CSEE 4840 Embedded System
Galaxian

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Introduction

Control with ps2 keyboard
Star background is implemented
Audio block is enabled

Game play

Player has 5 spaceships
Ship can only move left and right at the bottom
A matrix of swarm fluctuate back and forth on the top
Swarm can fire bullet
Goal: Shoot the swarm until all the enemies destroyed.
Several wave is designed
High score will be recorded.
Star background

- **Phase bias:** 4 different phases of stars
  - implement: counter based

- **Color:** changing every time star flash
  - Color is assigned as an register rather than a constant

- **Position distribution:** Biases on one base address
  1. Horizontal: uniform distributed
  2. Vertical: nearly randomly distributed
• 3 Different kinds of bees
VGA

- Bee Matrix
VGA

- 360 Degrees Bee Direction
Connection with Software

- Fast Moving Objects Synchronization
  - \texttt{vga_vsync} = ‘1’ and \texttt{vga_hsync} = ‘1’

- Time Synchronization

\begin{align*}
\text{start\_count} &= ‘1’ \\
\text{data\_send\_back} &= ‘1’
\end{align*}
Keyboard

- Use the de_ps2 vhdl file in Lab 3 audio part
- Only implement the read interface
- Use the data read from keyboard with logic condition to eliminate subtle stuck when moving
Audio

Connect to the Avalon bus

Audio_driver

-Modified version from Lab 3 audio part
-Use ROM to store music files
-Audio_driver implement the connection interface

wm8371
Audio(Cont.)

Connect to the Avalon bus

- `wm8371` implement the main function

- Involve discussion with Team Battle City
Software

- **IOWR_32DIRECT**(base, address, data)
  - **IOWR_32DIRECT**(VGA_BASE, address, data) to write data to VGA
  - **IOWR_32DIRECT**(AUDIO_BASE, address, data) to write data to AUDIO

- **IODR_32DIRECT**(base, offset)
  - **IODR_32**(VGA_BASE, 0) to read data from VGA

- **IODR_8DIRECT**(base, offset)
  - **IODR_8DIRECT**(PS2_BASE, 0)
  - **IODR_8DIRECT**(PS2_BASE, 4)
Main Moving Objects:
- 36 Alien Enemies
  - 20 Green (slowest)
  - 8 Purple (fastest)
  - 6 Red (median)
  - 2 Command (median)
- Spaceship
- Bullet from Spaceship
- Bullet from Enemy
Software

• Other Objects
  • Explosion
  • Start Screen
  • Game Over
  • High Score
  • Current Score
  • Level
  • Player Life
  • Ready
  • Pause
Enemy Movement

- Enemy randomly flying down
- Enemy flying down in a circle
- Enemy turning around when flying back
- Enemy tracing the position of the spaceship
- Enemy facing to the spaceship while flying
- Command enemy with two guards flying together
- Formation moving left and right
- Bullet from the enemy
- Bullet from the spaceship
Collision

- Enemy hits the spaceship
- Bullet from the enemy hits the spaceship
- Bullet from the spaceship hits the flying enemy
- Bullet from the spaceship hits the enemy in formation
Conclusion

- Communication between Hardware and Software
- Timing
- Team Collaboration
- Have Fun!