

Pong

EDA385

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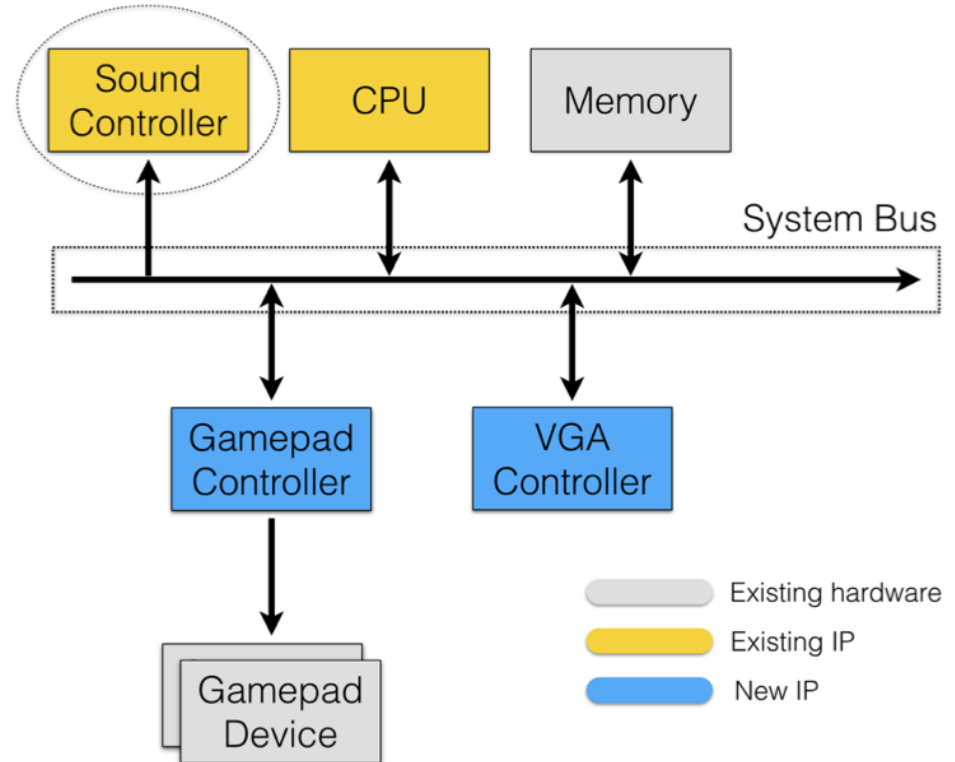
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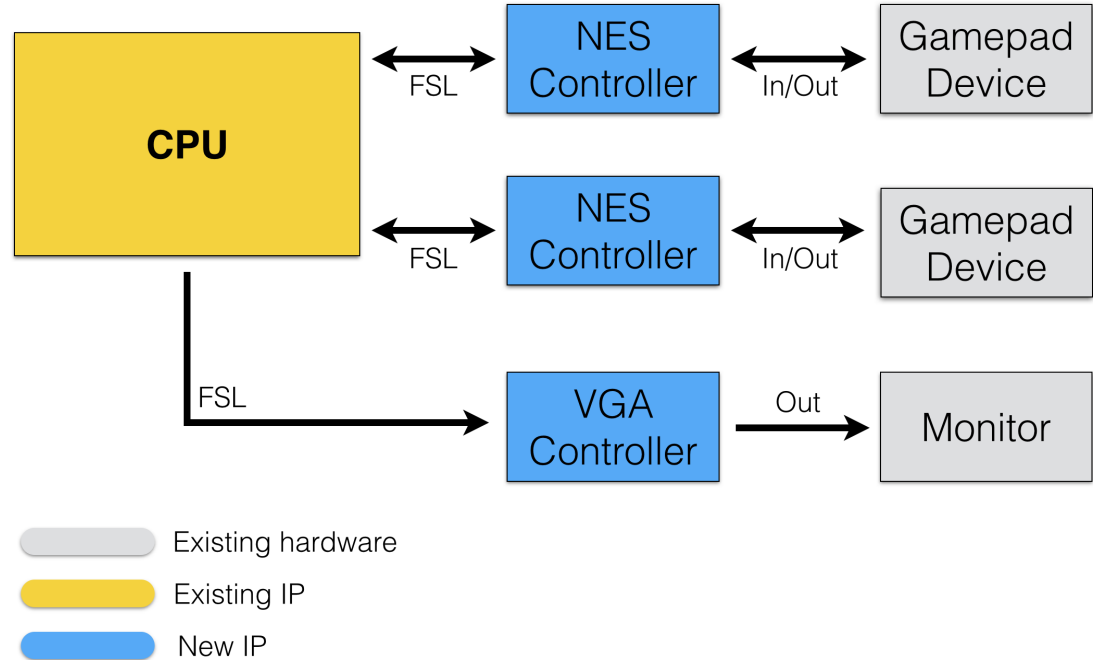
Proposed Design

- System Bus
- Memory
- Optional Sound Controller



Final Design

- No System Bus
- No memory
- No Sound Controller
- AI
- Two balls



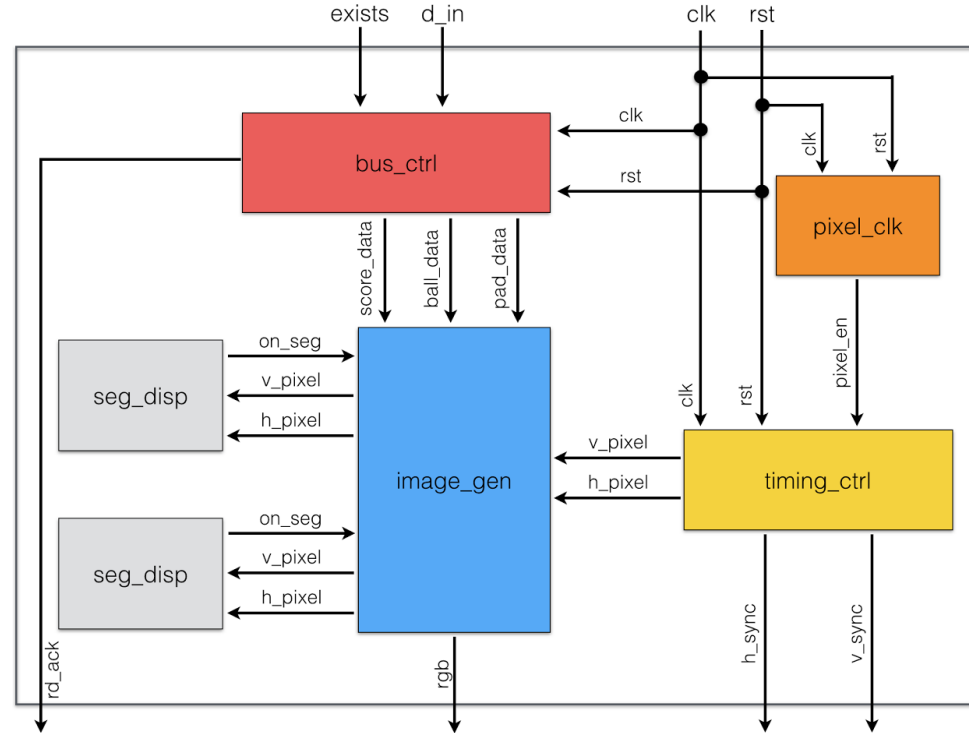
Design Utilization

Slice Logic	Utilization
Number of Slice Registers	8%
Number of Slice LUTs	24%
Number of occupied Slices	39%

IP	Flip Flops used	LUTs used
Whole System	2412	2884
VGA	122	347
NES	50	68

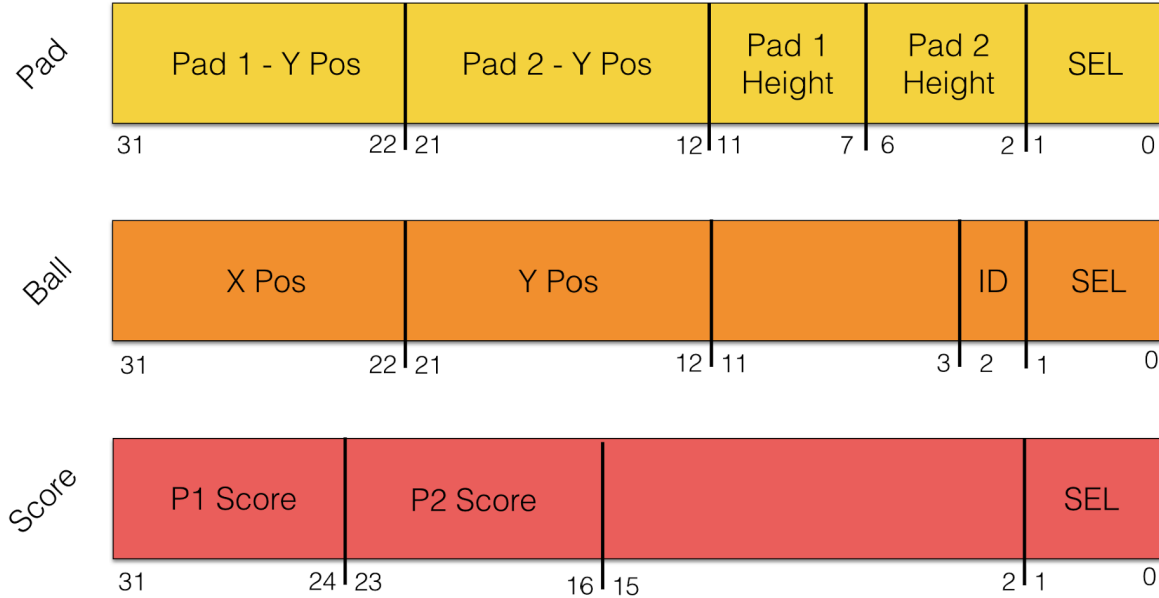
VGA Controller

- 640x480 pixels 60 Hz
- Black and white
- Generates image from position data
- One way communication CPU to VGA



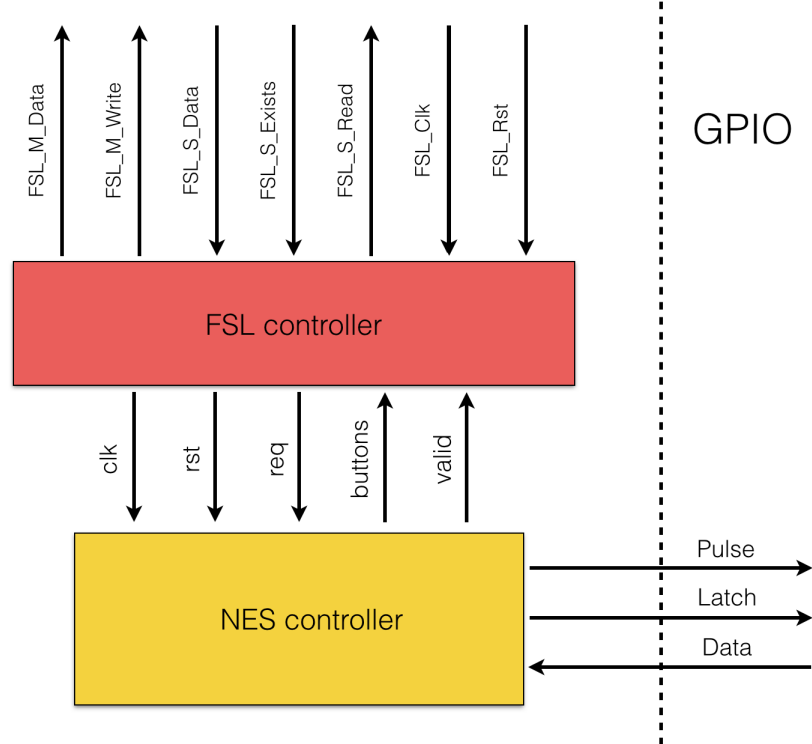
VGA Controller

- 32 bit FSL bus
- 3 instructions
- 2 bit op code



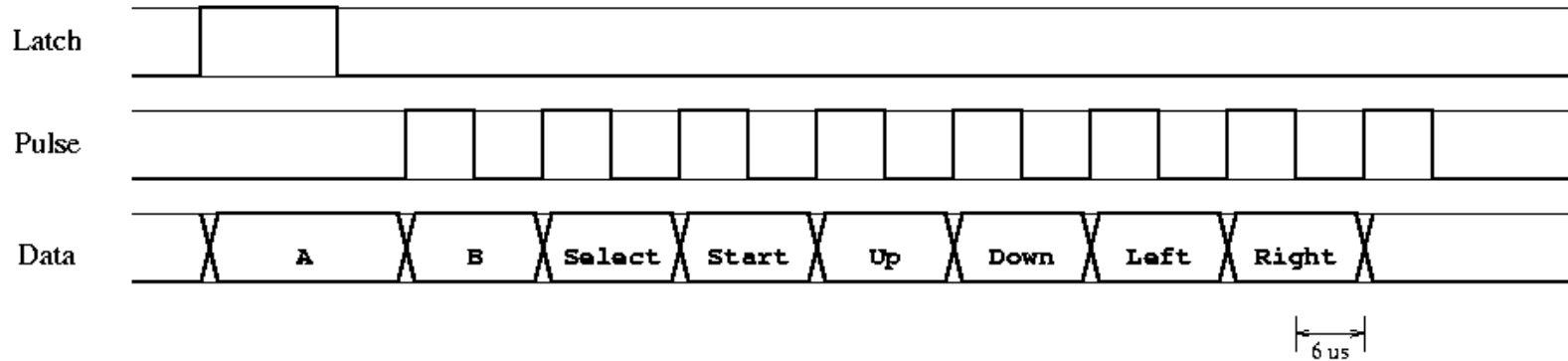
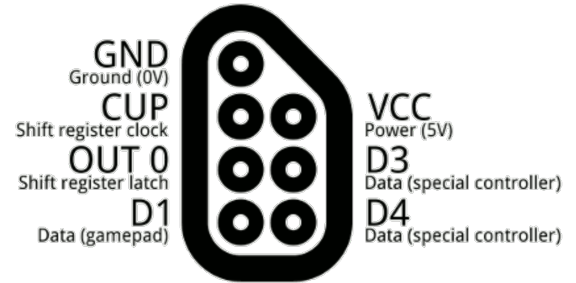
NES Controller

- Duplex FSL
- Reads gamepad 60 Hz
- Internal Shift register, 8 bits
- Uses GPIO



NES Gamepad

- Internal Shift register, 8 bits
- All button presses captured
- Runs on 3.3V, originally 5V



CPU Software

- Written in C
- Game data in structs and pointers to structs
- Software driver for VGA controller
- Uses a game loop
- Blocking FSL to read and write
- AI implemented in software

Problems & Solutions

- Unstable connection to gamepad
 - Possible solution: get a female connector
 - Possible solution: cut the cable, scale wires
- Flickering on screen
 - Solution: small timing adjustments in vga controller
- Problems with displaying colors
 - Unresolved problem
 - Solution: don't use any colors!

Problems & Solutions

- Weird ball bounces
 - Solution: debug code
 - boundary conditions
- Problems with realistic 2-ball AI
 - Solution: make a perfect AI

Lessons Learned

- Testbenches with higher coverage
- Write tests for software
- Divide work and tasks in a group

The end

Thank you for listening!