Computer Systems Project Proposal

Comparison of Digital Imaging Filter Techniques

Kevin Liu

Purpose and Scope

This project will explore the various digital imaging filter techniques, including the median filter and frequency filters, and will determine the advantages and disadvantages of each in filtering images.

The field of image processing has wide and important uses. Any field of work that involves images or videos has uses for research in this area. This topic is a great project for the Computer Systems Lab because not only does it involve computer software coding and testing, but also other practical subjects as well, including camera usage and video editing.

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 each kind of image.

This study will involve two filtering techniques: median filtering, and frequency filtering. First of all, algorithms will be developed for each of the two methods. After writing the code implementing these methods and conducting necessary testing, a variety of images will be put through the two filtering techniques to determine which filtering techniques work best for which types of images. The variety of images used will include images of people, objects, and landscapes. The quality, or the amount of noise, of the images used will be another independent variable.

Background Research

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. Such a conversion occurs inside a digital camera, when the camera takes the analog picture from the lens and stores it as a digital file.

To produce high quality images, for both aesthetic and additional high level processing purposes such as edge detection, noise reduction is very helpful and often required. The median and frequency filters are two such filters.

The median filter deals with each pixel and assures it fits with the pixels around it. Therefore, it is very useful in filtering out missing or damaged pixels.

The frequency filter implements the Fourier transformation to smooth out images. It is much more demanding in terms of computational complexity and processing time. Because of the sheer volume of data that normally needs to be filtered, the main problem in designing median and frequency filters is efficiency and time consumption.

This project will implement the median and frequency filters and evaluate them for their effectiveness in filtering different kinds of pictures. The results of this project may help determine the best filtering techniques to be used for an image that needs to be processed.

Procedure and Methodology

The first task is to design and produce implementations of the two filtering techniques. Testing to make sure these implementations work is the next step. For the purposes of this project, implementation efficiency and time consumption are not considered. After working versions of the two filtering techniques are produced, different images with different characteristics will be the input in testing the two techniques. Independent variables include the subject of the image (such as people, objects, cartoons, or landscapes) and the amount of original noise. The dependent variable will be aesthetic quality, which will be shown through visual outputs. This project may require the use of a digital camera to provide the various pictures required for the inputs.

The design and implementation of the two filtering techniques will require about two to three months. This is also the stage during which additional background literature and research will be explored.

The first testing stage, which aims to determine that the implementations for the two filtering techniques work, will take a much shorter amount of time, approximately three weeks.

The second stage of testing, which is the core of this project, will be the last stage of this project. This stage is the stage during which all the data will be collected. Different images will be fed into the two techniques and the results will be documented based on the effects of the filters.

Java will be used as the primary programming language. This choice was made mainly because it is the language the designer will be most familiar with.

To provide pictures with noise, a program will be written to introduce the most typical kinds of noise into already existing pictures. A comparison of the output of the filtering programs and the original image before noises were introduced will be made to illustrate the effectiveness of the filtering techniques.

Testing and Analysis

For the first testing stage, pictures with noise introduced manually will be processed by the programs. There will be expected results and if the resulting image fits the expected results, the program is working.

For the second testing and analysis stage, the analysis will be done mostly on a subjective basis. Obtained results for each of the typical types of input, such as landscapes, will be part of the conclusion of the project.

Expected Results and Value to Others

Expectations of the project include implementations of the median and frequency filters and how well they perform on different kinds of images. The types of images include portrait, landscapes, objects, low-noise, and high noise.

The final results will be presented with sample input images and their output images.

Future researchers may use the results of this project to determine what digital filter to use on which kind of pictures. In addition, researchers may use the results of this project to develop more advanced filters that combine the advantages of both the median and frequency filters.