Mudd Adventure

Group members: Mingrui Xu, Wei Cao, Shijie Hu, Bowen Dang

Contents

- 1. Overview

- 2. The architectural and timing design

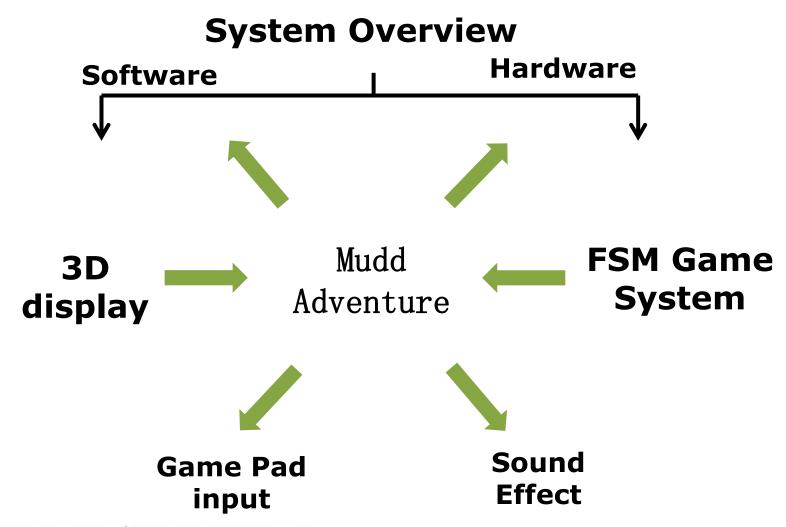- 3. Difficult parts

- 4. Performance

1.1 Overview

3D maze Adventure： The goal of this project is to develop a 3D video game with turn-based 2D fighting system. The player explores the 3D map and the mission of the game is to destroy all the enemies in the map and finally arrive the destination. A gamepad will be the game controller as an input. Also the sound effects will be sent from the speaker during the game.
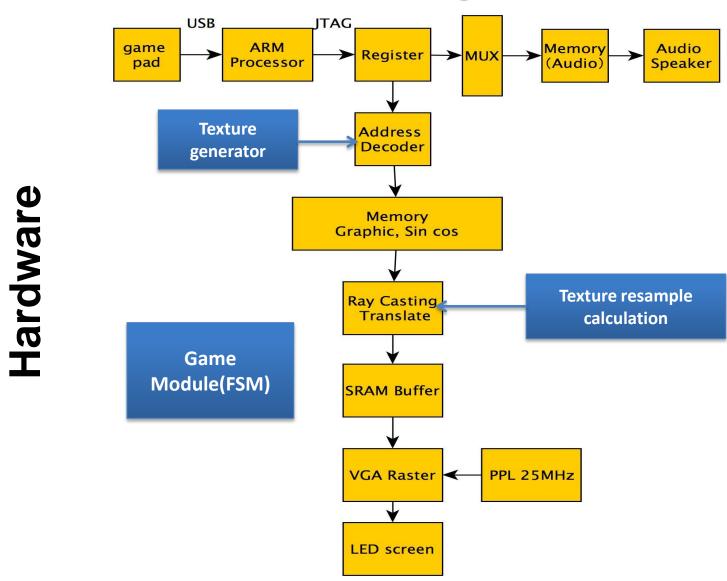
Functionality Graph

System Overview

Software   **Hardware**

3D display   →   Mudd Adventure   ←   **FSM Game System**

Game Pad input   **Sound Effect**

COLUMBIA ENGINEERING
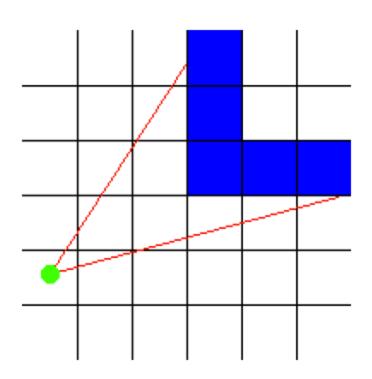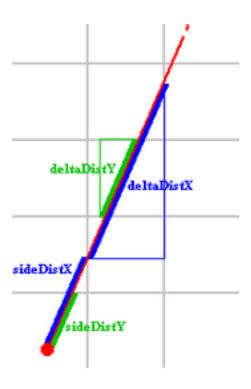The Fu Foundation School of Engineering and Applied Science

2.1 The architectural design

Hardware

2.2 Software

2.3 Timing design

1. FPGA parts works under 50MHz clock. The VGA pixel scanning frequency is 25MHz, and frame frequency should be no less than 25Hz.

2. One Frame time/# of pixels= $1/25/(480\times640)=1.3\times10(-7)$ s$\rightarrow$7.69MHz

3D ray casting block works under 50MHz clock, so every pixel has about 6 clock periods to do transform.

3 Difficult parts

- 1. 64 bit data transformation

- 2. Texture resample calculation

- 3. Timing analysis

- 4. **Gameplay based on FSM**

3.1 Difficult parts

- **1.64 bit data transformation**

    Control signals(gamepad, FSM, random number) (8 bits) + Raycasting results (20 bits) + Texture calculation results (22 bits) = 50 bits !

    Software kernel: 32 bits

    Use twice of order "iowrite32" and two RAMs in the hardware to store them and combine in a 64-bit variable

3.2 Difficult parts

- 2. Texture resample calculation

  Graph .mif file: 128*128*24 bits

  Two factors to locate the appearance of the graph and scale it with the resample coefficient.

  Method: Scan the screen from the bottom

  Division operation in software (Rescale the coff)

3.3 Difficult parts

- **3.Timing Analysis**

  Slowest clock frequency : 7.54 MHz

  $\longrightarrow$ noise points all over the screen

  Method: Lower the VGA resolution from 1280 to 640

  Do division calculataion in the software

  Use RAMs to store writedata

3.4 Difficult parts

- 4. Gameplay based on FSM

4 Performance

In summary, after solving these problems, our game can perform quite well. But there is still some problems with voice output remaining to be solved.

Now let's see it!

COLUMBIA ENGINEERING
The Fu Foundation School of Engineering and Applied Science