A Flexible Thresholding Based image Edge Detection with High Resolution

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***Abstract*: edge detection is one of the critical part of image processing but the question arise here is that the available methods are good or improvements required, answer is yes there are methods of edge detection which works good but not for all type of images, some methods like Canny, Roberts and Prewitt, works better for the images having high intensity and high frequencies in other hand Sobel works better for low intensity and low frequency images. Proposed work has better solution which provides edge detection for the high and low frequency/ intensity images with modified Thresholding and combination of sobel and canny Edge detection. Feature extraction is a classic problem image processing. Edges are often detected using integer-order differential operators. Hence proposed edge detection method is working in frequency and time domain parallel.**

***Keywords*: CA: Canny Algorithm, MFM: Morphological Filtering Method, ALE: Median Line Enhancer**

I-INTRODUCTION

The classification of the edge detection algorithms based on the behavioural study of edges with respect to the operators:
a) Classical or Gradient based edge detectors (first derivative)
b) Zero crossing (second derivative)
c) Laplacian of Gaussian (LoG)
d) Gaussian edge detectors
e) Colored edge detectors
Also it can be said that there are classical edge detectors that contain different operators and use first directional derivative operation. For example Sobel(1970), Prewitt(1970), Krisch(1971), Robinson(1977), Frei-Chen(1977). Detection of edges and their orientation is the main advantage of these types of edge detectors. Main disadvantage of these types of edge detectors is sensitive to noise and inaccurate [4].
The Sobel's and the Robert's detections use some mathematical procedures that offer two different images, the first one is for the vertical edges detection and the second for the horizontal detection. After this process, these two images are combined in one final image that offer the resulting edge detection image.

II-METHODOLOGY

In this thesis, median filter algorithm is used to replace Gaussian filtering method. The pixel value of a certain point in image is substituted by the median value in its neighbourhood; this method not only reduces the influence of noise, but also can eliminate the isolated point. The adaptive real-time dual-threshold algorithm is implemented by making a differential operation on the amplitude histogram of the image. First, we need to find the maximum value of the central pixel in the same gradient direction by the non-maximum value suppression method, then the maximum value is processed by double threshold, if it is not a maximum value, Figure 1 below shows flow and block diagram of the proposed work.
Step 1: Histogram of the given image, by employing a histogram for digital values in order to an image and redistributing stretching value over image variation for maximum range for possible values [14]. Furthermore linear stretching from 'S' value may provide stronger values to each range by looking at less output values. Here a percentage for saturating image may be controlled in order to perform better visual displays.
Consider 'a' is a discrete and let n_i be the number of occurrences of gray level i. The probability of an occurrence of a pixel of level i in the image is

$$P_a(i) = p(a == i) = \frac{n_i}{n}, \quad 0 \le i \le L$$

L being the total number of gray levels in the image (typically 256), n being the total number of pixels in the image, and $P_a(i)$being in fact the image's histogram for pixel value i, normalized to [0,1].
Step 2: The contrast/colour stretching algorithm is used to enhance contrast for image. This is carried out by stretching range for colour values to make use for all possible values using the information provided by histogram analysis. Contrast/ colour stretching procedure use linear scaling function in order to pixel values. Every pixel is scaled using following function below:-
$a_o = \{(a_i - c) \times (b-c) / (d-c)\} + a$
Where
a_o is normalized pixel value;
a_i is considered pixel value taken
a is minimum value for desire range;
b is maximum value for desired range

c is lowest pixel value present in image;
d is highest pixel value present in image
The values of a, b, c and d computed from histogram values $P_a(i)$

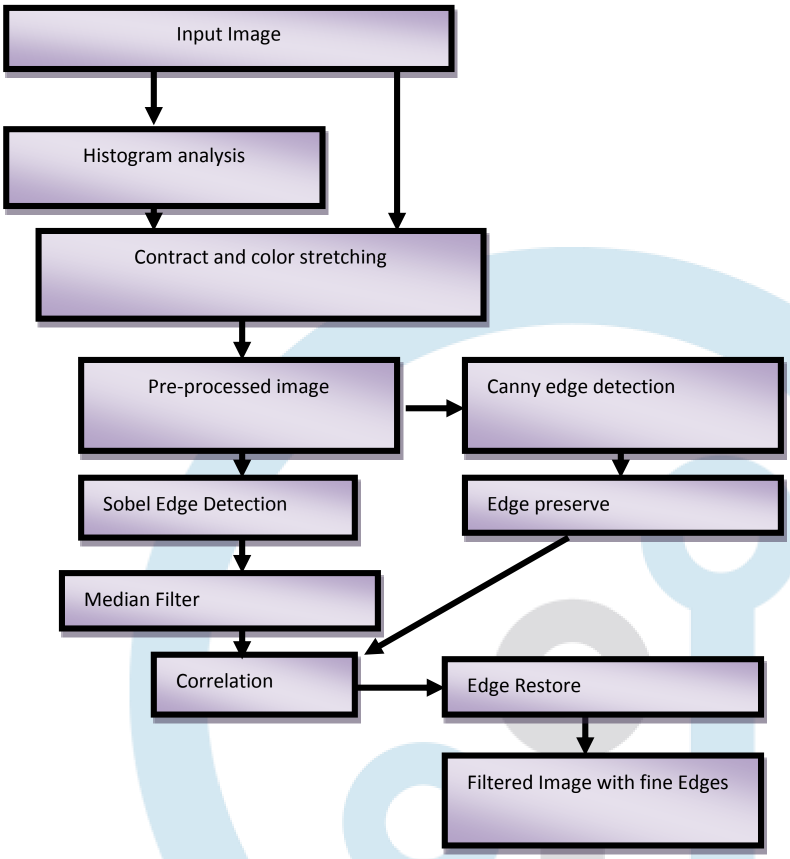

Figure 1 flow and block diagram of the work

Step 3: The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. An edge in an image may point in a variety of directions, so the Canny algorithm uses four filters to detect horizontal, vertical and diagonal edges in the blurred image. The edge detection operator (such as Roberts, Prewitt, or Sobel) returns a value for the first derivative in the horizontal direction (G_x) and the vertical direction (G_y). From this the edge gradient and direction can be determined:

$$G = \sqrt{a_x^2 + a_y^2}$$

$$\emptyset = arctan2(a_x, a_y)$$

where G can be computed using the hypot function and atan2 is the arctangent function with two arguments. The edge direction angle is rounded to one of four angles representing vertical, horizontal and the two diagonals (0°, 45°, 90° and 135°). An edge direction falling in each color region will be set to a specific angle values, for instance θ in [0°, 22.5°] or [157.5°, 180°] maps to 0°. The edges (G, ∅) will be preserve and at the time of image reconstruction it will be used and all the preserve pixels will replace the obtain pixels.

Step 4: 'a' is the image obtain after pre-processing (histogram and contrast stretching), DWT applied on 'a', Proposed work use 'sym4' type wavelet for decomposition of image

$$a(n)_L = \sum_{k=-\infty}^{\infty} a(k)g(2n-k)$$

$$a(n)_H = \sum_{k=-\infty}^{\infty} a(k)h(2n-k)$$

Where g and h coefficients of symlet. DWT2 is use for Images for two dimension DWT, hence $a(n)_L$ and $a(n)_H$ further need to filtered as below

$$a(n)_{LL} = \sum_{k=-\infty}^{\infty} a(n)_L g(2n-k)$$

$$a(n)_{LH} = \sum_{k=-\infty}^{\infty} a(n)_L h(2n-k)$$

$$a(n)_{HL} = \sum_{k=-\infty}^{\infty} a(n)_H g(2n-k)$$

$$a(n)_{HH} = \sum_{k=-\infty}^{\infty} a(n)_H h(2n-k)$$

DWT decomposing is require because after DWT decomposing, frequencies of image separates and with the help of that frequencies we can separate the LL, LH , HL and HH component and in proposed method different frequencies will be filtered differently.

Step 5: DWT based Median filter , The median filter is a nonlinear digital filtering technique, often used to remove noise from an image, The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors is called the "window", which slides, entry by entry, over the entire signal. For 1D signals, the most obvious window is just the first few preceding and following entries, whereas for 2D (or higher-dimensional) signals such as images, more complex window patterns are possible (such as "box" or "cross" patterns).

To demonstrate, using a window size of three with one entry immediately preceding and following each entry, a median filter will be applied to the following simple 1D signal:
x = [2 80 6 3]
So, the median filtered output signal y will be:
y[1] = Median[2 2 80] = 2
y[2] = Median[2 80 6] = Median[2 6 80] = 6
y[3] = Median[80 6 3] = Median[3 6 80] = 6
y[4] = Median[6 3 3] = Median[3 3 6] = 3
i.e. y = [2 6 6 3].

Note that, in the example above, because there is no entry preceding the first value, the first value is repeated, as with the last value, to obtain enough entries to fill the window. This is one way of handling missing window entries at the boundaries of the signal, but there are other schemes that have different properties that might be preferred in particular circumstances:

Avoid processing the boundaries, with or without cropping the signal or image boundary afterwards, Fetching entries from other places in the signal. With images for example, entries from the far horizontal or vertical boundary might be selected, Shrinking the window near the boundaries, so that every window is full. Hence proposed use boundary/edge perseverance along with median filter.

III-RESULT

Parameters for the valuation of the work are), Gradient (Grad), Entropy (Ent), SNR, Execution time and Speed Up ratio.

Signal to noise ratio (SNR) for denoised ECG signals was calculated & a four-dimension data was obtained. Where, calculation formula for SNR is expressed as follows

$$\mathrm{SNR} = 10 \times \log_{10}\left[\frac{\sum_{n-1}^{N} s^2(n)}{\sum_{n-1}^{N} |s(n) - \hat{s}(n)|^2}\right]$$

Gradient (Grad): An image gradient is a directional change in the intensity or color in an image. The gradient of the image is one of the fundamental building blocks in image processing.

$$grad = \frac{1}{rc}\sum_{i=1}^{RW}\sum_{j=1}^{CL} x_{ij} - x_{i(j-1)}$$

Entropy (Ent): Entropy is a statistical measure of randomness that can be used to characterize the texture of the input image

$$Ent = \sum_{i=1}^{RW}\sum_{j=1}^{CL} p_{ij}\, log_2 p_{ij}$$

Where p_{ij} is the histogram of the image x_{ij}

Execution time: it is the time for execution of the function or time from taking plane input image to develop output image with edge detected.

Speed up ratio: The speed-up factor measures how much a parallel algorithm is faster than a corresponding sequential algorithm.

$$Speedup = \frac{Sequential\ Time}{Parrallel\ Time}$$

The simulation results re been performed on the MATLAB standard images of Lena and Baboon also the Simulation is been carried out for the Medical test images of [1]

Figure 2 GIU for input image and Histogram Of Lena

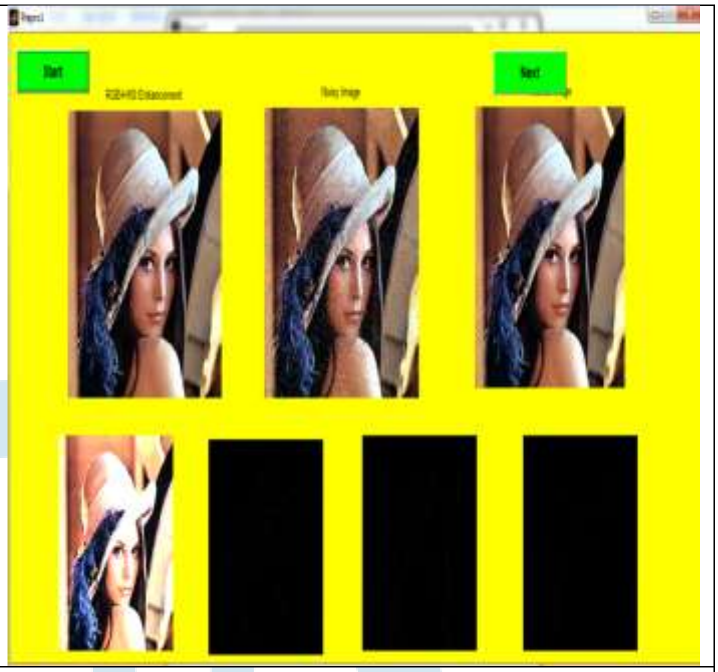

Figure 3 GIU for image enhancement of Lena

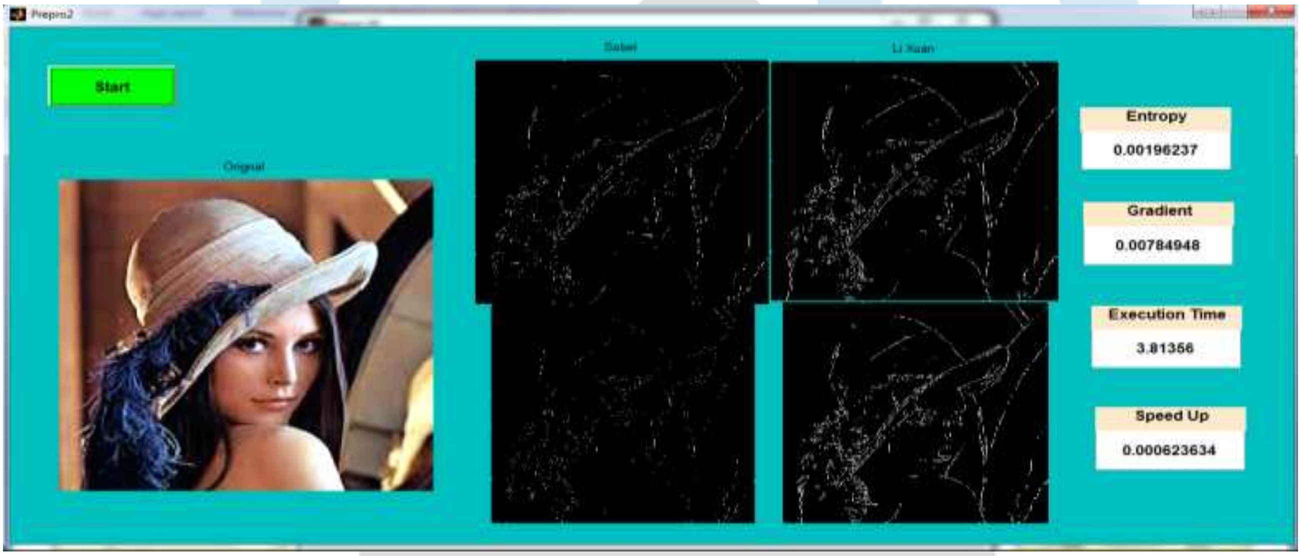

Figure 4 GIU for Edge detection and Results of Lena

Figure 6 original Lena Enhanced Image

Figure 7 Lena Enhanced Image

Figure 8 Noisy Lena Image

Figure 9 Noise Free Lena Image

Figure 10 internal Edge Detection of Lena Image

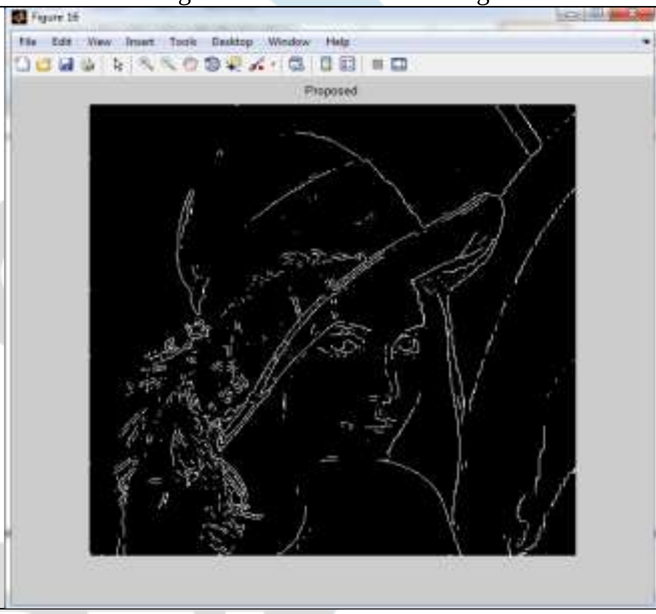

Figure 11final Lena Edge Detection

Image	**PSNR**	Speed Up ratio	Execution Time	Gradient	Entropy
Lena	37.21	1.31809	30.9863 sec	2.04181	0.510453
Baboon	39.48	1.7181	32.7936 sec	2.51478	0.628696
Medical MRI-1	38.25	1.41229	32.1961 sec	2.10553	0.526382
Medical MRI-2	37.82	0.958973	25.1398 sec	1.83099	0.457748
Average	38.21	1.345	30.27 sec	2.12	0.525

Table 1 Observe results of Entropy, Gradient, Execution time and Speed up ratio for Different Input Images

Work	**SNR**	**Gradient**	**Execution Time (seconds)**	**Entropy**	**Speed Up Ratio**
Proposed	38.21	2.12	30.27	0.525	1.345
Li Xuan/ IEEE/2017	31.94	3.15			
Tapan Sharma/ IEEE/2016	32.83	3.84			1.24
Abdelilah El Amraoui/ IEEE/ 2016				0.3662	
Bogdan Popa/IEEE/2017			75		
Meriem HACINI/IEEE/2017	29.11		85.036		

Table 2 Comparative results of of Entropy, Gradient, Execution time and Speed up ratio

IV-CONCLUSION

Image processing improvement of classical algorithm is one of the needs of our days. This study highlights that there are algorithms such as Robert or Sobel for edge detection and practical ways to improve traditional algorithms with new technology by the full utilization of the CPU on the full capacity. This article offers a comparative results study on the proposed new algorithm for edge detection and the classical ones. The new proposed strategy is based on the possibility of multiple calculus and good performances in time to the results. These analyses can convert to a good practical utilization presented in the last chapter. As edge detection is one of the fundamental operation in computer vision it is expected to be fast, accurate and reliable. Image data is typically massive in nature and it is always desirable to devise methods that can be implemented using parallel algorithms. Parallel proposed strategies perform faster than sequential processing in terms of speed but with a trade off with the performance and the efficiency of utilizing the processors individually. John Canny considered the mathematical problem of deriving an optimal smoothing filter given the criteria of detection, localization and minimizing multiple responses to a single edge.

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