An Implementation of the Median Filter and Its Effectiveness on Different Kinds of Images 2006-2007

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Abstract

This project explores digital image filtering techniques by determining the effectiveness of the median filter with different inputs. Implementations of the median filter were developed and noise-affected images such as portraits, scenery, objects, and people were used as sample inputs to determine the kind of image the filter is most effective for.

Introduction and Background

Digital image processing such as filtering was first developed in the 1960's. As computers became cheaper and faster, real-time image processing became available and its applications boomed. Digital filtering attempts to clear out noise, or useless and distracting information, in pictures. Examples of noise include missing pixels and wrong pixels. Noise is inevitable when converting analog information into a digital form. The most common source of noise is during the transmission of image files from one location to another, either through physical mediums such as cable or disk, or through wireless communication.

Larger Purpose

The field of image processing has wide and important uses. The results of this project will influence how images are processed and enhanced. Applications stemming from the results of this project will be important to image and video enhancement applications because this research project provides insights on the best techniques in filtering and enhancing digital images.

Procedures and Methods

This study involves the development of the median filter. There are different kinds of algorithms varying in complexity and effects for the two techniques. The intensity of the filter (The more intense the filter, the smoother the transition between colors and blurrier the edges and boundaries)

The implementations of the digital filters are written in Java. A specific Java development software was not used because the number of classes written was not high and the interplay between each class is not complicated.

To obtain images corrupted by noise, a module was created that changed random pixels within the image. This module can destroy images to different extents based on the user's desires.

The effectiveness of the median filter is evaluated based on a subjective standard. The criteria used in evaluation includes noise reduction, color preservation, and edge preservation.

Median Filter

Due to its relative simplicity, the median filter may be encapsulated into one module without any problems of over-complexity or size. The median filter is a Gaussian filter that slides a window of a certain size across each pixel of the image. The size of the window in this program is three by three. At each position of the window, the nine pixels values inside that window are copied and sorted. The value of the center pixel of the window is replaced with the median value of the nine pixels in the window. The implementation of this program does not do anything with the pixels on the edges.

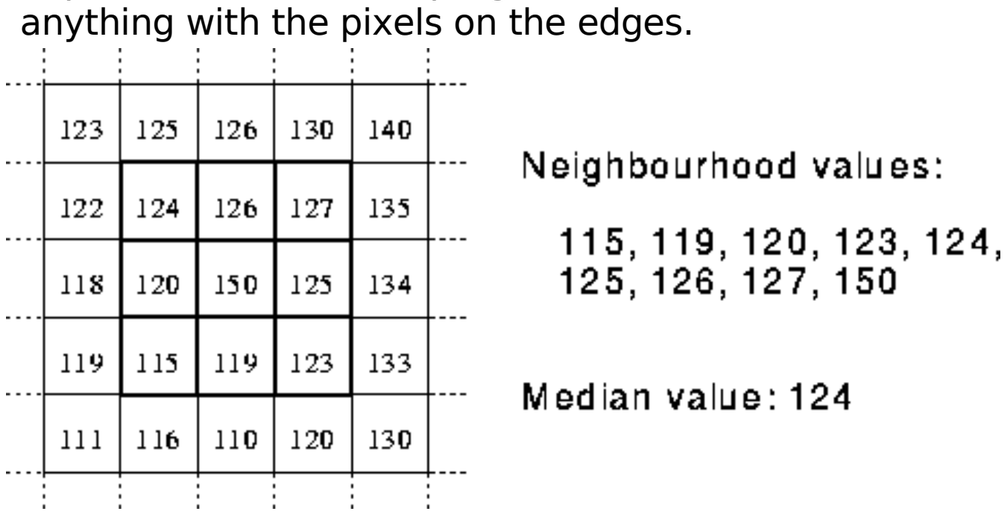

Illustration of the calculations at one position of the window.

Sample before and after effects of the median filter.

Blurring Effects

An image without noise and its output when processed by the median filter. This illustrates the blurring effect of the median filter on images, which was found to be the most intense with images of scenery.

Conclusions

The effectiveness of the median filter is evaluated based on a subjective standard. The noise reduction was found to be equally effective for all kinds of images. The decrease in quality, however, is highest for pictures of scenery and lowest for objects.