The Video Vitalizer

A system to receive, filter, and reconstruct NTSC video signal in real time for drone first-person video [FPV] applications

A 6.111 Final Project
By Jamie Abel and JT McGuire
Project Overview

NTSC Video Signal

Real-Time Processed Video
Project Overview

NTSC Video Signal

Real-Time Processed Video

Processing Options:
- Level Adjustment
- Edge Highlighting
- Noise Removal
- Data Overlays
Block Diagram - Memory Control System
Convolution Buffer Storage Scheme

**Pixel Storage method:**

<table>
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<tbody>
<tr>
<td>640</td>
<td>641</td>
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<tr>
<td>1280</td>
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**Word:**

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<tr>
<td>1282</td>
<td>1283</td>
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**Output Scheme for Convolution:**

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<td>7</td>
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Memory Interface Explanation
Input and Color Bar Generator Explanation
Output Control Explanation

- Frame Avg Lum
- Frame Deviation Lum
- Block of Nine Pixels
- Blank
- X Position
- Y Position

- inClk = 27 MHz from ADV7185
- SYS Clk = 125 MHz from PLL
- Out Clk = 12.5 MHz for 640x480 NTSC at 30 Hz frame rate

(Memory module outside FPGA)
Average and Deviation Computation
Explanation
Block Diagram - Image Processing System
Use median filter to remove salt and pepper noise
Convolution Filters - Edge Highlighting

Sobel edge filter to highlight obstacle edges for better visibility
Image processing Module

Inputs

- Frame Deviation
- Frame Average
- Pixel [1:9]
- Conv Filter Select Button
- Level Filter Select Button
- Signal Strength
- Antenna Selection
- X pos
- Y pos
- Blank

Convolution Filter

Level Filter

YCrCb to RGB Translator

VGA Clock

Outputs

- pixel
- H sync
- V sync
- Blank

VGA Generator

Text Overlay Module

Font ROM
Level Adjustment

Linear remapping of Y channel values to increase contrast in adverse lighting
Data Overlay

Display current filter state plus additional data (e.g. overall brightness, signal strength)
## Timeline

<table>
<thead>
<tr>
<th>Week of</th>
<th>J. Abel</th>
<th>J. McGuire</th>
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<tbody>
<tr>
<td>8 Nov</td>
<td>Design image filters in MATLAB, create sprites for overlay</td>
<td>Finalize block diagram and system-level design</td>
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<tr>
<td>15 Nov</td>
<td>Write VGA modules, level filters, test on static image</td>
<td>Write and test modules for ZBT memory interface w/ arbitrary values</td>
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<tr>
<td>22 Nov</td>
<td>Write convolution filters, filter control FSM, test as above</td>
<td>Write and test color bar and frame average/deviation modules</td>
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<tr>
<td>29 Nov*</td>
<td>Write data overlay module, image system test on static image</td>
<td>Write and test 9-pixel output buffers and modules</td>
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<tr>
<td>6 Dec</td>
<td>Integrate filters with live camera feed, memory controller</td>
<td>System integration and testing</td>
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<tr>
<td>13 Dec</td>
<td>System demo, report</td>
<td>System demo, report</td>
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