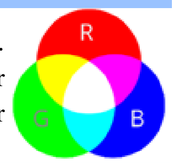
Image Color Filter Using Logic Gates

Students Names: Ezequiel Villanueva & Logan Doizaki Email: evillan5@msudenver.edu, ldoizak1@msudenver.edu
Advised by: Dr. Abdelhamid Elgzil Email: aelgzil@msudenver.edu
Department of Engineering & Engineering Technology | College of Aerospace, Computing, Engineering, and Design (CACED)

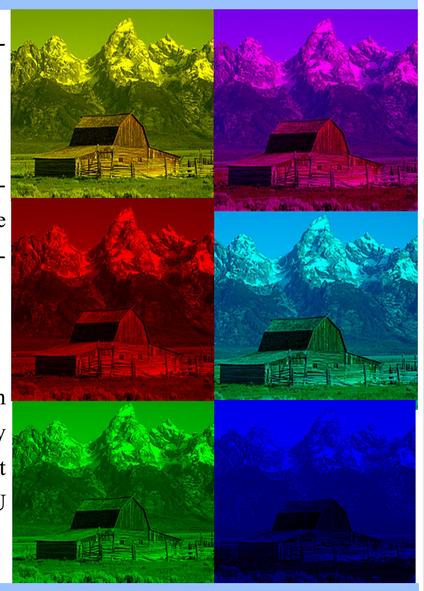
Abstract

A device was developed to take a colored image captured by a camera and apply color manipulation. By using user based inputs, specific colors are filtered. The modified image is displayed to the user and stored internally. Alongside this, a greyscale filter feature was created to show greyscale rather than showing a black image when all colors are filtered out.



Color Filter

The Color filter utilizes logic masks to filter out specific colors from the RGB information that consists of 24-bit color data per pixel.



Circuit:

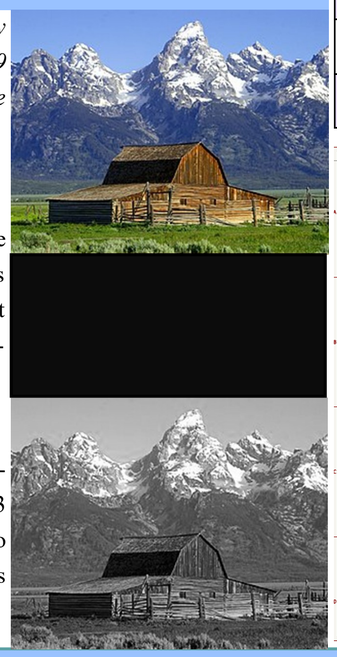
The circuit is built with AND gates, Demultiplexers, and Multiplexers. The Demultiplexers are used to deconstruct 8-bit color data into its individual bits to be sent to the AND gates. The AND gates are used to apply a mask to filter out the user selected colors. The Multiplexers is used for reconstruction of the signal.

Code:

The image taken by the MCU is broken into segments containing the file information and image data. The image data is then transmitted to the color filter through a daisy chain of Shift Registers along with selector bit and mask information to indicate the bit position and filtering to be applied. Once all three 8-bits are sent in parallel, the MCU reads the image provided by the Multiplexer and rebuilds the image 24 bits at a time.

Greyscale

*Greyscale is the representation of color using different shades of gray. Greyscale is achieved by converting the 24-bits of color data into 8-bit greyscale data through the formula: Gray = (0.299 * Red) + (0.587 * Green) + (0.114 * Blue). Since the amount of bits are reduced, there is some data loss.*



Circuit:

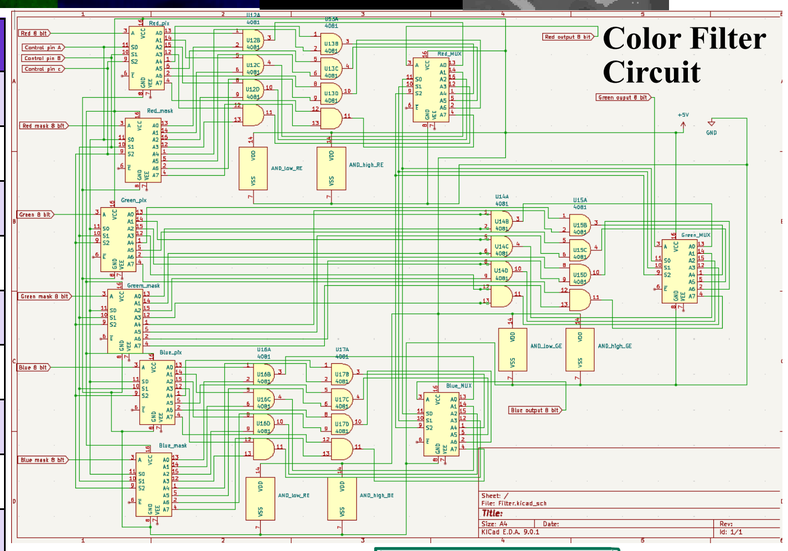
The circuit is built with Shifters, Full Adders, and a Multiplexer. The Shifters and Full Adders are used to perform the gray scale conversion. However, the conversion has a marginal error and is Gray = (0.25 * Red) + (0.5* Green) + (0.125 * Blue). This arithmetic is performed by doing bit division through the Shift Registers by shifting manually to binary divide. After sending the appropriate product to each Full Adder, the Multiplexer is used to reconstruct the image.

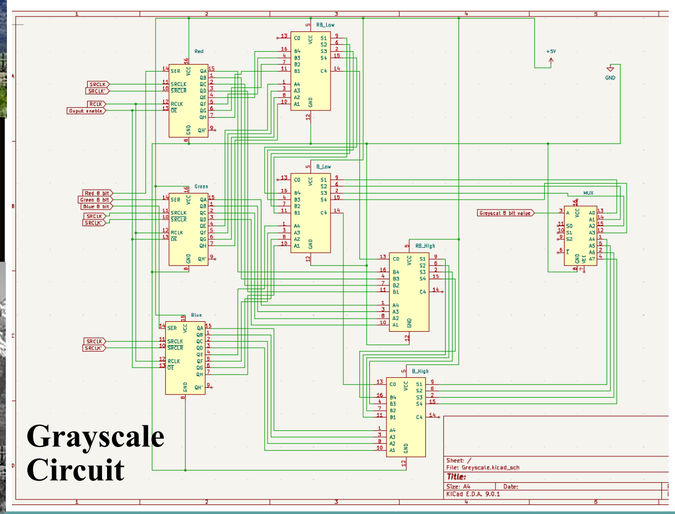
Code:

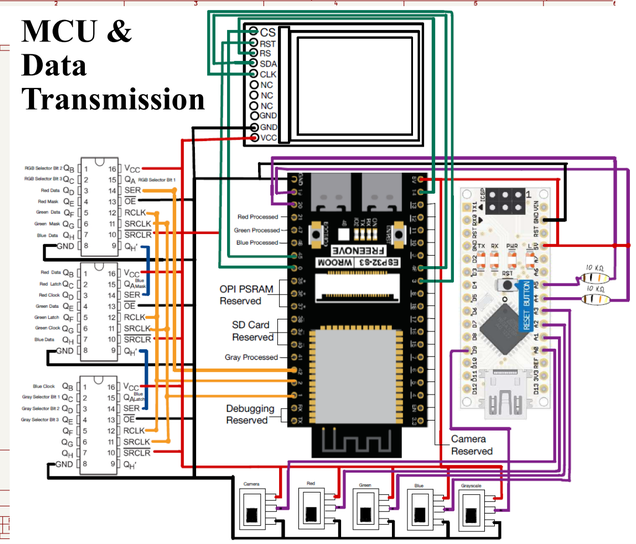
The image data is broken into its corresponding Red, Green, and Blue data. The data is transmitted to the circuit 1-bit at a time backwards by controlling the Serial, Latch, and Clock of the 3 Shift Registers. After sending all the three 8-bits in parallel, the clock is controlled manually to apply the coefficients of the grayscale equation to its corresponding data. Afterwards, the data is reconstructed by the Multiplexer and the 8-bit data is copied to fill the data back to 24-bit.

Results

Color	Button 3	Button 2	Button 1	Gray-scale
RGB	LOW	LOW	LOW	LOW
RG	LOW	LOW	HIGH	LOW
RB	LOW	HIGH	LOW	LOW
RED	LOW	HIGH	HIGH	LOW
GB	HIGH	LOW	LOW	LOW
GREEN	HIGH	LOW	HIGH	LOW
BLUE	HIGH	HIGH	LOW	LOW
BLACK	HIGH	HIGH	HIGH	LOW
GRAY	X	X	X	HIGH







Contact
<Ezequiel Villanueva >
<Metropolitan State University of Denver>
Email: evillan5@msudenver.edu

<Logan Doizaki>
<Metropolitan State University of Denver>
Email: ldoizak1@msudenver.edu

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