

COMPOUND APPROACH FOR DIGITAL IMAGE OF SOBEL, CANNY AND LOG EDGE DETECTION TECHNIQUES

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Abstract- Edge detection is a procedure of describes the points in an image. It can be used in many applications such as subdivision of region, registration, attribute extraction, feature detection and identification of objects in a scene. It aims at identifying points in a digital image. In this paper we proposed a new algorithm to detect edges. Also we proposed a hybrid algorithm using the Sobel, Canny and LoG. The hybrid technique improves the accuracy of edge detection and the final image contains a relatively complete edge profile.

IndexTerms- Hybrid, Edges, Detection, Log, Canny, Sobel.

I. INTRODUCTION

A digital image is digitized so that its conversion makes such type of configuration which can be saved in a computer's memory or on some form of storage media. Once the image has been initialized, it can be transacted upon by various image processing manipulations like zooming, noise devaluation, confining, intensification and many more. The basic types of images are Binary images, Greyscale images and True color images.

An edge can be illustrated as a congregation of consecutive pixels lying amid borderline of two regions. An edge is identical to local magnitude discontinuation of an image. Edge detection refers to the elicitation of the edges in a digital image. Edge detection is a procedure of describe the points in an image. Edge detection desire to confined the extremity of objects in an image and incomparably recede the expanse of data to be handled. Edge detection has its applicability in region subdivision, attribute derivation and borderline explanation. Edges accommodate the topography and configuration of objects in an image. There are different methods for edge detection. It includes First Order Derivative methods, Second Order Derivative methods, and Optimal Edge Detector

A. First Order Derivative methods

It identifies the edges by inspecting for the maximal and minimal in the first derivative of the image. The result of tapering an image is detection of magnificent details and exaggerates the dazzle images. The significance of the gradient is the most convincing approach that forms the basis for various procedure of sharpening. The gradient vector marks in the direction of maximal rate of change. The first order derivative method includes some of operators. These are:

1. Roberts Operator: The strains of this operator are modest, thus the reference of

the edges is ultra precise. This operator is of limited usage due to its minute functionality.

2. Sobel Operator: Technically, it is a distinct differentiation operator, computing a resemblance of the gradient of the image intensity function. At each count of the image, the outcome is always analogous gradient vector of norm of gradient vector.
3. Prewitt Operator: Prewitt operator works commendable for gray gradient images.

B. Second Order Derivative methods

Zero crossing in second derivative illustrate the presence of extremity

1. Laplacian Edge Detection: The Laplacian method inspect for zero crossings in the second derivative of the image to discover edges.
2. Laplacian of Gaussian (LoG): ItProvides velvety touch to the image using Gaussian filter, intensify the edges using Laplacian operator, Zero crossings represent the edge location.
3. Difference of Gaussian (DoG): It tapers the computational demands

Optimal Edge Detector: The Canny Edge Detector is remarked as one of the leading edge detectors presently in use

II. LITERATURE REVIEW

Simet presents a new hybrid edge detector that combines the advantages of Prewitt, Sobel and optimized Canny edge detectors to perform edge detection while eliminating their limitations. Compared to the other three edge detection techniques, the hybrid edge detector has demonstrated its superiority by returning specific

edges with less noise. When the Gaussian white noise in the original image increases, the Gaussian filter of the optimized Canny edge detector tends to increase the smoothing area of the Gaussian magnitude. As Gaussian standard deviation increases, the area of Gaussian gradient increases and it tends to overlap with another set of gradient image beside it. This proves that the optimized Canny edge detector has the possibility of being unable to detect some edges when image noise increases. In order to overcome this problem, a hybrid edge detector that is able to detect the optimum edges even in noisy images is formulated. The main component, which is the optimized Canny edge detector must be used to form the basic edge structure. Sobel and Prewitt edge detector components will detect edges that are close to each other. [16]

Denget proposed a modified Sobel edge detector, in which firstly the morphological filters are used to remove noise present in an image. Image is then sharpened by using Sobel operator. Then by using Otsu threshold method [14], improved Sobel operator is constructed. Then by making use of fusion technology, a kind of method combined with improved Sobel operator, wavelet transform, Canny algorithm and Prewitt operator is formulated, which keeps their respective advantages. In this way, edge extraction image contains a relatively complete profile and rich detailed information, effectively improves the accuracy of edge detection, and gets a quite ideal edge detection effect [4].

Mainiet presented a comparative analysis of various image edge detection techniques. Analysis shows that the Canny's edge detection algorithm performs better than other operators under almost all scenarios. Evaluation of the images shows that under noisy conditions Canny, LoG, Robert, Prewitt, Sobel exhibit better performance, respectively. It has been observed that Canny's edge detection algorithm is computationally more expensive as compared to LoG, Sobel, Prewitt and Robert's operator. Gradient based algorithms such as the Prewitt filter have a major drawback of being very sensitive to noise.

The size of the kernel filter and coefficients are fixed and cannot be adapted to a given image. An adaptive edge detection algorithm is necessary to provide a robust solution that is adaptable to the varying noise levels of these images to help distinguish valid image contents from visual artifacts introduced by noise. The performance of the Canny algorithm depends heavily on the adjustable parameters: σ , which is the standard deviation for the Gaussian filter, and the threshold values, $t1$ and $t2$. [10]

Wang proposed an improved template algorithm, which includes the first order partial finite differences of directions 45 and 135 degree in calculating the amplitude values. This improves the calculation accuracy of the amplitude values. In the non-maxima suppression process, the factor ratio of four quadrants of linear interpolation is improved to achieve better

detection results. Experiments show that this improved Canny algorithm has better noise suppression and edge continuity. The proposed algorithm is an effective, real-time detection algorithm. [17]

Nadernejad 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 grayscale 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.[12]

III. PROPOSED SYSTEM'S OBJECTIVES

In real world machine perceiving problems, issues such as noise and variable scene illumination make edge and object detection difficult. There exists no universal edge detection method which works under all conditions.

1. Effective edge detection is needed in object recognition and interpretation systems.
2. Traditional image edge detectors commonly infuse the edges by adopting specific instructions.
3. Some edge filtering methods often result in some shortcomings like broken edges, thick edges and false edges.

The significant aim of this research is to put forward a new algorithm to track down edges and to show that the edges detected by this algorithm have a relatively complete edge profile than detected by traditional methods like Sobel, Roberts, Prewitt and Canny. Then using the fusion technique a kind of hybrid algorithms proposed using Sobel operator, Canny operator and our proposed new algorithm, which keeps their respective advantages. The visual comparison of the results of the proposed algorithms with the results of the already existing algorithms shows the effectiveness of the proposed algorithms.

IV. RESEARCH METHODOLOGY

This section has been explained the steps which have been followed for edge detection. Make the 16×16 Gaussian filters ϕ_x and ϕ_y using the Gaussian

equation and all the steps has been explained in the algorithm steps.

A. Proposed New Algorithm

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

1. Make the 16×16 Gaussian filters ϕ_x and ϕ_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.

2. 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:

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

3. 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.

4. 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.

B. Proposed Hybrid Algorithm

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

2. 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 $[c1,s1]$, $[c2,s2]$, $[c3,s3]$.

3. 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.

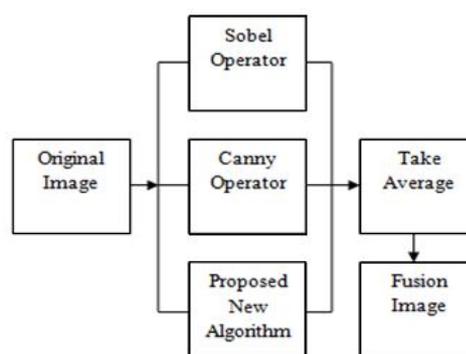


Fig 1 Fusion Image

V. RESULTS

A. Visual Comparison of the Results

In order to test the effectiveness, we implemented the proposed algorithms in MATLAB 7.10.0 and the output of the proposed new and proposed hybrid algorithm is compared with the existing algorithms as shown in the following figures:

Figure (a) shows Rice image.

Figure (b) shows edge detected image when Sobel operator is applied to original image

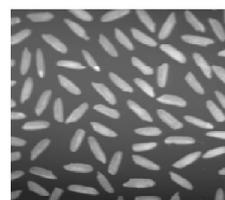


Fig a: Shows Rice image



Fig b: Sobel output

Figure (c) shows edge detected image when Prewitt operator is applied to original image. Figure (d) shows edge detected image when Roberts operator is applied to original image.



Fig c Prewitt output

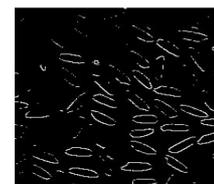


Fig d Roberts

output

Figure (e) shows edge detected image when Canny operator is applied to original image. Figure (f) shows edge detected image when proposed new algorithm is applied to original image.

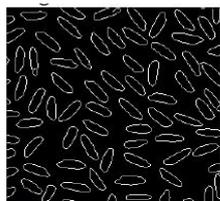


Fig e Canny output

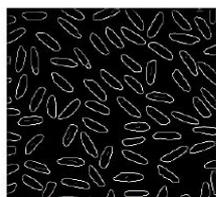


Fig f: New algo output

Figure (g): shows edge detected image when proposed hybrid algorithm is applied to original image.



Fig G Proposed Hybrid Algorithm Output

CONCLUSION AND FUTURE SCOPE

The result of proposed edge detection algorithm it's come on the conclusion that new algorithm provides more accuracy in detecting edges. The output of the proposed new algorithm clearly shows that it automatically obtains a relatively complete edge profile as compared to the traditional methods like Sobel, Prewitt, Roberts and Canny Experiments show that this hybrid technique improves the accuracy of edge detection and the final image contains a relatively complete edge profile. The output of proposed hybrid algorithm shows that it combines the edge detected images of all of the methods. It enlightens those portions of the final edge detected image where all of the fused edge detected images have edges and other parts are not highlighted well

Future Scope Edge detection is an important field in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction, which aims at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities.

The future scope will be to study the reasons for this in detail and improve this hybrid method so that it combines the advantages of all of these methods without affecting the highlighting of true edge.

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