Monkeys, Marbles & Trackballs

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Introduction

The motivation of our project is to create a fun arcade game at the intersection of the interests of our group in interesting hardware devices, silliness, and computer graphics. Our fascination with the trackball hardware device, as shown in Figure 1, inspired us to design an arcade console and a video game that uses the trackball as its main input source.

In order to find a game that best utilized the trackball input without requiring a full 3D environment, we took inspiration

Figure 1: Trackball

Figure 2: Super Monkey Ball & Marble Madness

from games like Super Monkey Ball, Marble Madness, and the bonus stages from some of the old Sonic games, which all feature spheres moving around perceived three-dimensional planes but are actually rendered in two dimensions. This allows our game to use the full range of motion of the trackball while keeping the scope manageable, and we thought the trackball would pair perfectly with this style of game!

For this project, we would turn the FPGA into an arcade machine, allowing for reset capabilities, video output, input from buttons and a trackball, and any other features we encounter as necessary for an arcade machine. We would then have to design a device driver for our trackball and any buttons we use. Lastly, we would be designing our game from scratch using the previously mentioned games as inspiration, all of which are shown in Figures 2 and 3.
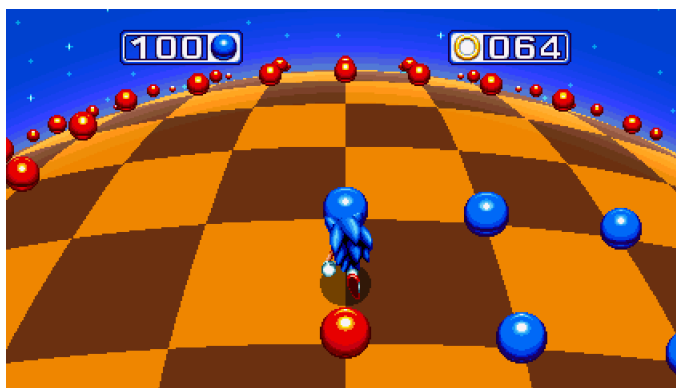
Figure 3: Bonus Stage, Sonic Mania

Hardware

The main component of our project will be the FPGA, which we will configure to function similarly to an 80s style arcade cabinet. This means that we will, at the very least, be designing our own audio and graphical processing units on the FPGA. For the actual core processor, we may choose to also create our own on the FPGA similar in power to the Z80 or 6502, though we may choose to just use the HPS for that purpose. We will also be designing device drivers for the trackball and any other buttons or input devices we decide to use, and may need custom device drivers for the output. In addition, since this game requires efficient collision detection, we could develop custom hardware to detect and process collisions in parallel.

Software

The game we will be designing will be similar to Super Monkey Ball and Marble Mania, in that the main playable character will be some kind of ball that can be controlled via the track-

ball. The core gameplay is not yet finalized, but will likely be a hybrid of the two aforementioned games. We will most likely use a 2D isometric display with sprites, rather than any sort of 3D rendering, due to hardware limitations. We will handle gameplay elements like score and success/fail-states in software.

Major Tasks

- Design the game and user interface.

- Drivers to interface with buttons the trackball, and audio peripherals.

- Iplement software to render the game world.

- Decide on and implement a collision detection algorithm (and decide if this should be implemented in software or hardware).