MINILAB 2 REPORT

Name: Harshul Jalan

Email: hjalan2@wisc.edu

Overview

The required functionality includes:

- Converting Bayer pixel data to grayscale

- Performing 3×3 two-dimensional convolution

- Implementing Sobel edge detection

- Producing grayscale output suitable for VGA display

Implementation

- The incoming pixel stream from the camera first goes through a 2×2 grayscale interpolation stage.
- A single row line buffer delays the input by 1280 clock cycles to access the previous row of data. An additional one-cycle register delay is used to complete the 2×2 window required for interpolation.
- The grayscale pixel is calculated by averaging the four samples in the 2×2 window.
- Following grayscale conversion, an additional line buffer with three taps is used to retain two previous rows of grayscale data. This allows formation of a complete 3×3 neighborhood for convolution.
- The convolution stage applies a fixed 3×3 Sobel kernel. The nine pixels in the window are weighted according to the Sobel coefficients and summed using signed arithmetic to compute the gradient value.
- Both horizontal (Gx) and vertical (Gy) Sobel operators are supported. The convolution output is obtained as the weighted sum of the nine neighborhood elements.
- Since Sobel filtering may produce negative gradient values, the signed result is converted to its absolute value prior to display.

Screenshots