International Journal of Engineering Trends and Applications (IJETA) – Volume 5 Issue 2, Mar-Apr 2018

RESEARCH ARTICLE OPEN ACCESS

# An Efficient Edge Detection Algorithm for Reducing the Limitations of Existing Operators

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## ABSTRACT

The existing edge detection operators are used in image processing techniques for many appliances. They have also some limitations in practice which are the slow process and gives noisy outputs. But, the accuracy and time consumption of those operators are very important to the exacted result. This research paper has proposed the edge detection algorithm, which is reducing the limitations and drawback of existing operators. The Butterworth filter, More Weighted Derivative Mask and Double thresholding techniques are used to get the more accurate results, noiseless outcomes and speed process. The drawbacks of existing operators will be surely replaced by the proposed method.

***Keywords:*** **—** Digital Image Processing, Edge Detection, Corneal Diseases.

## I. INTRODUCTION

Edge detection of the images is an important factor in image processing algorithms. There are many more edge detection algorithms are proposed by many researchers. But, they have some limitations like poor accuracy, noisy and slow. The proposed method is used to reducing those limitations for the consummate edge detection processes. In our previous work, the existing edge detection operators (Sobel, Robert, Prewitt, LoG and Canny) are reviewed and their drawbacks are discussed. In this work, those founded limitations are reduced by using this efficient edge detection algorithm. Finally, the performance of proposed algorithm has been analyzed and accurate levels will be compared with the existing operators.

## II. LITERATURE REVIEW

In our previous work [1], many existing edge detection algorithms are reviewed and the limitations are distinguished from other operators. Canny edge detector [2], having more accuracy and low level of Peak Signal to Noise Ratio values (dB). But, its speed is very poor when it is executed in practice. A novel particle swarm optimization approach is proposed [3], which gives more accurate edge detector than the canny operator. The proposed data fusion technology method [4] is complex to reduce the noise when compared to the Canny operator. Except for speed, the Canny operator is the ideal one than other edge detection operators.

After the Canny operator, the Sobel operator [5] is maximally used by researchers for those simple form. In the DCT domain [6], the Sobel operator is performed well and the edges are accurately separate from the image than the proposed method. Because of its less reliable in the process, the Improved Sobel Edge Detector is proposed [7] to reducing its limitation but not more difference in proposed and existing algorithm. Robert and Prewitt operators are easily executed, but its accuracy is very low and its noise ratio is also higher than other operators.

From these reviews, the proposed method should be easily executed one and give more accurate output images. They could not distract the original image structure and intensity features. The detected edges should be more sharpen and separated from the background noises. The noiseless outputs are needed for the edge detection applications. So any type of noises (like Salt and Pepper noise, Speckle Noise, Poisson Noise and Gaussian Noise) will be present in the images, the proposed method should clear those noise pixels.

## III. PROPOSED METHOD

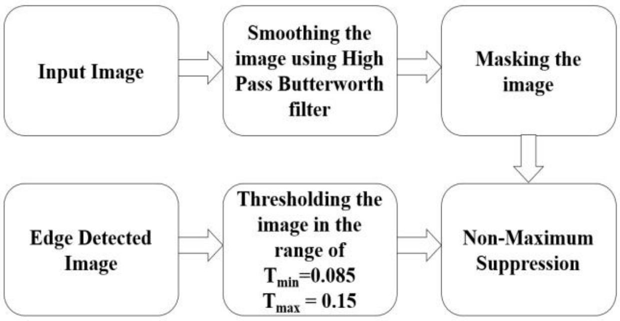



Fig. 1 Block Diagram

Fig.1 demonstrates the entire process of proposed edge detection algorithm. Naturally all images are having noises, so the smoothing is a very important step to the noiseless image and accurate result. Secondly, the derivative masks are used for the edge detection operation. Then, the Non-maximum values are eliminated by using Non-Maximum suppression. Finally, the double thresholding of image will be processed with two level of values for sharpening the detected edges.

The following steps and equations are explaining the proposed method theoretically.

**Step 1:** In this work, the image smoothing is done by using High pass Butterworth filter. The transfer function for the n[th] order of Butterworth High pass filter is given [11] as follows

$$I_s(u,v) = \frac{1}{1 + [I_0/I(u,v)]^{2n}} \quad \text{--- (1)}$$

Where $I_0$ is the cut-off frequency, $I(u,v)$ is input image and $I_s(u,v)$ is smoothed image.

**Step 2:** After applying Butterworth filter, the smoothed image is convoluted with a mask for edge detection. Commonly, all edge detected masks are also called as the derivative masks. We also propose one derivative mask as follows

$$M = \begin{bmatrix} 1 & 220 & 0 & 220 & 1 \\ 220 & -441 & 0 & -441 & 220 \\ 0 & 0 & 0 & 0 & 0 \\ 220 & -441 & 0 & -441 & 220 \\ 1 & 220 & 0 & 220 & 1 \end{bmatrix} \quad \text{--- (2)}$$

The above mask $M$ obeyed the properties of derivative masks, which are the presence of negative sign and sum of mask is equal to zero. Now the mask $M$ is convoluted with the smoothed image $I_s(u,v)$

$$I_m(u,v) = I_s(u,v) \otimes M \quad \text{--- (3)}$$

Where $I_m(u,v)$ is the masked image.

**Step 3:** In the image of $I_m(u,v)$ is an arrangement of maximum and non-maximum intensity values. The unwanted edges are also taken as the noise. So, the unwanted non-maximum values should be suppressed for the noise free edge detection process [12-14]. It is also used to sharpening the edges (only maximum values).

**Step 4:** After the Non-Maximum Suppression, there is also some of the unwanted edges are acquired. By using double thresholding process [15], we will reduce these type of noise and its intensity values are considered as follows,

$$I_T(u,v) = \begin{cases} 1 \text{ for } I_{nms}(u,v) > T_{max} \\ 0 \text{ for } I_{nms}(u,v) \leq T_{min} \end{cases} \quad \text{--- (4)}$$

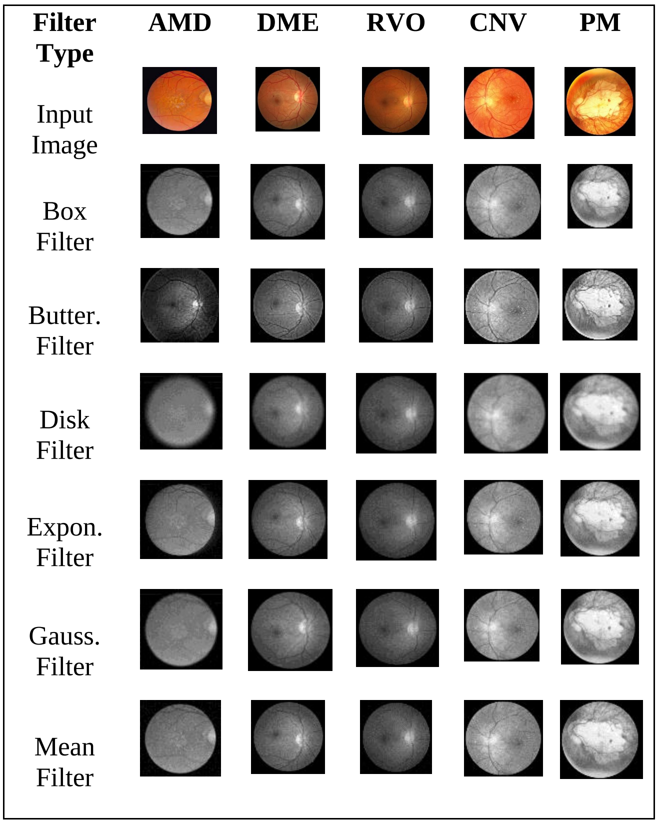
From Eqn.5, we set two values in between 0 and 1 in double thresholding process. For example $T_{max}$ =0.65 and $T_{min}$= 0.8, then the intensity values are larger than 0.8 will be a strong edge and lower than 0.65 will not be considered. Finally, $I_T(u,v)$ is the output image and the edges of the images will be detected clearly.

## IV. PERFORMANCE ANALYSIS

This work proposes to reduce the limitations of other edge detection operators. So the calculations of its accuracy, noise ratio and its execution time are very important to the ideal edge detecting operator. So, the proposed method will be analysed with other existing methods. The same input images are taken[1] for our research purpose. Those images are corneal images of various diseases, which are Age-related Macular Degeneration (AMD), Diabetic Macular Edema (DME), Retinal Vein Occlusion (RVO), Choroidal Neo Vascularization (CNV) and Pathologic Myopia (PM).

### *A. Smoothing*

In this work, the High pass Butterworth filter [16] is proposed, because of the Low pass and High boost type of Butterworth filters are having very low accuracy than High pass Butterworth filter [18]. So, it should be compared with other filters. Here, seven other filters are taken to prove the efficiency of Butterworth filter. Those filters are Box filter, Disk filter, Exponential filter [19, 20], Gaussian filter [21], Mean filter [22], Median Filter [23] and Weiner Filter [24]. The results of smoothed images of various corneal diseases are shown in Fig.2 and the Accuracy, PSNR (dB) and Execution time for those filters are tabulated in Table.1. Accuracy is calculated from its TP, TN, FP and FN. Peak Signal Noise Ratio is calculated from MSE value and expressed in dB. The execution time is the difference between the starting time and end time of the process and expressed in seconds.



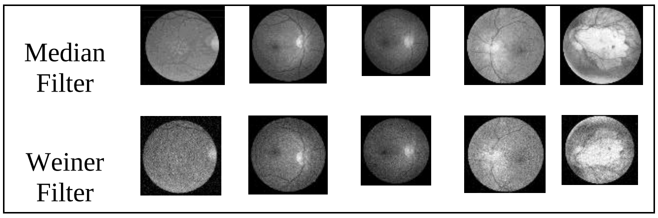



Fig.2 Smoothing results for Various Filters

Table. 1 Smoothing results for Various Filters

The great benefit of Butterworth filter is easily changing its nth order for sharpening the input image. From Table.1, the accuracy of the Gaussian Filter is better than Butterworth filter. But its PSNR (dB) value and Execution time (Sec) is very poor when compared to the Butterworth filter. The execution time of Butterworth filter is very faster than other filters.

The accuracy of the Mean filter is very nearer to the Butterworth filter but its noise ratio is so high. By using the Weiner filter, Exponential filter, Median filter and Box filter, the output images of those filters having high noise ratio in its peak signal. The disc filter having very low accuracy, its time consumption is very high, which takes 0.36 sec for AMD disease image and the PSNR value of disc filter is also higher (10.61dB) than other filters.

Comparatively, the accuracy of the Butterworth filter is very nearer to the Gaussian filter. At the same time, the Butterworth filter is very faster than the other filters and it is executed in 0.16sec. The main drawback of the Gaussian filter is time consuming, which takes 0.32 sec. This limitation is reduced by Butterworth filter.

***B. Masking***

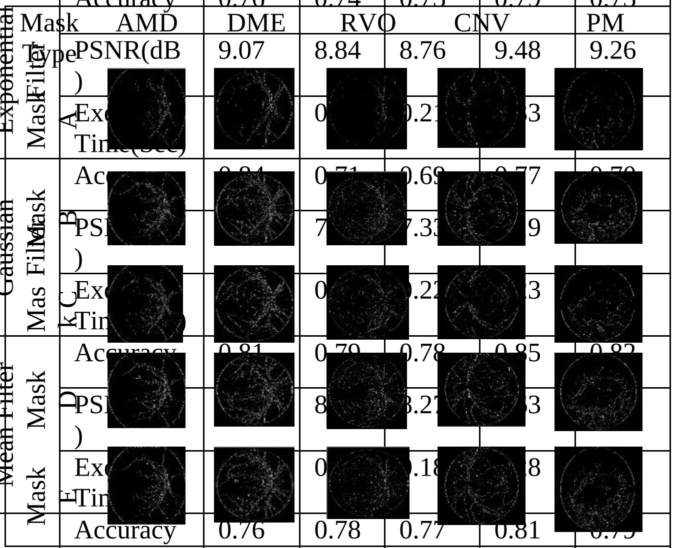
The derivative masks are used to detecting edges. The various values of masks are used which are named as Mask A, B, C, D and E and the Mask E is used in this work. Under the properties of masking technique, the more weighting values detect more edges. The masks are as follows,

$$\text{Mask A - }\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

$$\text{Mask B - }\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$$

$$\text{Mask C - }\begin{bmatrix} 1 & 0 & -1 \\ 0 & 0 & 0 \\ -1 & 0 & 1 \end{bmatrix}$$

| **Type of Filter** | **Type of Parameter** | **Name of the Disease** | | | | |
|---|---|---|---|---|---|---|
| | | **AMD** | **DME** | **RVO** | **CNV** | **PM** |
| Box Filter | Accuracy | 0.71 | 0.68 | 0.63 | 0.71 | 0.65 |
| | PSNR(dB) | 10.06 | 9.78 | 9.54 | 10.43 | 10.23 |
| | Execution Time(Sec) | 0.31 | 0.29 | 0.26 | 0.36 | 0.33 |
| Butterworth Filter | Accuracy | 0.82 | 0.81 | 0.79 | 0.89 | 0.85 |
| | PSNR(dB) | 7.85 | 7.72 | 7.61 | 8.16 | 8.03 |
| | Execution Time(Sec) | 0.16 | 0.09 | 0.06 | 0.07 | 0.08 |
| Disk Filter | Accuracy | 0.69 | 0.66 | 0.62 | 0.68 | 0.61 |
| | PSNR(dB) | 10.61 | 10.23 | 10.08 | 11.61 | 10.82 |
| | Execution Time(Sec) | 0.36 | 0.34 | 0.29 | 0.45 | 0.41 |
| Exponential Filter | Accuracy | 0.76 | 0.74 | 0.73 | 0.79 | 0.73 |
| | PSNR(dB) | 9.07 | 8.84 | 8.76 | 9.48 | 9.26 |
| | Execution Time(Sec) | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Gaussian Filter | Accuracy | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | PSNR(dB) | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Execution Time(Sec) | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Mean Filter | Accuracy | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | PSNR(dB) | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Execution Time(Sec) | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Median Filter | Accuracy | 0.76 | 0.78 | 0.77 | 0.81 | [illegible] |
| | PSNR(dB) | 8.81 | 8.73 | 8.74 | 9.14 | 8.93 |
| | Execution Time(Sec) | 0.29 | 0.27 | 0.25 | 0.32 | 0.30 |
| Weiner Filter | Accuracy | 0.72 | 0.69 | 0.65 | 0.74 | 0.68 |
| | PSNR(dB) | 9.74 | 9.63 | 9.58 | 10.17 | 9.81 |
| | Execution Time(Sec) | 0.33 | 0.29 | 0.26 | 0.39 | 0.35 |



| Type of Mask | Type of Parameter | Name of the Disease | | | | |
|---|---|---|---|---|---|---|
| | | AMD | DME | RVO | CNV | PM |
| Mask A | Accuracy | 0.72 | 0.68 | 0.65 | 0.74 | 0.76 |
| | PSNR(dB) | 16.26 | 14.93 | 12.64 | 19.12 | 18.23 |
| | Execution Time(Sec) | 0.15 | 0.10 | 0.11 | 0.13 | 0.14 |
| Mask B | Accuracy | 0.76 | 0.73 | 0.69 | 0.77 | 0.80 |
| | PSNR(dB) | 15.21 | 13.56 | 12.27 | 16.36 | 15.34 |
| | Execution Time(Sec) | 0.12 | 0.09 | 0.10 | 0.11 | 0.13 |
| Mask C | Accuracy | 0.78 | 0.75 | 0.71 | 0.80 | 0.82 |
| | PSNR(dB) | 12.18 | 11.86 | 11.13 | 13.82 | 12.47 |
| | Execution Time(Sec) | 0.05 | 0.02 | 0.04 | 0.04 | 0.06 |
| Mask D | Accuracy | 0.79 | 0.76 | 0.72 | 0.81 | 0.83 |
| | PSNR(dB) | 10.11 | 9.97 | 8.15 | 12.43 | 11.86 |
| | Execution Time(Sec) | 0.07 | 0.03 | 0.07 | 0.06 | 0.09 |
| Mask E | Accuracy | 0.82 | 0.79 | 0.77 | 0.83 | 0.86 |
| | PSNR(dB) | 8.76 | 6.36 | 5.32 | 9.76 | 9.42 |
| | Execution Time(Sec) | 0.06 | 0.02 | 0.06 | 0.05 | 0.08 |

$$\text{Mask D - } \begin{bmatrix} 1 & 4 & 6 & 4 & 1 \\ 4 & 16 & 24 & 16 & 4 \\ 6 & 24 & -220 & 24 & 6 \\ 4 & 16 & 24 & 16 & 4 \\ 1 & 4 & 6 & 4 & 1 \end{bmatrix}$$

$$\text{Mask E - } \begin{bmatrix} 1 & 220 & 0 & 220 & 1 \\ 220 & -441 & 0 & -441 & 220 \\ 0 & 0 & 0 & 0 & 0 \\ 220 & -441 & 0 & -441 & 220 \\ 1 & 220 & 0 & 220 & 1 \end{bmatrix}$$

Mask A is vertical a mask of Sobel operator and its center of the column is zero. So, it calculates the difference of values on both sides and the more weight is given to the center value so the edge intensity will be high and sharpen.

Mask B is looking like the Negative Laplacian operator. The center of the value is high but every direction around the edges are same and negative value. Mask D is also same as Mask B but it is 5 x 5 matrix and more weighted values. Also, the Mask C and Mask E are having the same arrangement of values, which are vertically and horizontally centered values are zero. But more weight is given to the Mask E and is 5 x 5 matrix. After the masking operation using Eqn.3, the results of images are shown in Fig.3 and the values of accuracy, PSNR and Execution time values are tabulated in Table.2.

Fig.3 Masking results for Various Masks

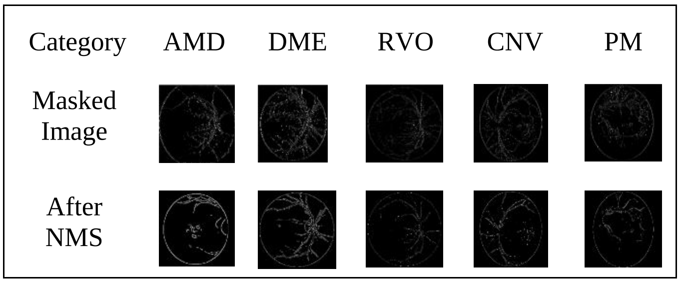
From Fig.3 and Table.2, for AMD images the accuracy of Mask C and Mask E are higher than other masks, which realizes that the values of zeros in the center of rows and columns increased the intensity of the edges. Mask D has also more accuracy but its error ratio is higher than Mask E. For AMD disease image, Mask E is executed in 0.06 sec which is slower than Mask C, but the main drawback is the noise ratio of peak signal for Mask C is so high. Comparatively, Mask A and Mask B are having the highest noise ratio and they get very slow process when compare to the other masks.

Table.2 Masking results for Various Masks

From this analysis, Mask E is good for the masking technique. It detects more edges and which are sharpened with high-intensity values. It will be reduced the limitations of other masks.

### *C. Non Maximum Suppression*

From Fig.3, after the masking process, there are many more edges are detected in the result images. Accompanied by the edges, there are many Non-Maximal values are also distracting the original edges. So that the Non-Maximum values are suppressed by (NMS) process.




. Fig. The disease images for before and after the Non-Maximum Suppression

After the process of Non-Maximum Suppression, the low level intensity values are fully suppressed is shown in Fig.4. Now, the detected edges are separated from edge noises and also they are sharper than masked image by the human vision.

### *D. Thresholding*

For the single threshold value, we will give only one constant value T. In this work, we are using double threshold values which are $T_{min}$ and $T_{max.}$ In this process the intensity values, which are lower than $T_{min}$ value, whose pixels are replaced with black pixel (set to 0) other pixels are replaced with white pixels (set to 1). Here, the five types of ranges are taken for the thresholding process. The results of those

| Threshold Value | Type of Parameter | AMD | DME | RVO | CNV | PM |
|---|---|---|---|---|---|---|
| | | **Name of the Disease** | | | | |
| $T_{min} = 0.5$ $T_{max} = 0.6$ | Accuracy | 0.62 | 0.57 | 0.51 | 0.73 | 0.68 |
| | PSNR(dB) | 18.67 | 16.52 | 14.67 | 20.36 | 21.83 |
| | Execution Time(Sec) | 0.21 | 0.19 | 0.12 | 0.15 | 0.17 |
| $T_{min} = 0.5$ $T_{max} = 0.7$ | Accuracy | 0.68 | 0.45 | 0.56 | 0.77 | 0.73 |
| | PSNR(dB) | 14.55 | 12.56 | 11.32 | 16.56 | 18.27 |
| | Execution Time(Sec) | 0.18 | 0.15 | 0.10 | 0.13 | 0014 |
| $T_{min} = 0.55$ $T_{max} = 0.7$ | Accuracy | 0.76 | 0.63 | 0.58 | 0.81 | 0.79 |
| | PSNR(dB) | 12.86 | 11.43 | 10.64 | 14.98 | 16.08 |
| | Execution Time(Sec) | 0.16 | 0.14 | 0.09 | 0.09 | 0.12 |
| $T_{min} = 0.6$ $T_{max} = 0.8$ | Accuracy | 0.83 | 0.73 | 0.62 | 0.88 | 0.85 |
| | PSNR(dB) | 11.43 | 10.15 | 9.11 | 12.45 | 13.15 |
| | Execution Time(Sec) | 0.13 | 0.12 | 0.08 | 0.09 | 0.11 |
| $T_{min} = 0.65$ $T_{max} = 0.8$ | Accuracy | 0.94 | 0.92 | 0.84 | 0.96 | 0.95 |
| | PSNR(dB) | 9.15 | 7.38 | 5.13 | 10.68 | 11.08 |
| | Execution Time(Sec) | 0.09 | 0.09 | 0.06 | 0.07 | 0.08 |

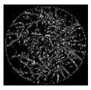
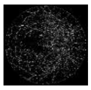
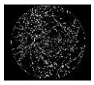
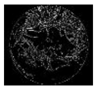
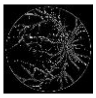
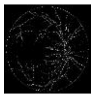
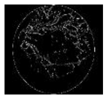
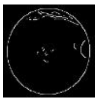
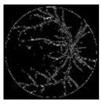
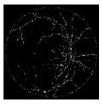
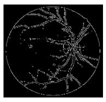
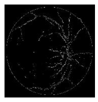
threshold values are shown in Fig.5.

. Fig.5 The disease images for before and after Double Thresholding

The lower and higher threshold values are taken as 0.5-0.6, 0.5-0.7, 0.55-0.7, 0.6-0.8 and 0.65-0.8. These are sharpening the edges and the performance will be analyzed by Table.3 as follows.

Table.3 Thresholding Results for various $T_{min}$, $T_{max}$ levels

From Table.3, the accuracy is very high for all disease images in the thresholding level of $T_{min}$= 0.65 and $T_{max}$=0.8. For AMD disease, the accuracy of those threshold levels is

| Threshold Value | AMD | DME | RVO | CNV | PM |
|---|---|---|---|---|---|
| | **Type of Disease** | | | | |
| $T_{min} = 0.5$ $T_{max} = 0.6$ |  |  |  |  |  |
| $T_{min} = 0.5$ $T_{max} = 0.7$ |  |  |  |  |  |
| $T_{min} = 0.55$ $T_{max} = 0.7$ |  |  |  |  |  |
| $T_{min} = 0.6$ $T_{max} = 0.8$ |  |  |  |  |  |
| $T_{min} = 0.65$ $T_{max} = 0.8$ |  |  |  |  |  |

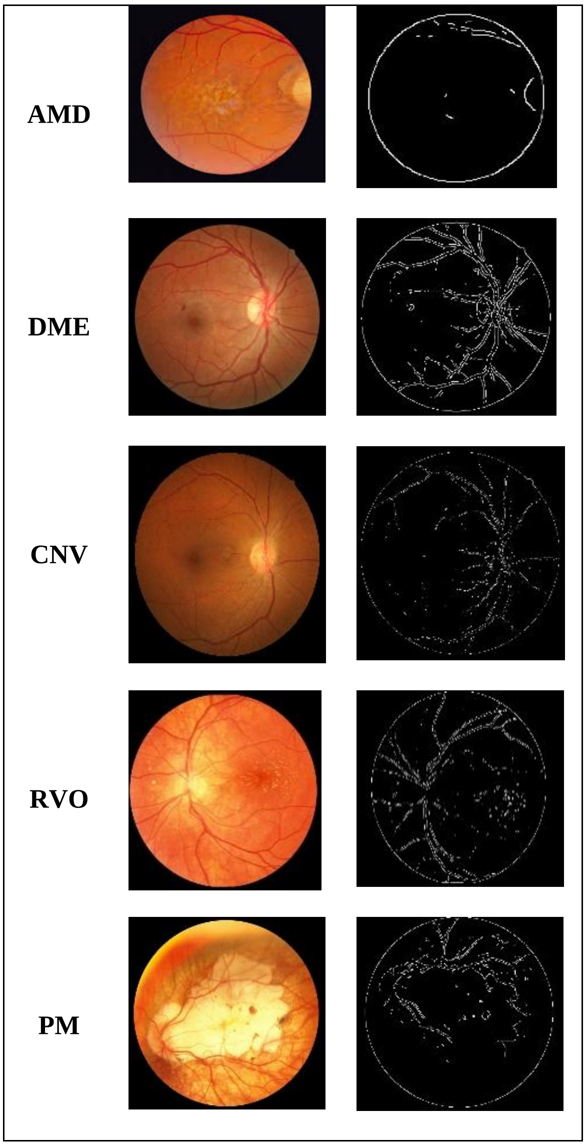
calculated as 0.94. The comparison of PSNR value in $T_{min}$= 0.65 and $T_{max}$=0.8 level is lesser than with other levels. This gives the solution as the interval of $T_{min}$= 0.65 and $T_{max}$=0.8 level is the noiseless and more sharpening edge detecting thresholding values. The main reason for taking this thresholding interval level in which execution time is very low (0.09sec). But other levels are slower (more than 0.09sec) than the $T_{min}$= 0.65, $T_{max}$=0.8 level.

From the performance analysis, the edge detection steps by using the Butterworth filter, Mask E and Double thresholding ($T_{min}$= 0.65, $T_{max}$=0.8) level are giving the best results. They are more accurate, noiseless and fast. So, the proposed method will be more efficient one.

## V. RESULTS AND DISCUSSION

The original image and its edge detected images by using proposed method for preferred corneal diseases are shown in Fig.6.

| Name of the disease | Original Image | Edge Detected Image |
|---|---|---|



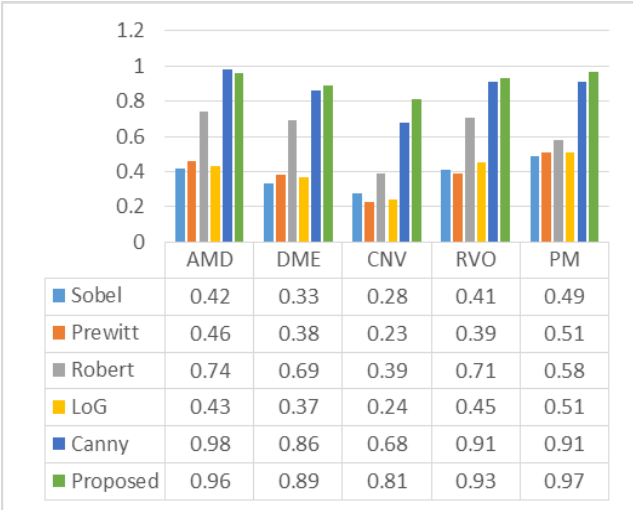

. Fig.6 Final Edge detected Results for Proposed Edge Detector

From Fig.5 the edges are accurately detected by using the proposed method. They are very sharp and noise free edges as per the human vision. But, the main goal of this work is reducing the limitations of other edge detection operators. So, the comparative studies of proposed edge detection algorithm with existing operators is the must. Now, the accuracy, noise ratio and its speed of proposed method will be analyzed with existing methods.

Table.4 Results for Proposed Edge Detector

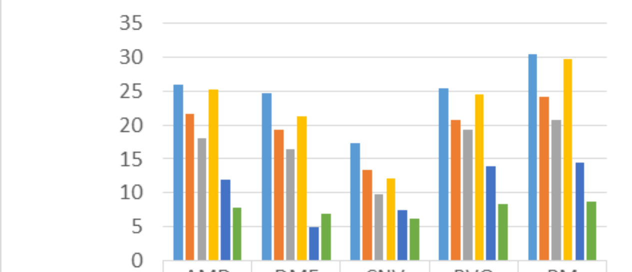
| Disease Name | Accuracy | PSNR(dB) | Execution Time (sec) |
|---|---|---|---|
| AMD | 0.96 | 7.71 | 0.31 |
| DME | 0.89 | 6.85 | 0.24 |
| CNV | 0.81 | 6.13 | 0.26 |
| RVO | 0.93 | 8.26 | 0.25 |
| PM | 0.97 | 8.77 | 0.33 |

From Table.4, the results are tabulated for the proposed method. There are three types of parameters are used to analyzing the performance of proposed edge detector. These results are compared with the results of existing edge detectors, which are already calculated in our previous work. The comparative studies between proposed and existing edge detection operators are as follows.




. Fig.7 Comparison of Accuracy values

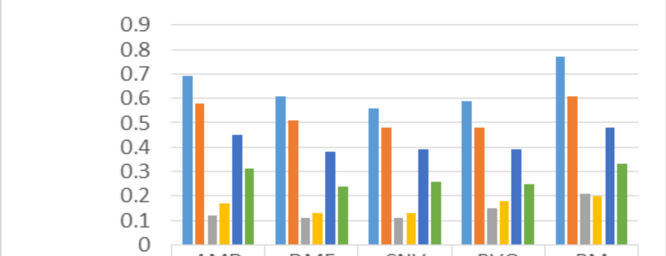
In Fig.7, the accuracy values of edge detectors are calculated. For only AMD disease, the Canny edge detector has the more accuracy (0.98) otherwise the proposed method is more accurate than the Canny operator in all images. As the calculation of accuracy, there is no more difference between Canny and Proposed algorithm. But, when compared to the other operators (LoG, Prewitt and Sobel) are having very low-level accuracy. From these discussions, the Canny and the proposed method are more accurate than others.




| | AMD | DME | CNV | RVO | PM |
|---|---|---|---|---|---|
| Sobel | 26.03 | 24.78 | 17.27 | 25.46 | 30.49 |
| Prewitt | 21.75 | 19.26 | 13.46 | 20.71 | 24.13 |
| Robert | 18.13 | 16.48 | 9.71 | 19.3 | 20.75 |
| LoG | 25.31 | 21.27 | 12.19 | 24.57 | 29.81 |
| Canny | 11.94 | 4.87 | 7.48 | 13.87 | 14.52 |
| Proposed | 7.71 | 6.85 | 6.13 | 8.26 | 8.77 |

. Fig.8 Comparison of Peak Signal to Noise Ratio (dB) values

Commonly PSNR (dB) value should be very low, then only the edge detection operator is more coherence and noiseless result. From Fig.8, the proposed method is having very low noise ratio when compared to the others. For the result of DME disease image, the Canny operator is also noiseless output image but not in other disease results. In the CNV disease image, the Robert operator is nearer to the noiseless level but it performs very noisy conditions to detect the edges in another result. Otherwise, Sobel operator gives very poor edge detection results and Prewitt and LoG are also lost their efficiency level in the readings of PSNR (dB) calculation.




| | AMD | DME | CNV | RVO | PM |
|---|---|---|---|---|---|
| Sobel | 0.69 | 0.61 | 0.56 | 0.59 | 0.77 |
| Prewitt | 0.58 | 0.51 | 0.48 | 0.48 | 0.61 |
| Robert | 0.12 | 0.11 | 0.11 | 0.15 | 0.21 |
| LoG | 0.17 | 0.13 | 0.13 | 0.18 | 0.2 |
| Canny | 0.45 | 0.38 | 0.39 | 0.39 | 0.48 |
| Proposed | 0.31 | 0.24 | 0.26 | 0.25 | 0.33 |

. Fig.9 Comparison of Execution Time (Sec) values

Then the execution time values of edge detectors are shown in Fig.9. The main drawback of the Canny edge detection is very slow when compared to the Robert and LoG operators. Now, the proposed method is also faster than the Canny edge detector. For DME disease image results, the proposed operator is quickly executed (0.24 sec) than the Canny edge detector (0.38 sec). The Sobel and Prewitt operators are also very slower than proposed edge detection algorithm.

## VI. CONCLUSION

The efficiency of proposed edge detection algorithm is proven by the performance analysis and results of this work. By using this proposed algorithm, the more accurate, noiseless and speed edge detection is possible in practice. Also, the limitations of other edge detectors are reduced by the proposed method. The most used edge detector is the Canny detector, which will be replaced (for poor execution time) by the proposed algorithm for the more effective and speed process.

## ACKNOWLEDGEMENT

This research is supported by Promotion of University Research and Scientific Excellence (PURSE) - Phase II, Department of Science and Technology (DST), Bharathiar University, Coimbatore, Tamilnadu. Award Letter No.: BU/DST PURSE (II)/ APPOINTMENT/ 9

## REFERENCES

[1] Dr. J. Vijayakumar and L.Jeganson Durai, *A Review and Performance Analysis of Image Edge Detection Algorithms*, IJFRCSCE Volume 3 Issue 12, December 2017, ISSN: 2454-4248 (397-401)

[2] Canny J., *A Computational Approach to Edge Detection*. IEEE Trans. Pattern Anal. Mach. Intell. 1986; vol. 8, no. 6, p. 679–698.

[3] Mahdi Setayesh, Mengjie Zhang, Mark Johnston, *A novel particle swarm optimisation approach to detecting continuous, thin and smooth edges in noisy images*, Information Sciences 246 (2013) 28–51

[4] Yang Oua, Dai GuangZhi, *Color Edge Detection Based on Data Fusion Technology in Presence of Gaussian Noise*, Procedia Engineering 15 (2011) 2439 – 2443

[5] Sobel, I., *An Isotropic 3×3 Gradient Operator, Machine Vision for Three – Dimensional Scenes*, Freeman, H., Academic Pres, NY, 376-379, 1990.

[6] Zhenxing Qiana, Wenwen Wang, Tong Qiao, *An Edge Detection Method in DCT Domain*, Procedia Engineering 29 (2012) 344 – 348

[7] Neha Mathur, Shruti Mathur , Divya Mathur, *A Novel Approach To Improve Sobel Edge Detector*, Procedia Computer Science 93 ( 2016 ) 431 – 43

[8] Sheng Zheng , JianLiu, JinWenTian, *A new efficient SVM-based edge detection method*, Pattern Recognition Letters 25 (2004) 1143–1154

[9] Sasirooba Thirumavalavan, Sasikala Jayaraman, *An improved teaching–learning based robust edge detection algorithm for noisy images*, Journal of Advanced Research (2016) 7, 979–989

[10] Dr.S.Vijayarani, Mrs.M.Vinupriya *Performance Analysis of Canny and Sobel Edge Detection Algorithms in Image Mining*, International Journal of Innovative Research in Computer and Communication Engineering Vol. 1, Issue 8, October 2013, ISSN(Online): 2320-9801

[11] Rafeal C. Gonzalez, Richard E. Woods, Steven L. Eddins, *Digital Image Processing*, Second Edition, Tata McGraw Hill Education Private Limited, New Delhi.

[12] Guonian Jin a,b, Xiaoxia Wana,, *An improved method for SIFT-based copy–move forgery detection using non-maximum value suppression and optimized J-Linkage*, Signal Processing: Image Communication 57 (2017) 113–125

[13] Zunlin Fan ⇑, Duyan Bi, Linyuan He, Shiping Ma, *Noise suppression and details enhancement for infrared image via novel Prior*, Infrared Physics & Technology 74 (2016) 44–52

[14] Vahid Ziaei-Rada,b, Li Shenc, Jiahao Jiangc,1, Yongxing Shen, *Identifying the crack path for the phase field approach to fracture with non-maximum suppression*, Comput. Methods Appl. Mech. Engrg. 312 (2016) 304–321

[15] Qiang Chena, Quan-sen Suna, Pheng Ann Hengb,c, De-shen Xia, *Adouble-threshold image binarization method based on edge detector*, Pattern Recognition 41 (2008) 1254 – 1267

[16] Holger G. Adelmann, *Butterworth equations for homomorphic filtering of images*, Computers in Biology and Medicine 28 (1998) 169-181

[17] Yihao Zhou, ChenSun, YuntaoSong, JubingChen, *Image pre-filtering for measurement error reduction in digital image correlation*, Optics and Lasers in Engineering 65(2015)46–56

[18] Amit Shukla1, Dr R.K. Singh, *Performance analysis of frequency domain filters for noise reduction*, e-Journal of Science & Technology (e-JST)

[19] V.A. Fursov, *Identification of square-exponential FIR - filter parameters in the absence of a test image* 3rd International Conference "Information Technology and Nanotechnology", ITNT-2017, 25-27 April 2017, Samara, Russia

[20] Zhiying Long, Li Yao, Kewei Chen c, Danling Peng, *An improved exponential filter for fast nonlinear registration of brain magnetic resonance images*, Progress in Natural Science 19 (2009) 759–767

[21] Ahlad Kumara, Mohd Fikree Hassanb, P. Raveendran, *Learning based restoration of Gaussian blurred images using weighted geometric moments and cascaded digital filters*, Applied Soft Computing 63 (2018) 124–138

[22] CengizKandemir, CemKalyoncu, ÖnsenToygar, *A weighted mean filter with spatial-bias elimination for impulse noise removal*, Digital Signal Processing 46 (2015) 164–174

[23] Ugur Erkan, Levent Gökrem, Serdar Enginoglu, *Different applied median filter in salt and pepper noise*, Computers and Electrical Engineering 0 0 0 (2018) 1–10

[24] Sovira Tan, Rubert C. D. Young, David M. Budgett, John D. Richardson, Chris R. Chatwin, *A pattern recognition Weiner filter for realistic clutter backgrounds*, Optics Communications 172 (1999) 193 - 202

[25] S. Jayaraman, S. Esakkirajan, T. Veerakumar *Digital Image Processing* Tata McGraw HillEducation private limited, New Delhi 110008.

[26] T. Venkat Narayana Rao, *Statistical Analysis for Performance Evaluation of Image Segmentation Quality Using Edge Detection Algorithms* Int. J. Advanced Networking and Applications Volume: 03; Issue: 03; Pages:1184-1193 (2011)

[27] Bhawna, 2Sukhjeet Kaur Ranade, *Performance Analysis of Filter based Techniques for Image Denoising*, IJCST Vol. 6, Iss ue 2, April - June 2015, ISSN: 0976-8491.

[28] Peter Amoako-Yirenkyi, Justice Kwame Appati1, Isaac Kwame Dontwi *Performance Analysis of Image Smoothing Techniques on a New Fractional Convolution Mask for Image Edge Detection*, Open Journal of Applied Sciences, 2016, 6, 478-488