Let’s Dance

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What is *Let's Dance*

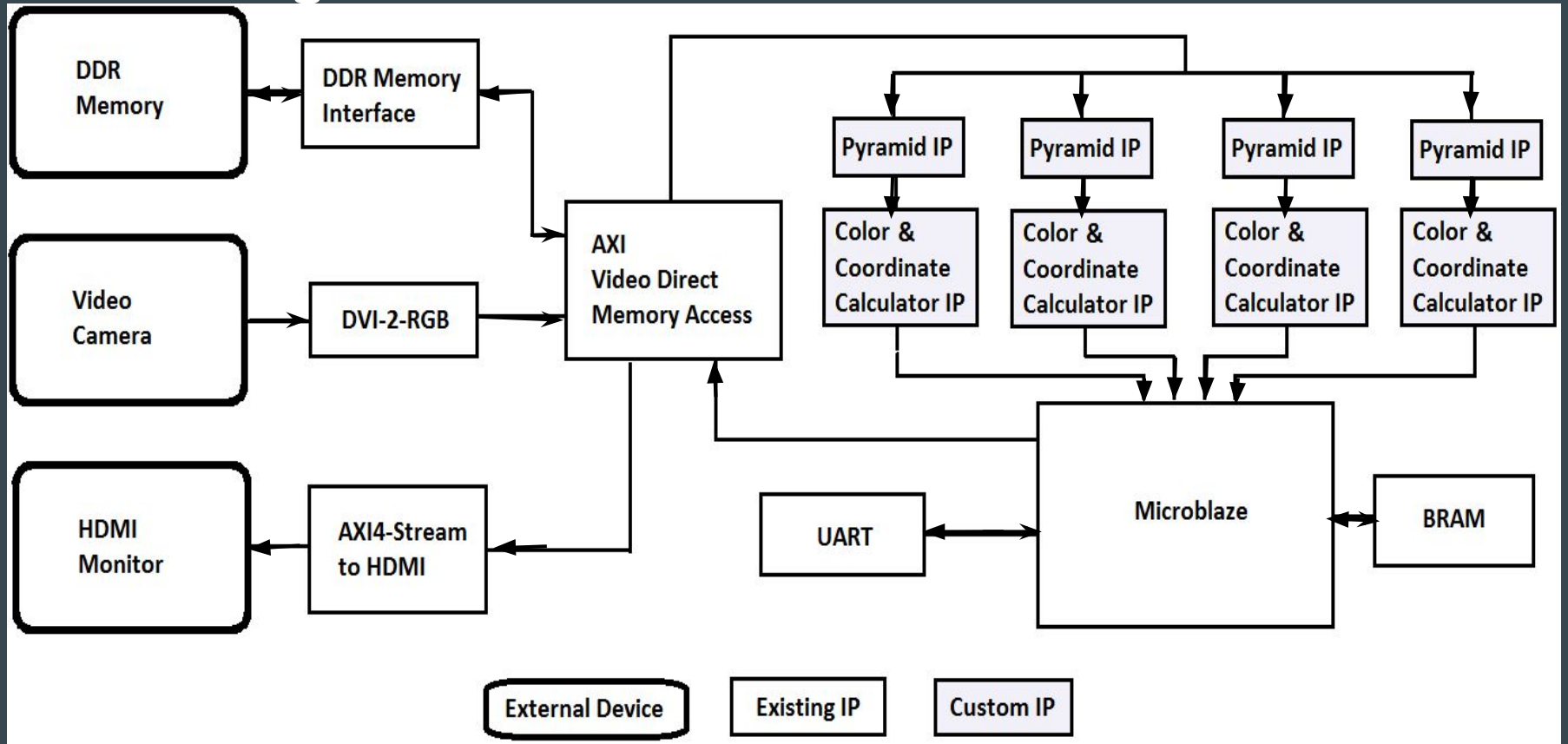
- Dancing Game
- Colour bands around wrists and ankles
- Dance instructions on screen
- Move hands & legs as indicated to gain points
- See how you dance on the screen

Our Goal Is...

Creating a videogame that

- guides users to dance
- is able to recognize the movements
- reports the performance of the player
- is easy to learn and enjoyable to play

Initial Design



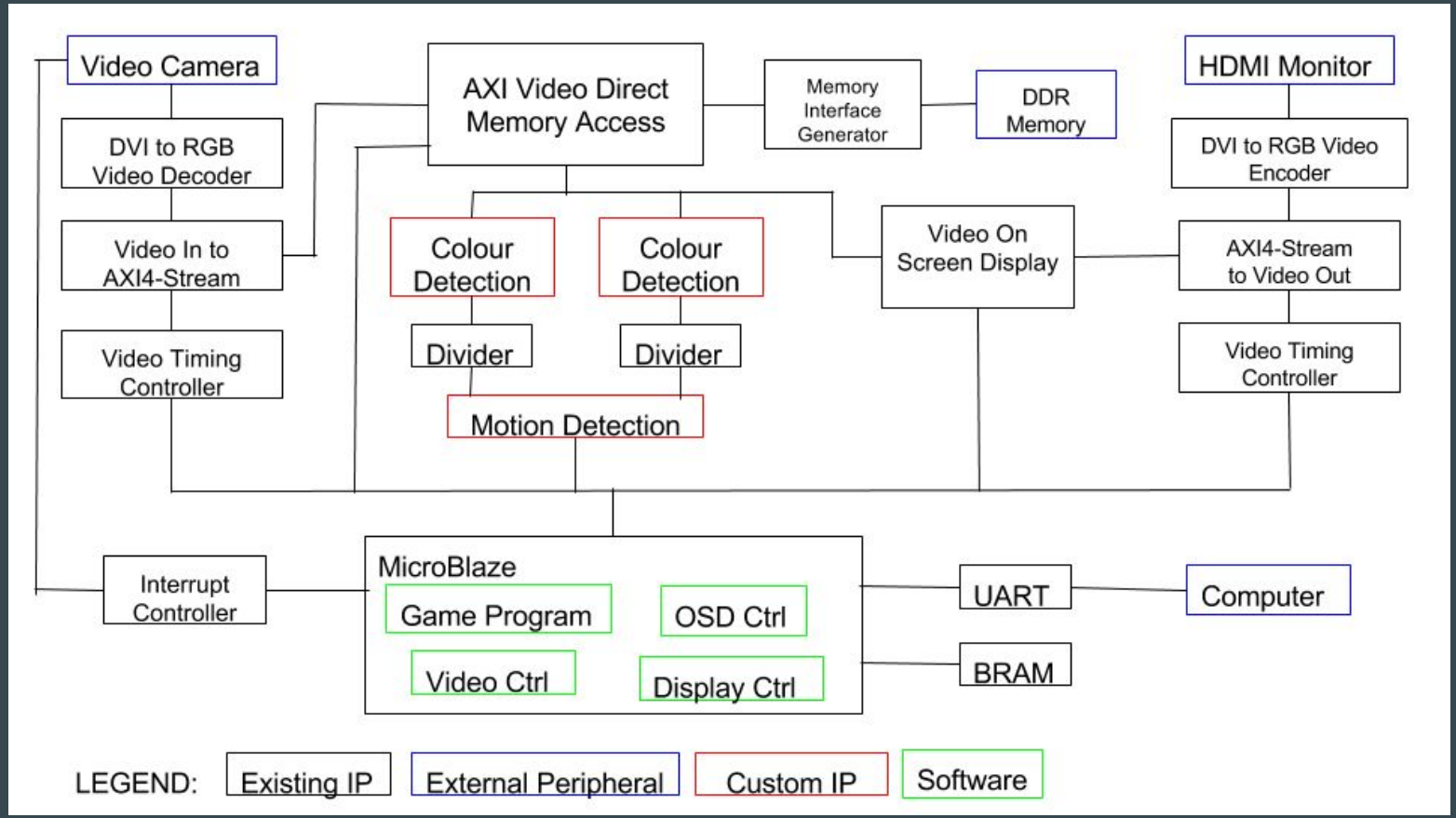
Major Changes & Updates

- 16:1 Pyramid IP is dropped
  - AXI VDMA feeds one pixel at a time, in sequence
    - Time complexity is fixed
  - Impact:
    - \+ Higher accuracy
    - \- More delay
- Motion Detection IP is added
  - Software -> Hardware
  - Impact:
    - \+ Less workload for MicroBlaze
    - \+ Faster

Challenges & Modifications

- Timing violation and resource depletion
  - Cause: division in Verilog: *avg = sum / counter*
  - Solution: pipeline *Division IP* (less expensive)
- Color detection
  - Cause: environment lighting, material
  - Solution: trial & error
- Motion detection
  - Cause: disturbance in the movements
  - Solution: accepts imperfect movements within a certain range

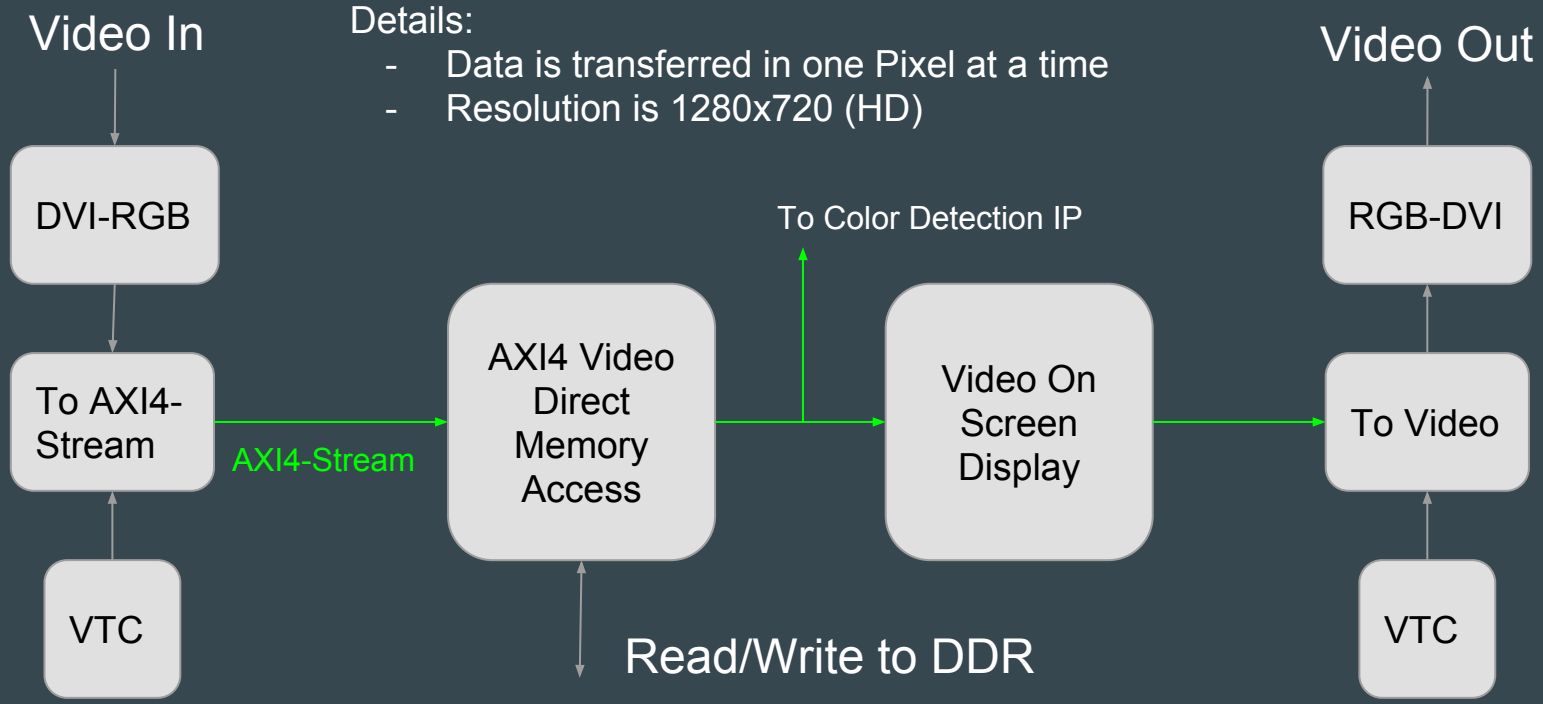
Final Design



System In General

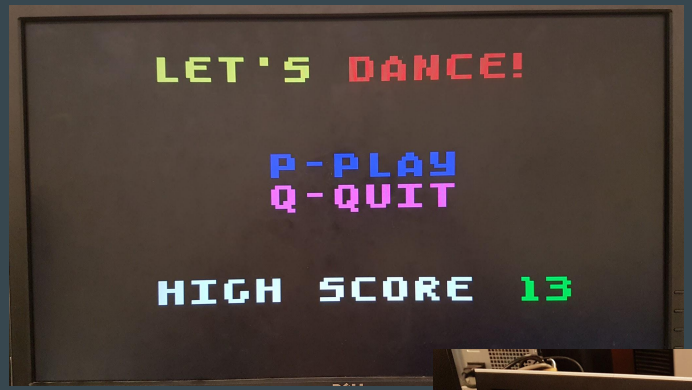
- Custom IPs
  - Color Detection IP
  - Motion Detection IP
- Existing IPs
  - AXI4 Video Direct Memory Access
  - DVI-RGB Video Decoder
  - RGB-DVI Video Encoder
  - Memory Interface Generator
  - Video On Screen Display
  - Video In to AXI4-Stream
  - AXI4-Stream to Video Out
  - BRAM
  - Divider Generator
  - Video Timing Controller
  - AXI4-UART
  - AXI4 Interrupt Controller

System In Details - HDMI/Video

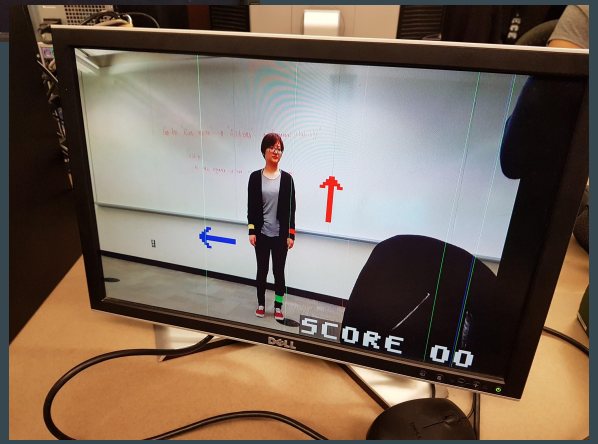


System in Details - Video On Screen Display

- Uses the concept of layers:
  - Video (Base Layer)
  - Graphics (Layer 1)

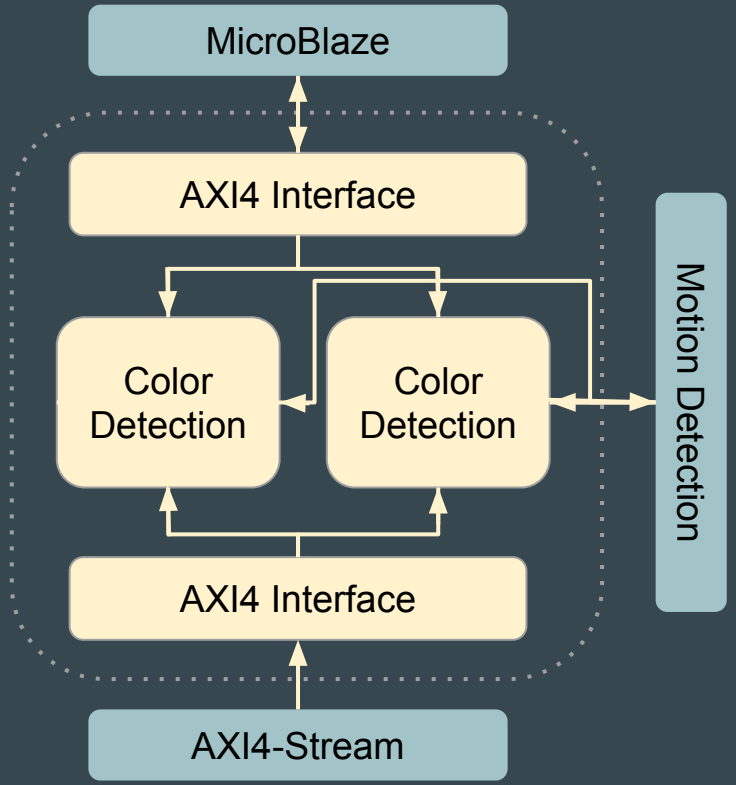


- Graphics Controller:
  - Draw Boxes and Text
  - Colours/Fonts loaded into **banks**

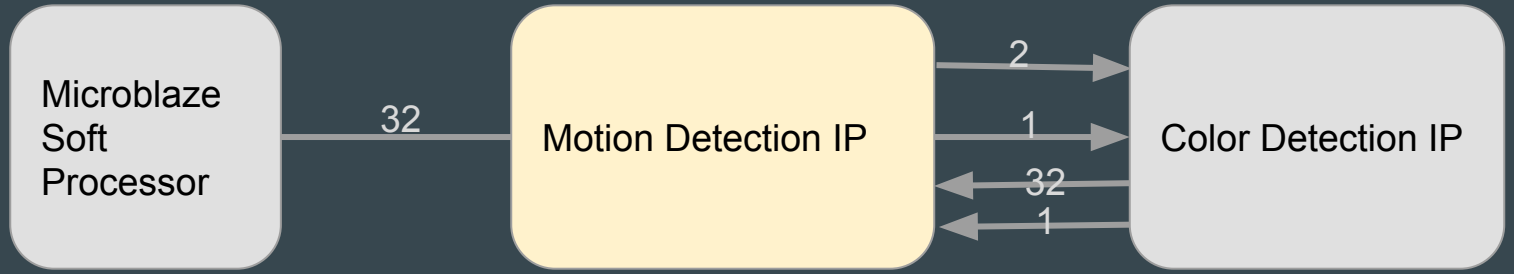


System In Details - Color Detection IP

- Color Detection Core
  - Enabling signal - Motion Detection IP
  - Desired colour - Motion Detection IP
  - Pixel data - AXI4-stream
  - Sampling rate - MicroBlaze via registers
  - Finds the average position of desired colour
- AXI4 Interface
- Custom AXI4-Stream Interface



System In Details - Motion Detection IP



Reg0
- Motion detection start/stop
- Instructions
- Color code

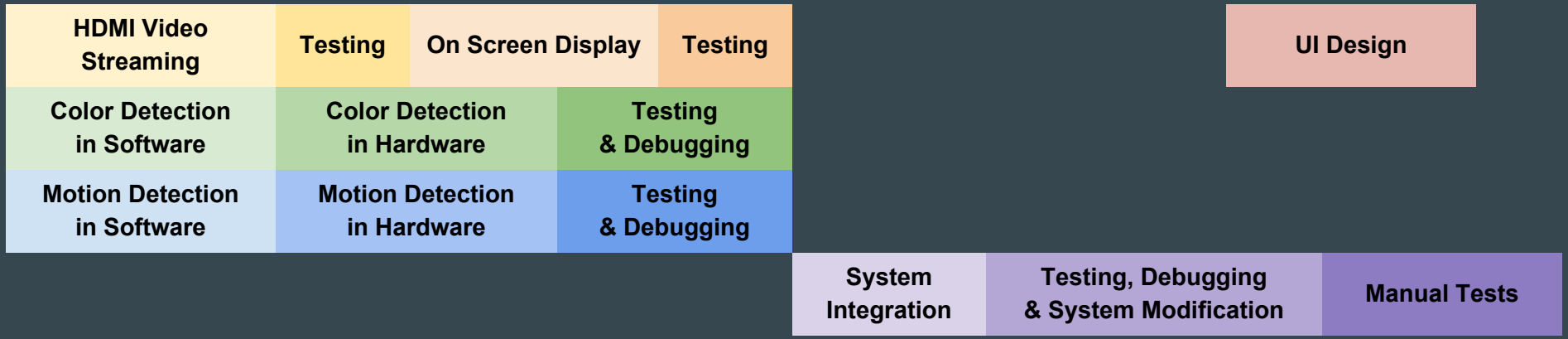
Reg1
- Results
- Results ready

Inputs
- Coordinates ready
- Coordinates

Outputs
- Color detection start/stop
- Color code

Description:
- Checks if a sequence of coordinates of a movement match the corresponding instruction
- Connects to two color detection IPs
- Robust with disturbance in the movements

Design Process & Management



- Software development for feasibility study
- Parallel development
- Unit tests before integration

What We've Learned

- Video processing
- Video data format in hardware
- AXI protocols
- Colour detection algorithm & implementation in hardware
- Motion detection algorithm & implementation in hardware

Now,
Let's Dance!