Parallel Computing

Image Filtering

Arihant Jain	2019213
Arjun Khare	2019214
Naman Bohra	2019290
Kushagra VijayVergiya	2019279

Introduction

Problem Definition

To implement image filtering techniques, this takes an image file as the input and generates a filtered image file as the output. The central idea is to demonstrate the execution time running the algorithm on a CPU.

What is Image Filtering

An image filter is **a technique through which size, colors, shading and other characteristics of an image are altered**. An image filter is used to transform the image using different graphical editing techniques. Image filters are usually done through graphic design and editing software.

Representation of image in memory

Image is represented by a set of pixels i.e. a matrix of pixel values. In the gray image, the pixel values range from 0 to 255 and represent the intensity of that pixel. For example, if you had a 20 x 20 size image, it would be represented by a 20×20 matrix (total value of 400 pixels).

If you are working with a color image, you should know that we will have three channels – Red, Green, and Blue (RGB). Therefore, there will be three such matrices for one image.

Why do we need Image filtering?

Image filtering is often regarded as improperly exploiting the image in order to achieve a level of beauty or to support a popular reality. However, image filtering is most accurately described as a means of translation between a human viewing system and digital imaging devices. The human viewing system does not see the world in the same way as digital cameras, which have additional sound effects and bandwidth. Significant differences between human and digital detectors will be demonstrated, as well as specific filtering steps to achieve translation. Image editing should be approached in a scientific way so that others can reproduce, and validate human results. This includes recording and reporting filtering actions and applying the same treatment to adequate control images.

Image filtering is a way to do something working on an image to get an enhanced image or to cut out some useful information from it. It is considered signal filtering where engagement is the image and the crop can be an image or related topographies. Currently, image filtering is in the midst of rapid growth technology. It forms the main research area within engineering and computer science commands as well.

Image filtering mainly involves the following three steps:

- Importing an image with image detection tools;
- Exploring and manipulating the image;
- An outcome where it can be improved or reported that is built on image analysis.

Steps in Image filtering

Image Acquisition: This is the first digital step in image filtering.Image acquisition can be understood by considering the pre-existing image digital form.

Image Enhancement: Image enhancement is a process of switching digital images to more results suitable for display or multiple image analysis.

Image filtering: It includes modification of image at pixel-level.

Image compression: Image compression is a type of data useful pressure digital photography, reducing their costs last or spread. Processes can reap visual benefits awareness and asset data image assets to complex effects related to normal pressure strategies.

Few of the common filtering techniques

Box Filter

One of the most commonly used filters in graphics is the *box filter* (and, in fact, when filtering and reconstruction aren't addressed explicitly, the box filter is the *de facto* result). The box filter equally weights all samples within a square region of the image.

A simple blur can be done using this kernel:

$$\frac{1}{9}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

This is called the Box Blur. Each pixel is computed as the average of the surrounding pixels.

Laplacian Filter

The Laplacian L(x,y) of an image with pixel intensity values I(x,y) is given by:

This can be calculated using a convolution filter.

$$L(x,y) = \frac{\partial^2 I}{\partial x^2} + \frac{\partial^2 I}{\partial y^2}$$

Since the input image is represented as a set of discrete pixels, we have to find a discrete convolution kernel that can approximate the second derivatives in the definition of the Laplacian.

0	−1	0
−1	4	−1
0	−1	0

−1	−1	−1
−1	8	−1
−1	−1	−1

Two commonly used discrete approximations to the Laplacian filter. (Note, we may have define the Laplacian using a negative peak because this is more common; however, it is equally valid to use the opposite sign convention.)

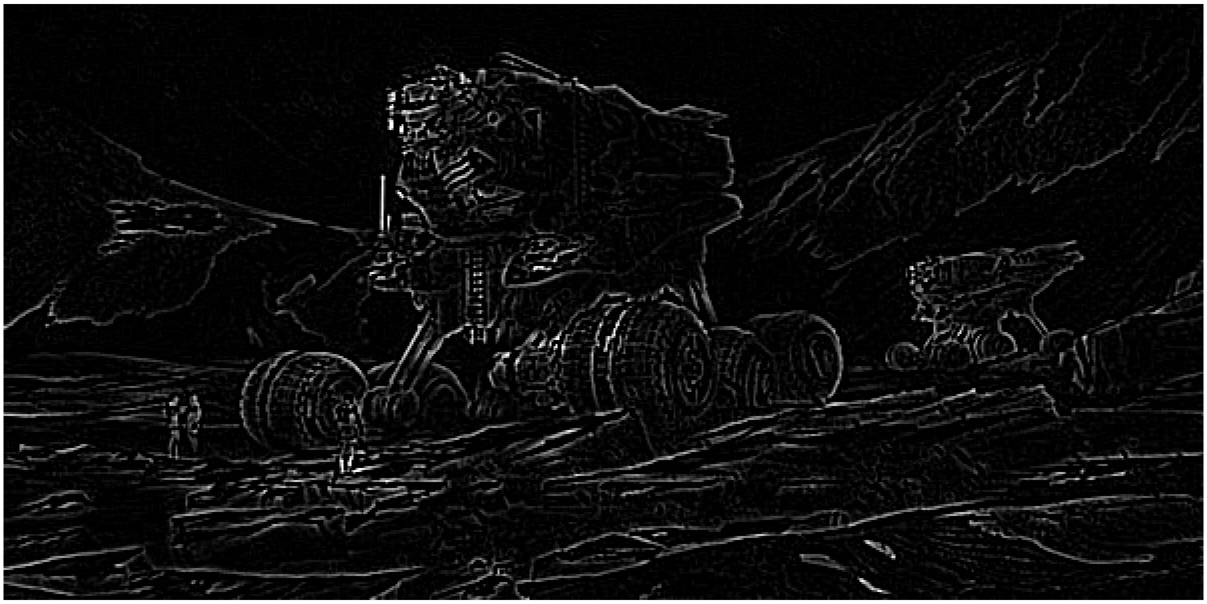
Using one of these kernels, the Laplacian can be calculated using standard convolution methods.

Results of Image Filtering

Original image:

Filtered image by Box filtering:

Filtered image by Laplacian filtering:



Filtered image by Median filtering:

Filtered image by Sharpening filtering:

Filtered image by Sobel filtering:

Filtered image by TV filtering:

Output

Filtering Method	Speed on CPU (ms)
Box Filter	18.4831
Laplacian Filter	5.00039
Median Filter	45.3957
Sharpening Filter	18.0252
SobelEdgeDetect Filter	1.03197
TV Filter	1.29161

Conclusion

This project aimed at showing the execution speed of the image filtering algorithm on a traditional CPU. The development and implementation of this system has given us a great satisfaction. Through our efforts, we have shown the sequential running time for image filtering of the input image.