

Chroma Key Compositing with FPGA

6.111 Final Project

November 6, 2014

Daniel H. Moon

Thipok (Ben) Rak-amnouykit

Chroma Key Compositing

A special effects technique

The “Green Screen” technique

Replaces a specific “color” in a video feed with an image or another video feed



Traditional Method for CKC

Editing happens after video is taken

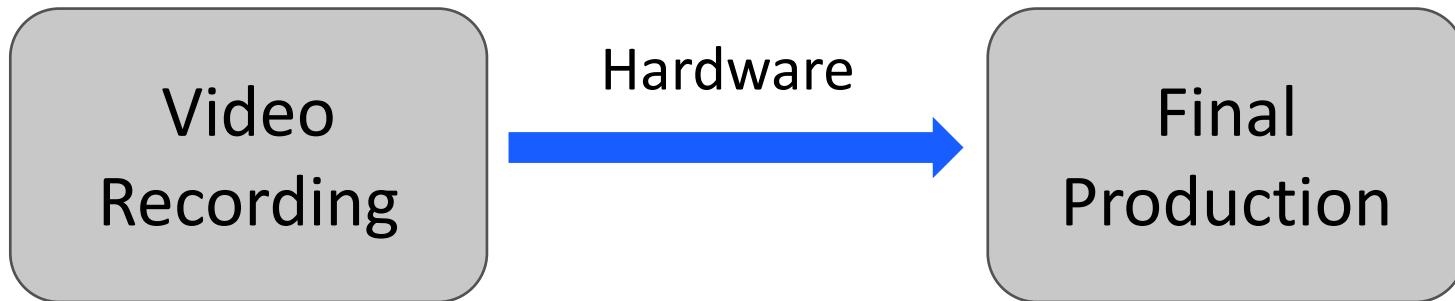
Use software to process the video



How about with hardware?

Replicate Chroma Key Compositing on an FPGA

Process video feeds in real-time



Overview

Receive a video feed with Chroma Key background

Identify the Chroma Key pixels

Replace the pixels with a static image or another video

I – Camera Selection

NTSC camera :

- Low resolution
- Auto-gain to adjust saturation
- Output data in YCbCr format



II – Memory Management with DDR RAM

- External Flash Memory – to store image data
- Image FSM – to load image at startup
- External DDR RAM – to store video data



- Memory Arbiter Module
 1. Coordinate data storage of the video feed and image
 2. Assign storage address to each video pixel
 3. Interface with the RAMs

III – Compositing Selector

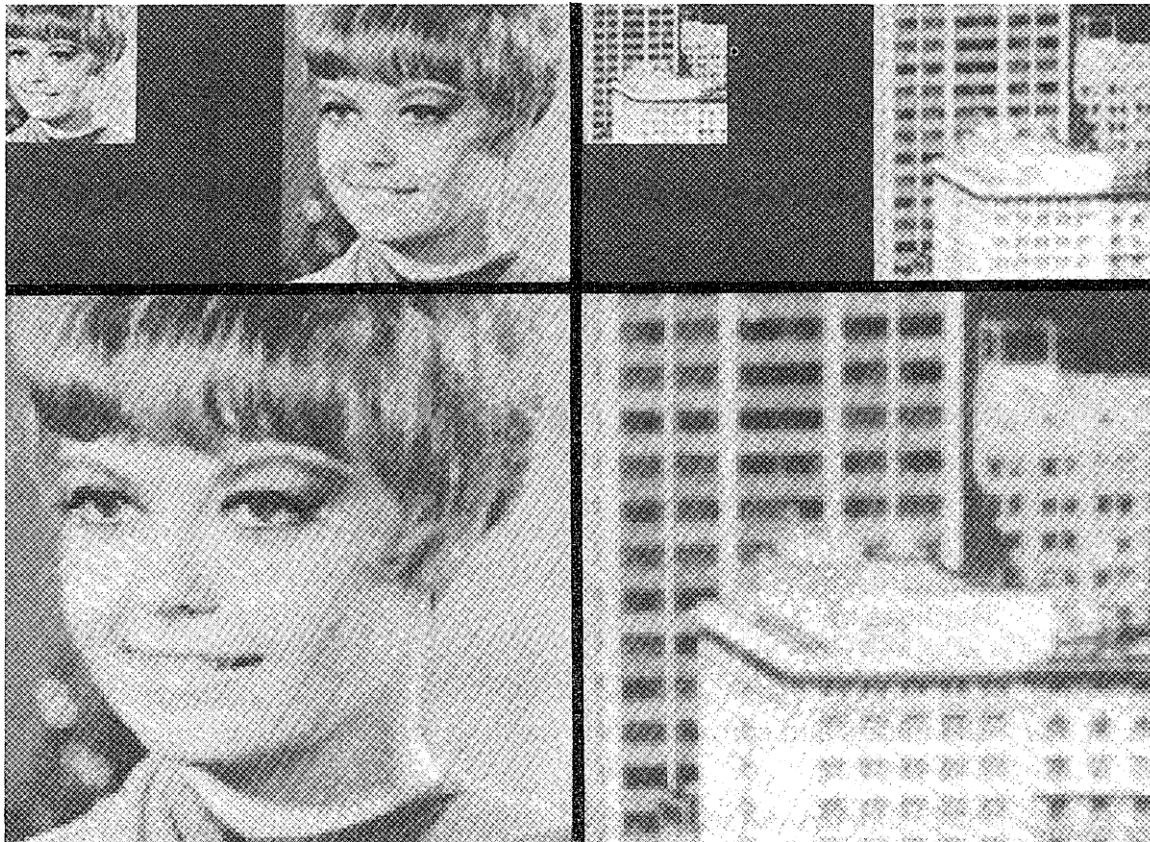
Selector Module:

- Basic – compare and replace selected pixel
- Advanced – implement morphological processing

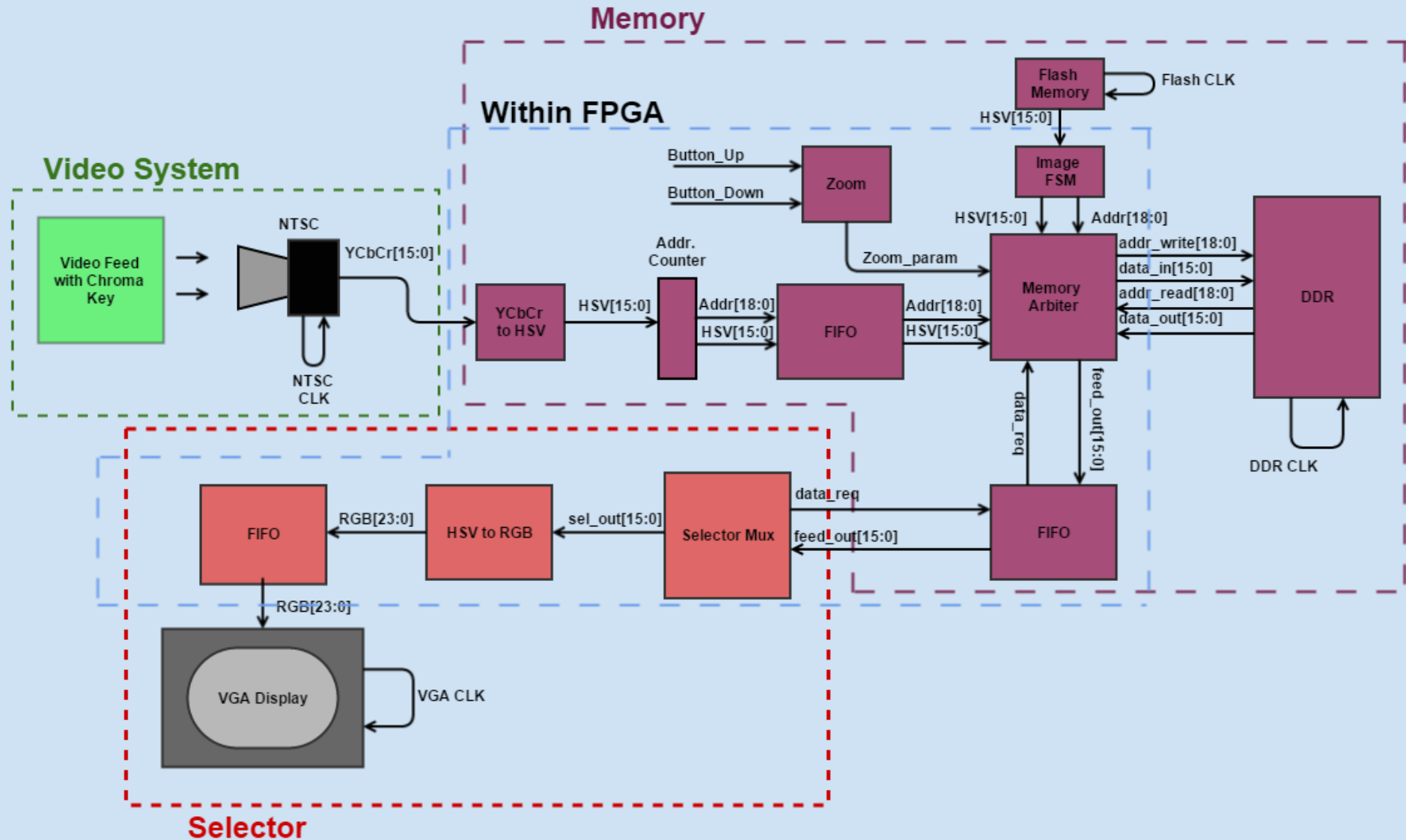


IV – Zooming In and Out

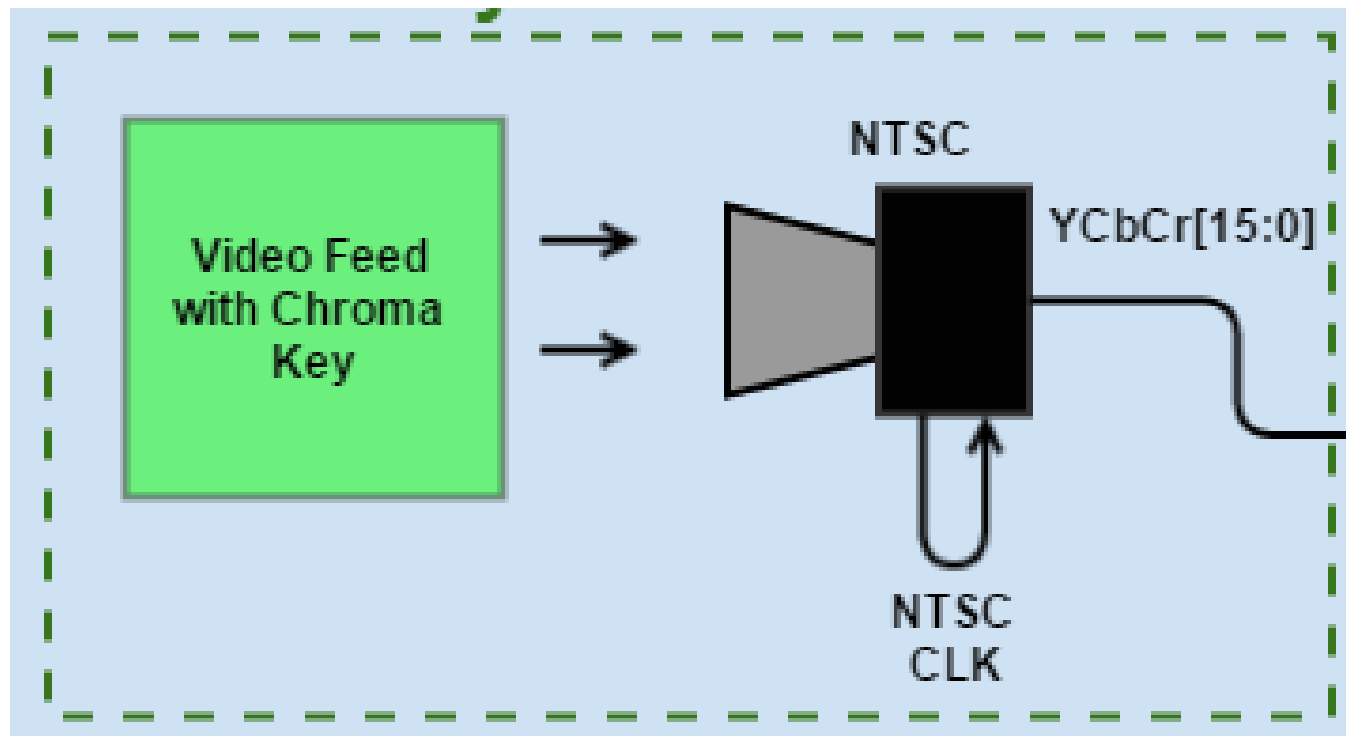
Zero-order Hold Interpolation



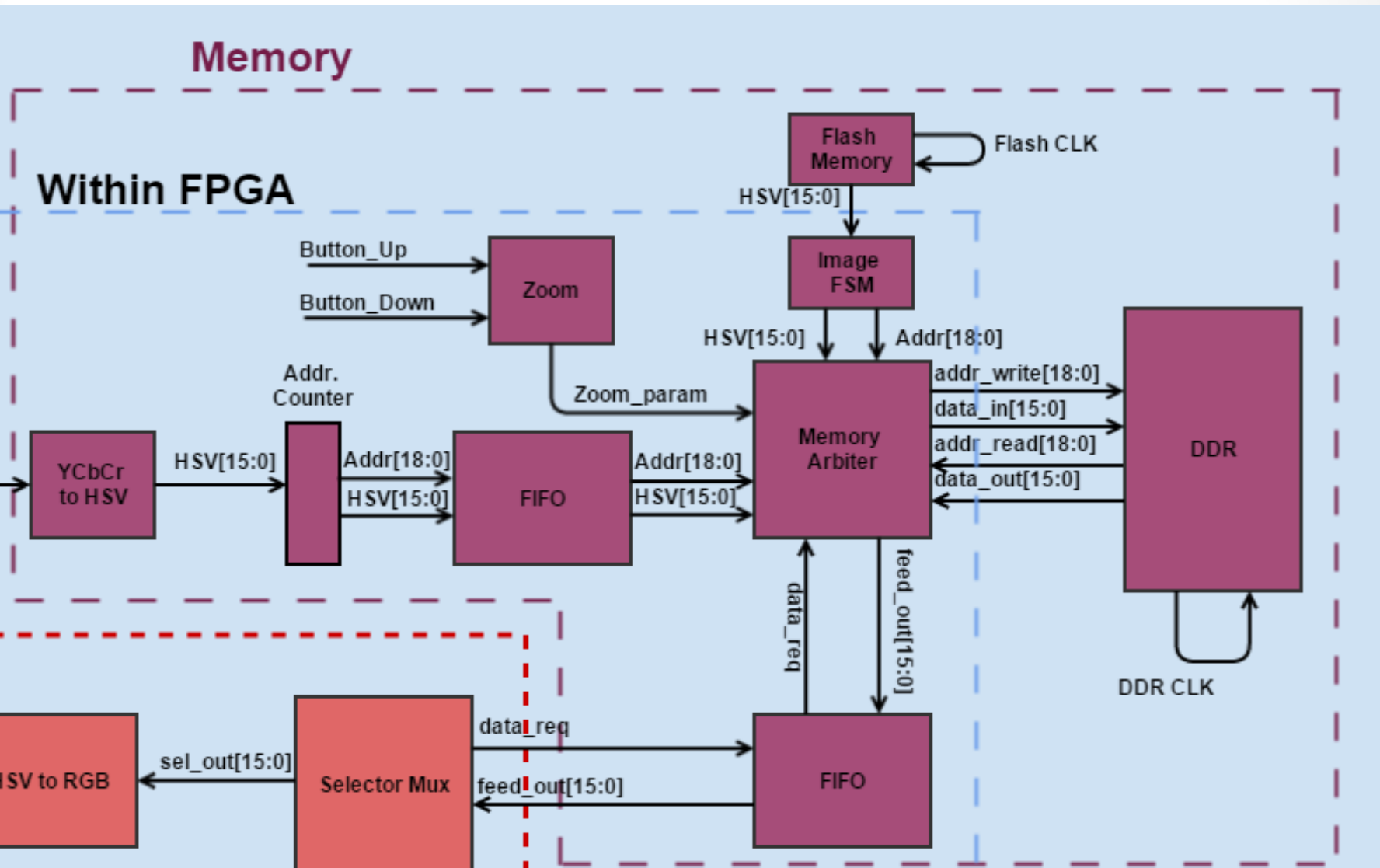
The Block Diagram



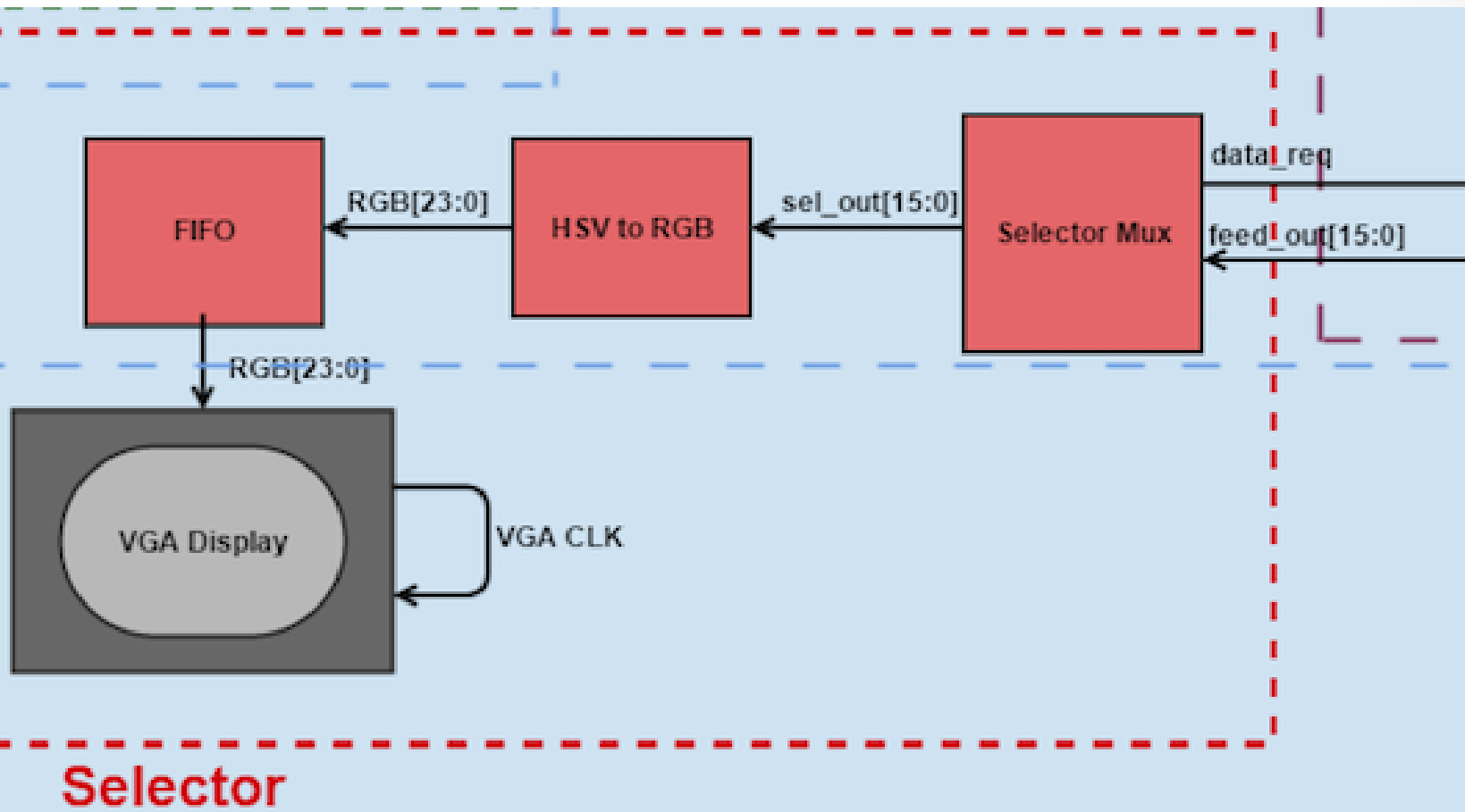
Module I – Video System



Module II - Memory



Module III - Selector



Testing

Test and debug each module separately

1. Video System Module

- HSV pixel streaming with logic analyzer

2. Memory Module

- Data storage and retrieval

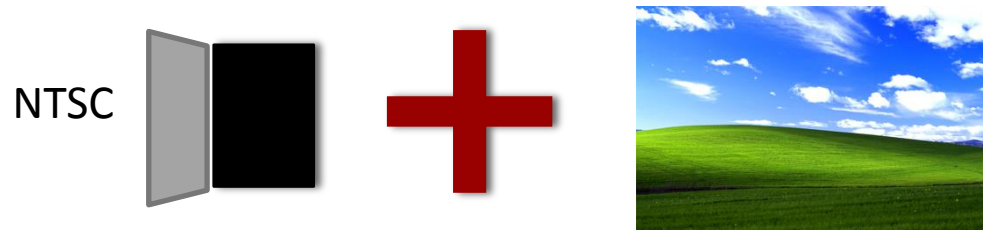
3. Selector Module

- Output resulting composite video on VGA monitor

Testing

Integrate all modules and test with:

1. Video feed with Chroma Key screen + Static Image



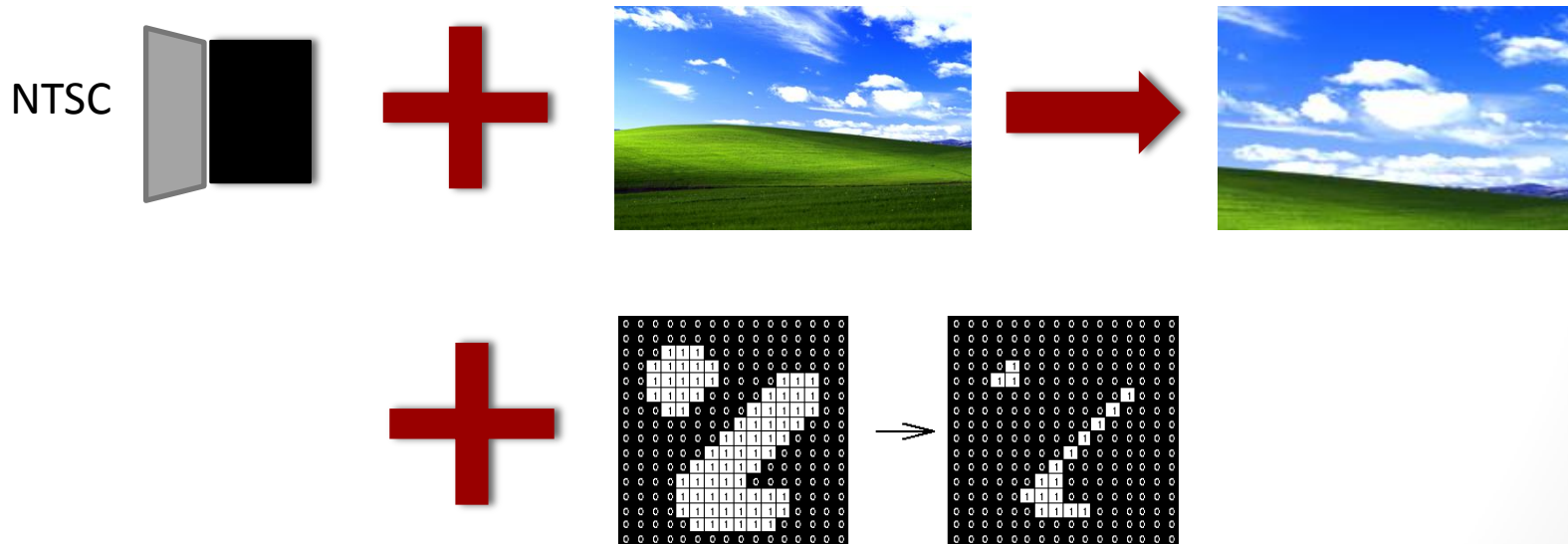
2. Video feed with Zoom – in/out



Testing

Integrate all modules and test with:

3. Video feed with Chroma Key screen + Zoom – in/out + Morphological image processing



Conclusion

Chroma Key Compositing using the FPGA:

Eliminating the need for post-processing

Features

Chroma Key selection, Zooming, and
Morphological processing

Hardware

Chroma Key Screen, NTSC, DDR RAM, and Flash memory.

Modules

Video System, Memory Arbiter, and Selector

Image Sources

- Slide 2: <http://www.ddreams.ca/wp/wp-content/uploads/2013/11/Green-Screen-2700-800.jpg>
- Slide 3: <http://www.aimersoft.com/blog/wp-content/uploads/2014/05/chroma-key.jpg>
- Slide 6: <http://www.intertest.com/media/images/Wat-250D2-cameras.jpg>
- Slide 7: <http://www.bechtle.co.uk/medias/HTULxBTRBTG57M5NkJYV58-30.jpg>
- Slide 8: <http://images2.memedroid.com/images/UPLOADED24/518849d96e228.jpeg>
- Slide 9: http://ict.udlap.mx/people/oleg/docencia/IMAGENES/chapter3/image_321_IS548.html
- Slide 15: http://www.hdwallpapers.in/walls/windows_xp_bliss-wide.jpg