The USB Encoder allows us to turn the button inputs from the 20 arcade buttons and the joysticks into a USB controller input. Both USBs are plugged into the Rasperry Pi and the buttons can be mapped to any button that appears on classic videogame controllers!

Conclusion

Overall, the Retro Arcade Game System offers a fun and competitive way to enjoy retro gaming with friends and family. Its portable design, customizable lighting patterns, and compatibility with classic games make it a must-have for gaming enthusiasts.