Overview

- To build an Image Browser:
  1. VGA Module
  2. USB Reader
  3. Processing Module
  4. Memories
  5. GUI
  6. Finite State Machine
    - Add switches and pipelines to taste
Memory and Resolution

- Two frame buffers
- Required memory = 2 * (height * width) * 24
- 1024x768? Requires 4.7Mb → 😞
- 800x600? Requires 2.88Mb → ☺
- Choose SVGA
Image Size and Number

• Compress images → 8-bit image (256 color) + color map (MATLAB)
• Three LUT per image (RGB)
• Size limit: 640x480
• Can store 3 images
Display FSM

Three states:

- Load
- Browse
- Edit
Transformations

• Scaling
  – Anti-Aliasing: Zooming out. Displaying a high-res image at a low resolution.
  – Interpolation: Zooming in. Displaying more pixels than image resolution.

• Rotation
  – Nearest Neighbor Rotation
  – Rotation by Sub-pixel Area Average
Scaling

• Anti-Aliasing
  – Bi-Linear \( \Rightarrow \) considers pixels on all 4 sides
  – Coefficients in ROM \( \Rightarrow \) only certain levels of zoom out allowed
  – Without optimization it can take \( O(pS^2) \). \( p = \) #output pix, \( S = \) scale factor

• Interpolation
  – Bilinear \( \Rightarrow \) uses a 2x2 pixel block

\[
\frac{3P_1 + 2P_2 + 2P_3 + P_4}{8}
\]
Timing Constraints

• Interpolating a 2x2 pixelblock requires (S==scale factor):
  – $S^2$ coefficients
  – 4 Multiplications/output pixel
=> 4$S^2$ signed decimal multiplications / block
• 1/60 sec Frame rate with system clock @65Mhz $\Rightarrow 10^6$ clock cycles
• 640x480 = 300k pixels $\Rightarrow$ 3 cycles/pixel 😞
• Solution: Pipelining
Block Diagram

Source Pxs

Rotation Value

Color Table

Buffer

Scalers

Scale Factor

To Framebuf

Rotation Value

Scale Factor

Source Pxs

Color Table

Buffer
## Timeline

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