A Review: Sobel Canny Hybrid Theoretical Approach & LOG Edge Detection Techniques for Digital Image

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Abstract: **Edge detection is an important field in image processing. The purpose of image's edge Detection is image segmentation, data compression, well matching such as image reconstruction and so on. Images to be compressed are first differentiated and edge information is extracted by investigation of the histogram of small non-overlapping blocks of the differential image. The image is classified into visually active and visually continuous blocks which are then coded individually. There are different methods for achieve the edge detection such as first-order derivatives in an image are computed using the gradient, the second-order derivatives are obtained using the Laplacian and one method for edge detection uses Hilbert Transform. Edge detection refers to the process of locating sharp discontinuities in an image. These discontinuities originate from different scene features such as discontinuities in depth, discontinuities in surface orientation, and changes in material properties and variations in scene illumination. Edge detector is a fundamental tool in image processing, machine vision and computer vision. An effective edge detector reduces a large amount of data but still keeps most of the important feature of the image.**

Keywords: Edge, Segmentation, Compression, Hilbert Transform, Laplacian.

I. Introduction

Edge detection (EDT) is fundamentally important for image analysis like segmentation, registration, and identification of scene's objects. It is the most used form for detecting the useful discontinuities in gray level image. Edges are significant local changes of intensity in an image. Edges typically occur on the boundary between two different regions in an image. An image is measured to exist a meaning of two genuine variables. It can be demonstrated with a example, a(x,y) where a as the amplitude known as brightness of the image at the real match up position (x,y. The image might be measured to hold sub-images now and again referred to as region of awareness or simply regions.

A digital image is digitized to change it in the direction of a shape which is able to be store in a processor memory or on a number of forms of storage space media such as a hard disk. As the image has been digitized, then it could be operated upon by various pictures processing operation like zooming, noise reduction, compression, enhancement and many more. The types of operations to transform an input image a[m,n] into an output image b[m,n] can be classified into three categories:

a. Point: the output value at a specific coordinate is dependent only on the input value at that same coordinate.

b. Local: the output value is dependent on the input values in the neighbourhood of that coordinate.

c. Global: the output value is dependent on all the values in the input image.

1. Noisy Image

To reduce the effects of noise, pre-processing of the image is performed. The pre-processing can be performed in two ways, filtering the image with a Gaussian function, or by using a smoothing function.

Figure 1 Noisy Image Demonstration.

The problem with the existing approaches is that the optimal result may not be obtained. Edge detection is susceptible to noise. This is due to the fact that the edge detectors algorithms are designed to respond to sharp changes, which can be caused by noisy pixels. Noise may occur in digital images for a number of reasons. The most commonly studied noises are white noise, “salt & pepper” noise and speckle noise.

An edge is a property attached to an individual pixel and is calculated from the image function behaviour in the neighbourhood of the pixel. If a pixel’s gray-level value is similar to those around it, there is probably not an edge at that point. If a pixel has neighbours with widely varying gray levels, it may present an edge point. Along the edge direction, pixel value changes more gently, while perpendicular to the edge direction, pixel value changes more dramatic. 1st derivative tells us where an edge is, 2^{nd} derivative can be used to show edge direction.

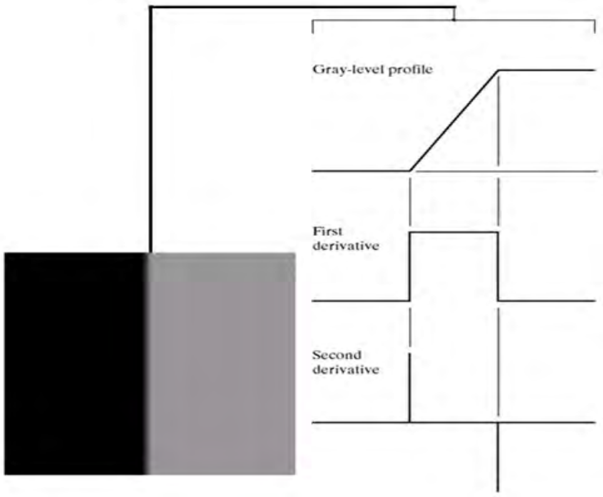

Figure 2 Graphical Representation of Derivatives.

The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. The same problem of finding discontinuities in 1D signals is known as step detection and the problem of finding signal discontinuities over time is known as change detection.

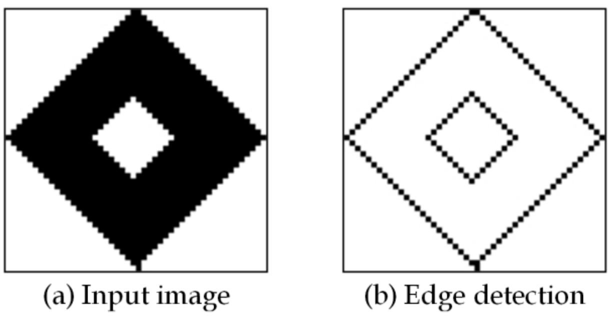

Figure 3: Edge Detection

II. LITERATURE REVIEW

There is lots of research has been done in this detection techniques and we have been proposed an new technique to detect the edge of the images.

Author has been explained and compared several techniques for edge detection in image processing. The Boolean edge detector performs similar to the Canny edge detector even though they both use different approaches. Canny method is still preferred since it produces single pixel thick, continuous edges. The Boolean edge detector's edges are often spotty. Color edge detection seems like it should be able to outperform greyscale edge detectors since it has more information about the image. In the case of the Canny color edge detector, it usually finds more edges than the grayscale version. The Euclidian Distance/Vector Angle detector identifies the borders between image regions, but misses fine grained detail. Multi-flash edge detection strives to produce photographs that will be easy to edge detect, rather than running on an arbitrary image. One problem inherent to the Multi-flash edge detector is that it will have difficulty in finding edges between objects that are at almost the same depth or are at depths which are very far away [1].

Author has been explained and discussed several digital image processing techniques applied in edge feature extraction. Firstly, wavelet transform is used to remove noises from the image. Secondly, some edge detection operators such as Differential edge detection, Log edge detection, Canny edge detection and Binary morphology are analysed And then according to the simulation results, the advantages and disadvantages of these edge detection operators are compared. It is shown that the Binary morphology operator can obtain better edge feature. Finally, in order to gain clear and integral image profile, the method of bordering closed is given [2].

Image segmentation is an active topic of research for last many years. Edge detection in images significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image. In this paper, the two most commonly used edge detection methods (Laplacian and Sobel edge detectors) are discussed. It is found that Sobel edge detection algorithms perform better than Laplacian algorithms; however, the false edges are high in both cases for blurred or low resolution images.

Therefore, a new algorithm and set of filters (kernels) is proposed and its results are compared with the Sobel and Laplacian filters for three images. From the results obtained it is found that the proposed algorithm performs better than in terms of less false edges than the Sobel and Laplacian filters [3]. Edge detection is an important step in digital image processing and is mainly used in the application of feature extraction. One major application of edge detection is in the field of medical image processing. Edge detection is basically the process of detection of those regions in the image where there is an abrupt change in the brightness of the image. In this paper, various edge detection methods are described and compared [4].

Author presents a review on different color based edge detection techniques. Edge detection has found to be most important step in many critical vision applications. It actually results in the black and white (binary) image where each object is differentiating by lines (either black and white). Edges are basically the area in the image where sharp changes exist. It has been found that the most of the existing techniques has neglected the use of colors while detecting the edges but in many applications a region can be categorized based upon the color. This paper has shown that the most of the existing techniques fails in case of images with complex background [5].

III.OBJECTIVES

In the research scenario, the Edge Detection technique will be implemented. The main objective to develop a new edge detection algorithm for detection of edges in an image and to analyse the method for assure that the new algorithm can improve the performance of already defined edge detectors.

1. To Develop Edge Detection Algorithm which have a relatively complete edge profile.
2. To Compare Proposed Algorithm with traditional methods such as Sobel, Roberts, Prewitt and Canny.
3. To show the effectiveness of the proposed algorithms by compare the results.

IV.PROPOSED METHODOLOGY

The proposed new algorithm mainly consists of the steps explained below:

a. Make the 16×16 Gaussian filtersphi_x and phi_y using the Gaussian equation:

$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

These kernels are designed to respond maximally to edges running vertically and horizontally relative to the pixel grid, one kernel for each of the two perpendicular orientations. The kernels are convolved separately with the input image, to produce separate measurements of the gradient component in each orientation.

b. Apply above filters to find the gradient of the image in x and y directions. Then find magnitude of the gradient by using the formula:

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

c. The angle of orientation of the edge (relative to the pixel grid) is given by:

$$\theta = \tan^{-1}\left(\frac{G_y}{G_x}\right)$$

Non-maximal suppression: Edges will occur at points where the gradient is at a maximum. Therefore, all points not at a maximum should be suppressed. In order to do this, the magnitude and direction of the gradient is computed at each pixel. Then for each pixel check if the magnitude of the gradient is greater at one pixel's distance away in either the positive or the negative direction perpendicular to the gradient. If the pixel is not greater than both, suppress it.

d. Use Hysteresis based thresholding (uses two thresholds):

Take mean of the edge image and multiply it by 2 to get the high threshold.

Use k_{high} to find strong edges to start edge chain. Use k_{low} to find weak edges which continue edge chain.

Typical ratio of thresholds is roughly:

$$k_{high} / k_{low} = 2$$

Edge magnitudes above the upper threshold are preserved. Edge magnitudes below the upper threshold but above the lower threshold are preserved only if they connect to edges that are above the upper threshold. And edge magnitudes below the lower threshold are discarded. This process is known as hysteresis and allows edges to grow larger than they would by using a single threshold without introducing more noise into the resulting edge image.

The proposed hybrid algorithm uses the technique. It is described as follows:

a. Apply Sobel operator, Canny operator and proposed new algorithm to the input image to get edge detected images *u(x,y)*, *v(x,y)*, *w(x,y)*.

b. Make double two-dimensional wavelet decomposition of the images *u(x,y)*, *v(x,y)*, *w(x,y)* and respectively get three groups averages and details [*c1*,*s1*], [*c2*,*s2*], [*c3*,*s3*].

c. Take the averages of three groups: averages and details.

$$ca = \frac{(c1 + c2 + c3)}{3}$$

$$sa = \frac{(s1 + s2 + s3)}{3}$$

4. Make wavelet reconstruction using [*ca*,*sa*] and get the fusion image.(as shown in Figure 5.1).

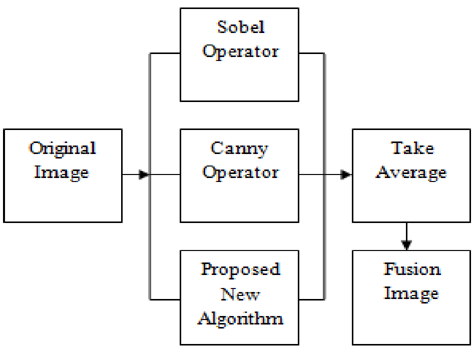

Figure 4: An image explaining fusion method

V. CONCLUSION AND FUTURE WORK

In this paper, we have been proposed the edge detection algorithm which can be used for detecting the edges properly. The proposed implemented part has not been explained in this paper.

The implementation part will be covered in the next paper, which will demonstrate the real working of proposed algorithm.

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