To implement convolution in image processing

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***Abstract*— Edge detection is one of the most frequently used techniques in digital image processing[27]. An Edge in an image is a significant local change in the image intensity, usually associated with a discontinuity in either the image intensity. Edges detection is a problem of fundamental importance in object extraction as it reduces image data and detects the object which is required [8] [9]. Edges identify object boundaries and are detected through changes in gray level above a particular threshold. Operators that are sensitive to the change in gray levels can be used as edge detectors. The edge detection is mainly applicable in case of data transmission; in that case the detected edge data reduce the amount of data to be transmitted. Sobel operator is one of the most commonly used detection methods and returns edges at points where the gradient of image intensity is maximum. Locations whose gradient value exceeds or greater some threshold are declared edge locations [5]. Prewitt method finds edges using the Prewitt approximation to the derivative and returns edges at those points where gradient of image intensity is maximum or greater. Prewitt operator does not place any emphasis on pixels that are closer to the centre of the masks. The Canny edge detector is considered as the standard methodology of edge detection and it finds edges by looking for local maxima of the gradient of Image [7]. But the advantage of sobel edge detector is that it requires less time and it can be use in most applications where detailing is not required.**

***Index Terms*— Digital image processing, Sobel edge detector, Guassian filter, kernel matrix.**

I. INTRODUCTION

Digital image processing refers to processing digital images by means of a digital computer. Digital image is composed of a finite number of elements, each of which has a particular location and value An image, digital image, or still image is a binary representation of visual information such as drawing, pictures, graph, logos or individual video frames. An image consists of matrix of pixels. An pixel is an arrangement of row and columns means a picture element. An 8 bit images have 256 colors per channel with over trillion possible tones. Enhancing images in this mode increase the chances of banding since there is less data to work with. Banding occurs when there is lack of tonal values, creating posterizaton, which is not a pleasing effect if there are smooth gradient in a picture, whether be colour or black and white. This unwanted artifact often shows up in pictures with smooth skies or plain backdrops. If you know your prints will be small and there is very little art work to be applied, then 8 bit images are fine. But 16 bit images have 16 levels of intensity, with over 280 trillion possible tones. So when there is need of more detailing and contrast enhancement 16 bit images are much better. Also providing greater tonality range which prevents aliasing, known as banding. . The most important and well known application of DSP are related to enhancing or extracting information from signals that have been corrupted. Image processing is an important subset of DSP that involves analyzing the characteristics of image signals or modifying an image in some way to enhance or remove certain features. For instance, communication between a pilot in the cockpit and a control tower is inevitably exposed to noise which reduces signal quality, from a variety of sources such as other wireless transmitters and electromagnetic noise from the atmosphere. In such cases, DSP techniques can remove noise from the signal and restore parts of the signal that were distorted during transmission. For instance, images of space from satellites or telescopes are often incomplete due to the limitations of the imaging hardware and communication equipment.

II. PROCEDURE

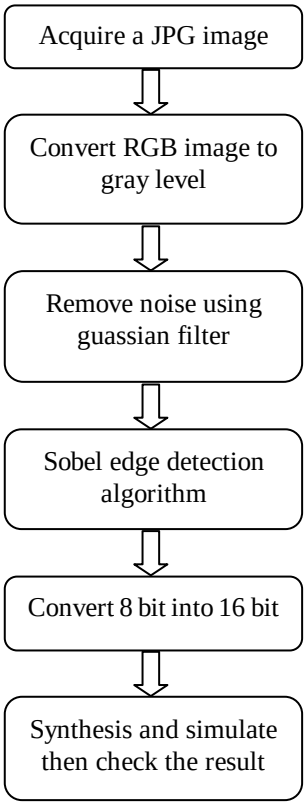

Figure 1. Proposed flow chart

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A. Sobel Edge Detector

Edge detection is the very important area in the field of image processing. An edge-detector can process and extract relevant features in a set of images before they are fed into a pattern recognition algorithm, which gives the superior performance in less time. The following are two such kernels for detecting horizontal and vertical edges, together called the sobel operator.

$$K\_v=\begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}, \quad K\_h=\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

Sobel operator, sometimes called the Sobel filter, is used in image processing and computer vision, particularly within edge detection algorithms where it creates an image emphasizing edges. Technically , it is discrete differentiation operator, computing an approximation of the gradient of the image intensity function. The sobel operator is based on convolving the image with a small separable, and integer-valued filter in the horizontal and vertical directions and is relatively crude, in particular for high frequency variations in the image[2].

Following are the result of sobel operator:

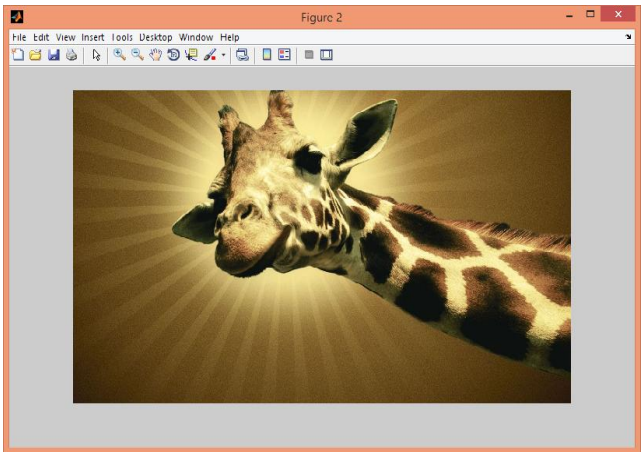

Figure 2: Original image

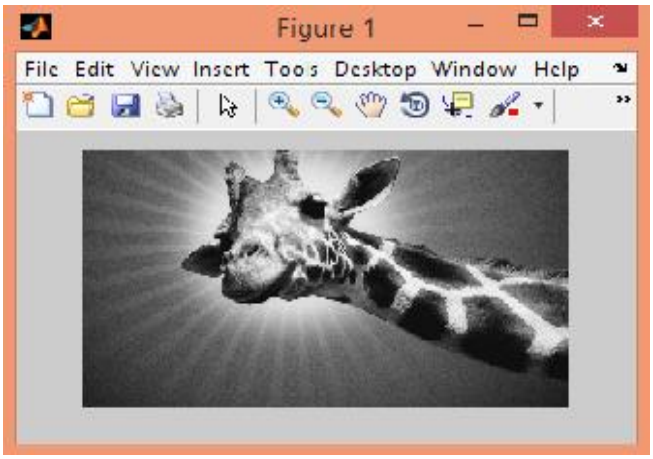

Figure 3: Grayscale image

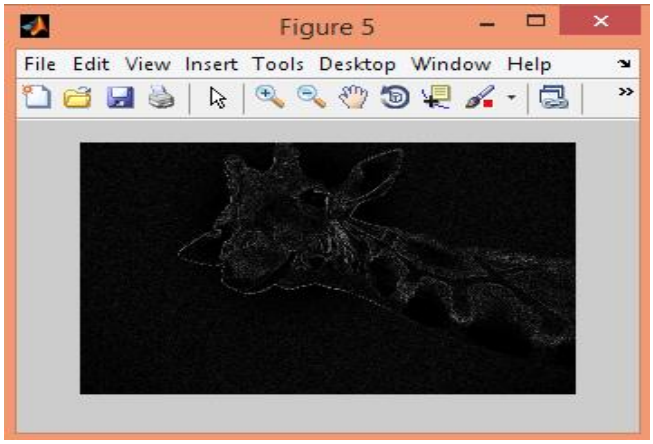

Figure 4: Sobel edge detector

The operator utilizes two 3x3 kernels: one estimates the gradient in the x-direction, while the other one estimate the gradient in the y-directionls. The image is convolved with both kernels to approximate the derivatives in horizontal and vertical change At each given point, magnitude of the gradient can be approximated with:

$$G = \sqrt{G_x^2 + G_y^2}$$

However, it is faster to compute the gradient magnitude with:

$$G = |G_x| + |G_y|$$

B. Convolution

The convolution at a point is the product of two function tht occurs when the leading edge of the moving pulse is at that point. When actually taking the convolution of two function, one function is flipped with respect to the independent variable before shifting[2].

$$f * g = \int_{-\infty}^{\infty} f(\tau) g(t-\tau) d\tau$$

In image processing, many filter operations are applied to an image by performing a special operation called convolution with a matrix called a kernel. Kernels are typically 3x3 square matrices that is in sobel operator 3x3 matrix is used, although kernels of size 2x2, 4x4, and 5x5 are also used. The values stored in the kernel directly relate to the results of applying the filter, and filters are characterized solely by their kernel matrix. When applying the convolution operator, the function is merely a weighted average of the within-window pixels. Convolution is a general purpose filter effect for images. Convolution is a matrix applied to an image and a mathematical operation comprised of integers. It works by determining the value of a central pixel by adding the weighted values of all its neighbors together. The output is a new modified filtered image. A convolution is done by multiplying a pixel's and its neighboring pixels color value by a matrix. A kernel is usually a small matrix of numbers that is used in image convolutions. Differently sized kernels containing different patterns of numbers produce different results under convolution. The size of a kernel is arbitrary but 3x3 is often used.

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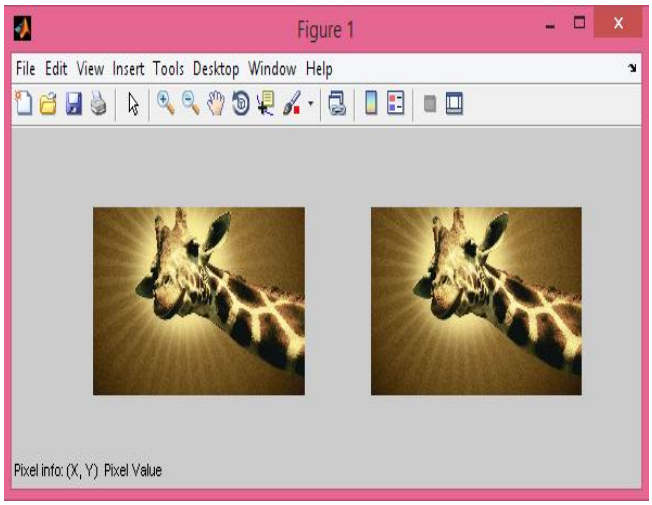

Figure 5: 8 bit to 16 bit conversion

III. GUASSIAN FILTER

In addition to applications such as feature extraction, filters can be used for denoising signals and images. Many different filters can achieve this purpose and the optimal filter often depends on the particular requirements of the application[2]. One such filter is called a Gaussian, so named because the filter's kernel is a discrete approximation of the Gaussian (normal) distribution. The Gaussian filter is known as a 'smoothing' operator, as its convolution with an image averages the pixels in the image, affectively decreasing the difference in value between neighboring pixels.

$$g[i,j] = e^{-\frac{i^2+j^2}{2\sigma^2}}$$

One major problem with edge detection is when noise is present in images. It is not enough to simply reduce the noise, because the image will be either distorted or blurred. Fortunately, the operator can average enough data to discount localized noisy pixel. Gaussian filtering is a common first step in edge detection. The images below have been processed with a Sobel filter. The image to the right has had a Gaussian filter applied prior to processing.

IV. CONCLUSION

The edge detection holds a big importance in image retrieval, image recognition, and image segmentation. this paper analyzed and detect the edges in an image using sobel edge detector. sobel edge detection operator is insensitive to noise, this methodology reduces the complexity of the look and conjointly the processing time.

We perform this experiment in three levels: image processing, image analysis, computer vision. The execution time for the complete program of edge detection for a picture of 256*256 is of few seconds. To improve the efficiency and detailing image is converted into 16 bits.

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