USB arcade joystick x4 plus Simon game

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1 Introduction

1.1 Motivation

Thanks to the emulators available nowadays I was able to make my own arcade cabinet. Although I employed genuine arcade joysticks and a vintage CRT display I didn't get the same feeling that playing the original arcades. When playing the original, death was dramatic: if you "died" in the game and you wanted to continue playing you had to spend a valuable coin. Since emulators let you simulate the insertion of a coin just by pressing a key, in practical terms you have unlimited lives and the feeling is lost. To solve this I devised a joystick system with an integrated credit counter. The system disables the insert coin buttons unless credits are available and includes a little challenge that must be won in order to obtain them.

1.2 The challenge

It is the Simon electronic game created by Ralph Baer and Howard J. Morrison in 1978. The following description of the game has bee taken from wikipedia (`https://en.wikipedia.org/wiki/Simon_%28game%29`):

> The device has four colored buttons, each producing a particular tone when it is pressed or activated by the device. A round in the game consists of the device lighting up one or more buttons in a random order, after which the player must reproduce that order by pressing the buttons. As the game progresses, the number of buttons to be pressed increases.

As in the original Simon game there will be four skill levels. The number of credits obtained when the game is won will depend on the selected skill level.

1.3 Features

- Includes four arcade joysticks using just an USB connector.
- No special drivers are needed.

- Each joystick have six generic buttons, a start button and an insert coin button.
- The insert coin buttons are also employed in an integrated Simon game in order to obtain credits.
- The insert coin buttons are disabled when there are no credits available.

2 What is needed

2.1 Hardware

- Four arcade joysticks and, for each of them, six generic buttons and an start button
- Five retroiluminated arcade colored buttons (yellow, blue, red, green and white)
- A little speaker or buzzer
- At least a resistor of about 1000 ohms. The lights of the retroiluminated buttos may require additional series resistors.
- 48 Schottky diodes
- A Teensy++ 2.0 board (available at `https://www.pjrc.com/teensy`)
- Interconnection wires

2.2 Firmware

The compiled firmware can be downloaded from `http://www.dte.us.es/Members/guerre/firmware_arcade/at_download/file`. The source code is available at `https://github.com/gambaman/ArcadeJoystickX4PlusSimonGame`.

2.3 Software

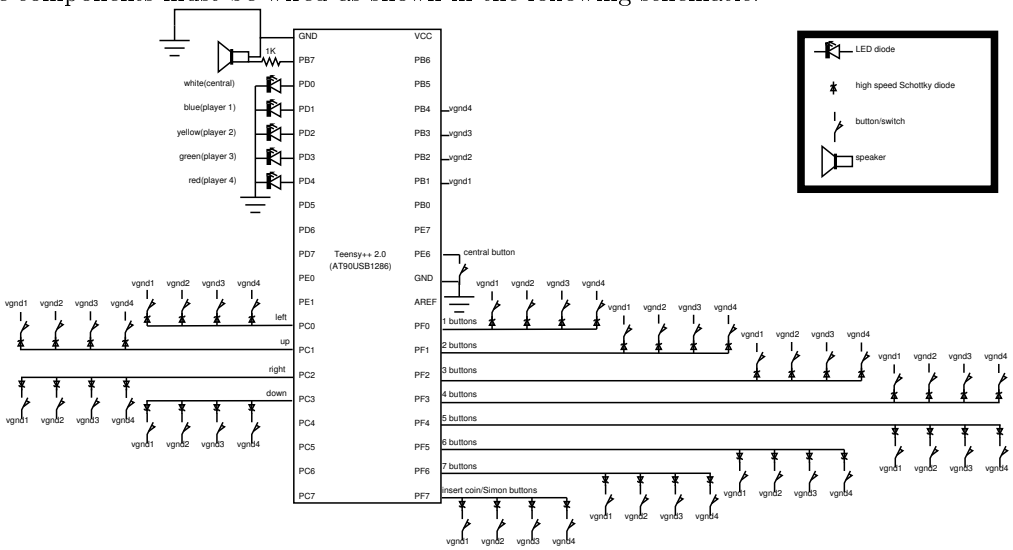
In order to program the board you will need the Teensy Loader application available at `https://www.pjrc.com/teensy/loader.html`. If you also want to recompile the firmware you will need the avr-gcc compilator (`http://www.nongnu.org/avr-libc/`) as well as the GNU Make tool (`http://www.gnu.org/software/make/`).

Of course, in order to enjoy playing you will need games and/or emulators, for example the MAME emulator (`http://mamedev.org/`).

3 Building

3.1 Hardware

The components must be wired as shown in the following schematic:



The blue, yellow, green and red retroiluminated insert coin buttons must be connected to the lines vgnd1, vgnd2, vgnd3 and vgnd4 respectivelly. The white retroiluminated button is tagged as "central button" and has special functions. Note that, in my case, the lights of the retroiluminated buttons can be connected directly to a voltage of 5V like the one generated by the board. Other models may require additional series resistors in order to limit the current throught the LEDs. In case of doubt look at its datasheet.

3.2 Firmware

3.2.1 Compiling

This step is not required unless you want to modify the source code. From a terminal/command line go to the folder/directory containing the source code and execute the following:

- make clean
- make

This will generate a .hex file containing the compiled firmware. After connectig the teensy board you can program it as shown in the next section or, if you have installed the command line version of the teensy loader application, program it directly by executing this:

- make program

You will be requested to push the button of the teensy board. Do so and the firmware will be downloaded.

3.2.2 Programming

You can find a detailed description of the following stelps at `https://www.pjrc.com/teensy/loader.html`.

- Connect the teensy board to your computer.
- Execute the teensy loader application.
- Push the botton of the teensy board.
- From the File name, choose "Open HEX File" and open the .hex file containing the firmware to be programmed.
- Select "Program" from the "Operations" menu, or click the Program button on the tool bar. You should see the "Download Complete" message.
- Choose "Reboot" from the "Operations" menu, or click the Reboot button on the tool bar.

3.3 Software

When connecting the system to your computer it will recognize a set of joysticks. No special drivers should be needed. However, if the system is going to be used with arcade emulation software you will need to configure the emulator properly. First you will need to set the first four detected interfaces as the joysticks of the players 1, 2, 3 and 4. Also you will have to set the last button of each joystick as insert coin button. The fifth interface is used for interacting with the emulator and is not linked to any joystick by default (see the next section). You will have to configure its buttons for tasks such as pausing the emulation, reseting the emulated system, etc.

4 Usage

4.1 Interacting with emulators

Sending commands to the emulator (for example to pause or quit the emulation) requires setting one of the joysticks as emulation controller. To do so, while pushing the white retroiluminated button, push the insert coin button of the joystick to be set as emulation controller. That button will light up to indicate that the associated joystick does not work as game controller anymore. Its buttons will have associated the functions you configured in the previous section. If you want to change the joystick to be used as emulation controller repeat the previous step but pushing the insert coin button of another joystick. You can make the joystick used as emulation controller work as game controller again.

To do so just press its insert coin button again while holding the retroiluminated white button pressed. After that the insert coin button will light down.

4.2 Getting credits

In order to obtain credits you will have to play the embebed Simon game by following these steps:

- Push the white retroiluminated button. All the insert coin buttos will light up.
- Select the skill level by pushing one of the insert coin buttons. The following table describes each skill level.

color of the insert coin button	yellow	blue	green	red
maximun length of the sequence	8	14	20	31
credits obtained when winning the game	1	4	16	unlimited

- The system will generate sequences of lights and sounds. Reproduce those sequences by pressing the buttons till the white button flashes. That will indicate you have won the game and got one or more credits. The white button will keep shining as long as you have credits.

4.2.1 Cheating

The sequence lengths shown in the previous table are those of the original Simon game. However, it is possible to halve the maximun length of the sequences. To do so just push exactly three times the white retroiluminated button before selecting the skill level.

Acknowledgments

The firmware is based on the Teensy Gamepad proyect by Josh Kropf (josh@slashdev.ca) which in turn is based on the keyboard example for the Teensy board (`http://www.pjrc.com/teensy/usb_keyboard.html` , Copyright (c) 2008 PJRC.COM, LLC).

The Simon game replication was possible thanks to the reverse engineering carried out by Simon Inns (`http://www.waitingforfriday.com/index.php/Reverse_engineering_an_MB_Electronic_Simon_game`).