Designing a Video Game Arcade

The video game Pong introduced by Atari in 1972 established the video game industry. This led to development of coin-operated video game arcades. These arcades made use of custom hardware and controls for operation of video games housed in a cabinet decorated with graphic designs.

These games were developed with limited memory and computational power. The popular game Pacman introduced in 1980 was powered by an eight-bit Z80 computer with 16 kilobytes of permanent memory and 2 kilobytes of random-access memory (RAM). The video display had a screen resolution of just 224 x 288 pixels. The computational power of todays computers makes it possible to recreate classic arcade games or design new games in the same genre.

Video Game Software

The educational computing language Snap*!* is particularly well suited to design of video games. An introduction to Snap*!* is provided at:

https://maketolearn.org/introduction-to-snap/

A gallery of sample arcade games developed in Snap*!* is available at:

https://maketolearn.org/games

A broader collection of games is available on the Snap*!* web site at:

https://snap.berkeley.edu/collection?username=snapcloud&collection=Games

A welcoming community is available to answer questions about game design on the Snap*!* forum:

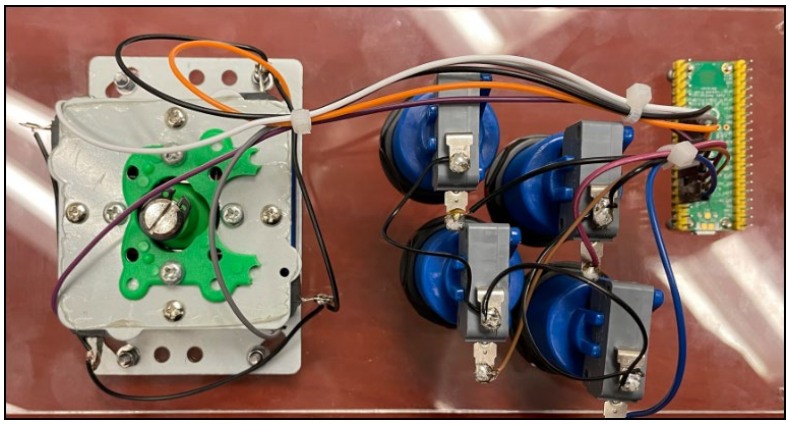
https://forum.snap.berkeley.edu/

Other documents describing design of specific games are available on the *Make to Learn* site.

Arcade Controls

The video game controls can be assigned to keys on a computer keyboard such as the arrow keys (for movement) and the spacebar. Classic arcade games employed customized controls such as the joystick and arcade buttons shown below. The joystick and arcade buttons communicate with the computer via a microcontroller. Wires from each of the controls are connected to the microcontroller – i.e., the computer chip in the lower right-hand corner of the illustration. The microcontroller, in turn, is connected to the computer via a USB cable.

If the arcade control bar is flipped over, it is possible to see that each arcade button causes the circuit in a pressure switch to be completed when the button is depressed. The joystick in this instance consists of four pressure switches that register the movement of the joystick in up, down, left and right directions.



The microcontroller monitors the status of the pressure switches, and notifies the computer (via a USB cable) when a switch closure occurs. The specific microcontroller used in this instance is the Raspberry Pi Pico:

https://www.raspberrypi.com/products/raspberry-pi-pico/

This microcontroller is about the size of a stick of chewing gum, and can be acquired for a retail price of about five dollars. The combination of compact size and affordable price makes the Raspberry Pi Pico well suited to this application.

There are a number of ways in which the software to monitor the switch status can be coded. The software used in this particular case is *MicroBlocks*, a block-based language inspired by Scratch designed for microcontrollers:

https://microblocks.fun/

The MicroBlocks "Key and Mouse" library developed by Bernat Romagosa was used to communicate with the computer (via a USB cable). The *Key and Mouse* library provides software that translates switch closures monitored by the microcontroller into a format that is interpreted by the computer as a keypress on the computer keyboard. A separate document covers installation of MicroBlocks and use of the Key and Mouse Library with the Raspberry Pi Pico.

Arcade Enclosure

The arcade control bar described above can be plugged into a laptop or desktop computer. If the Snap*!* videogame uses keys on the computer keyboard as game controls, the arcade control bar can emulate the keypresses to control the game. Therefore, the Snap*!* software itself does not need to be modified to use the arcade control bar.

The arcade control bar makes it possible to use a joystick and arcade buttons with a Snap*!* video game. The arcade experience can be further enhanced through use of an arcade enclosure. The arcade enclosure can be made inexpensively using cardboard.

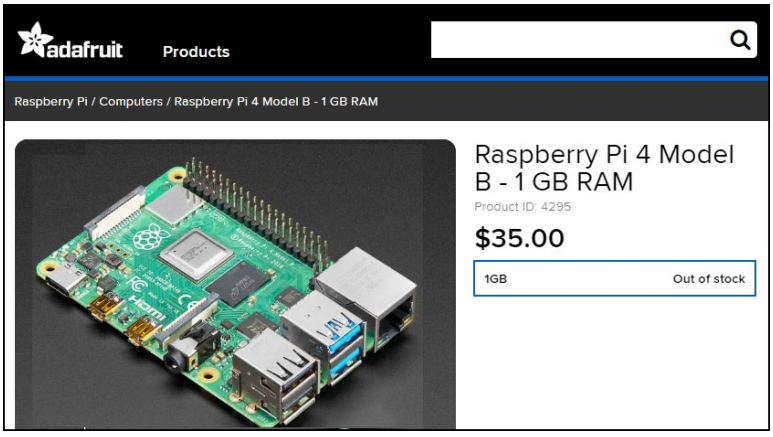
Use of an inexpensive, flexible material such as cardboard makes it straightforward to develop a mockup or prototype. Arcades come in many formats – for example, a tabletop arcade often incorporates controls for opposing players on either side of the arcade – so the form factor of the arcade does not need to follow the example show in the illustration above. The actual format used for the enclosure is dependent only on the creativity and imagination of the designer.

If time and resources permit, the cardboard prototype can be translated into more durable materials and decorated with art and graphics. The example in the illustration below was fabricated using birch plywood.

There are many other materials that could be used to create an arcade enclosure. Since the enclosure does not affect the functionality of the arcade game or arcade controls, the specific materials and format used are up to the designer.

Arcade Computer

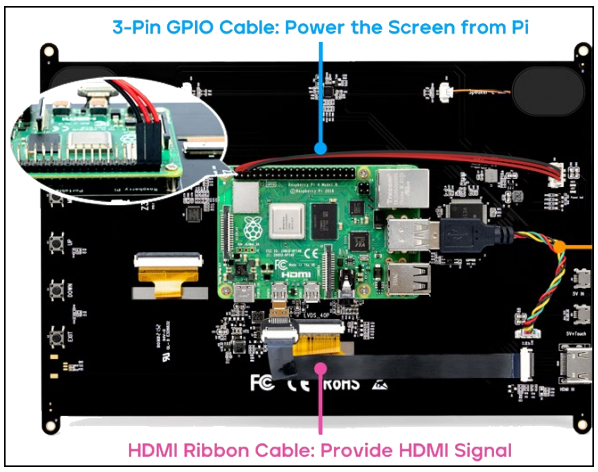
An arcade enclosure such as the one depicted above requires a dedicated computer that can be permanently left in the enclosure. A Linux computer makes a good choice for a dedicated computer, since the operating system is open-source, resulting in a lower cost. The Raspberry Pi is a popular computer that uses a version of Linux as the basis of its operating system. It can be acquired for a list price of $35.



The popularity of the Raspberry Pi sometimes results in supply constraints that cause it to be out-of-stock. When this occurs, there are a number of other Linux computers in a comparable price range that can be used as a dedicated arcade computer. A separate document covers installation of the Linux operating system on an arcade computer.

The remaining component of the arcade consists of a video display screen. A 10-inch screen designed for the Raspberry Pi was used in the arcade displayed above.

Video display screens designed specifically for the Raspberry Pi sometimes have mounting brackets on the back of the screen, which simplifies installation of the computer.



In this instance, an HDMI cable connected the computer to the display. A second cable made it possible to power the screen via a connection from the computer.

Accessories

Several accessories can enhance the development process. A Bluetooth keyboard can facilitate use of the arcade as a computer. The Logitech K380 Bluetooth keyboard, recommended by Wirecutter, can be acquired for about $30

The Raspberry Pi Model 4B has two HDMI ports, so mirroring the arcade screen to a larger monitor via the HDMI port can facilitate demonstrations.