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Linear Structure Extraction Using Hough Transform

CS 425

Edge Detection and Line Detection Program Report

**Overview**

This report provides an analysis of a C++ program designed for edge detection and line detection in images. The program reads an input image, ‘building.raw”, applies Sobel and Laplacian operators, combines the results where a pixel is an edge point if it is a zero-crossing point and the gradient at this point is greater than or equal to a pre-specified threshold, and performs a Hough Transform to detect and display the 3 longest lines. The processed images are saved as separate output files.

A building with many windows

Description automatically generated

Displayed above is the original “building.raw” image at 560x420.

**Program Structure**

**1. Image Processing Functions**

The program consists of three main image processing functions:

a. Sobel Operator

The Sobel operator is employed for edge detection. The program convolves the image with Sobel kernels in both horizontal and vertical directions, computes the gradient magnitude, and applies a threshold to generate binary edge images.

A building with a black background

Description automatically generated

b. Laplacian Operator

The Laplacian operator is used for edge enhancement. The program applies a Laplacian kernel to each pixel to accentuate changes in intensity, resulting in an image highlighting edges.

A building with many colored squares

Description automatically generated with medium confidence

c. Combined results

The result of combining the two previous edge images is a result edge image where the pixels are edge-points and gradients that are set to an intensity of 255 if they are over a set threshold. The resulting image is both more visible than the results of the Laplacian operator and more detailed than the results of the Sobel operator.

A building with a black background

Description automatically generated

d. Hough Transform

The Hough Transform is employed for line detection. The program iterates through edge points from the combined result, converting them into Hough space, and accumulates votes in a 2D array (**A**). Peaks in this array indicate potential lines. The top three lines are selected based on length and drawn on the final image.

A black background with colorful squares

Description automatically generated

**2. File I/O Operations**

The program reads the input image from a binary file and saves processed images, including Laplacian result, Sobel result, combined result, and Hough result, as separate binary files.