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Performance Analysis of Filters on Complex Images for Text Extraction through Binarization

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Abstract- Text data present in image contain useful information and extraction of text from complex images is an extremely difficult task and challenging job due to variation in style, font,alignment,background intensity, illumination and various other factors. Image binarization is a technique in which text is extracted from image in dual color i.e. black and white. The extracted text will be in black color and background will be in white color. A suitable threshold value is calculated from the pixels of the input image. Existing research has been shown that different image require different method for detection or extraction of text. Filters are used for removing the noise from images and preserving the edges of text in images.. In this paper, we are doing the performance analysis of image filters on complex images for text extraction through binarization using analytical simulation in MATLAB.

Keywords: Text detection, Filters, Binarization, Thresholding, binary images.

I. INTRODUCTION

Text extraction from image is concerned with extracting the proper and suitable text data from the collection of images. Image binarization is the process of converting a image into a binary image. A binary image is the digital image which has two colors i.e. 0 and 1.The pixel value 0 represent the black color for foreground and 1 represent the white color for background. Thresholding is a technique which is used for image binarization. The pixels of an image are distinguishes as a background and foreground by comparing them to threshold value. Thresholding is further classified as global and local. Global threshold method is suitable for images with contrast foreground and background. There are certain images which contain large amount of noise, illumination and uneven lightning. In such cases, local threshold is suitable. The binary images [3] frequently occur in image processing as masks or as the outcome of segment and threshold.

Figure1: Original Image [1]

Figure2: Binarized Image

Document image binarization [10] is generally performed in the pre-processing phase of the distinctive archive picture handling related requisitions, for example optical character distinguishment and report picture recovery. There has been an increased use of cameras in acquiring document images as an alternative to traditional flat based scanners and research towards camera based document analysis is growing[2].In image processing system, a binarization process is done before the analysis and recognition procedures. Much research work has been done in the field of binarization but the effects of image filters before applying

binarization algorithm on images for text extraction is still an area of study. This dissertation has focused on effects of different filtering techniques like wiener, wavelet denoising, average, median and trimmed on image binarization. This paper is organized as follows, Section II discuss about related work with binarization. Section III includes proposed binarization technique. Section IV includes the results which simulated using MATLAB. In Section V there is a brief conclusion.

II. RELATED WORK

Jagroop Kaur et al.(2014)[13] has proposed a new method to improve degraded document binarization using guided filter. Image filters are used to remove the noise from the images. A combination of a global and a local adaptive binarization method at connected component level is proposed that aims in an improved overall performance is proposed by K. Ntirogiannis et al.(2014)[14].

Ioannis Pratikakis et al.(2013)[9] has discussed about the DIBCO(Document Image Binarization Contest). The general objective of the contest is to identify current advances in document image binarization for both machine-printed and handwritten document images using evaluation performance measures that conform to document image analysis and recognition..Konstantinos Nitrogiannis et al.(2013)[14] has addressed a pixel-based binarization evaluation methodology for historical handwritten/machine-printed document images. The recall and precision evaluation measure are properly modified using a weighting scheme that diminishes any potential evaluation bias.

Abedenour Sehad et al.(2013)[10] has proposed a scheme for binarization of ancient and degraded document images, grounded on texture qualities. Hossein Ziaei Nafchi et al.(2013) [11] has concluded that the pre-processing and post processing phases meaningfully advance the performance of binarization approaches, particularly in the situation of harshly degraded ancient documents. An unverified post processing technique is presented founded on the phase-preserved denoised image and also phase congruency features extracted from the input image. The central part of the technique comprises of two robust mask images that can be used to cross the false positive pixels on the production of the binarization technique. Djamel et al.(2013)[15] has proposed a method in which nature of every pixel is approximate using a hierarchal local thresholding in order to classify it as foreground ,background or ambiguous pixel. Marian Wagdy et al(2013)[16] has implemented a quick and proficient document image clean up and binarization technique depend on retinex hypothesis and global thresholding.

Satish Kumar et al(2012)[1] has developed a system which takes the advantage of the distinctive characteristic of text that makes it stand out from other images material i.e. text possesses certain frequency and orientation information.; text shows spatial cohesion-characters of the same text strings are of same heights, orientation and spacing. Vassilis Papavassiliou et al. (2012) [5] has discussed an capable technique dependent upon mathematical morphology for extracting text regions from degraded document images. Bolan Su et al. (2012) [6] has studied a document image binarization structure that makes utilization of the Markov Random Field model. Structure isolates the document image pixels into three classes i.e. document background text, document foreground text, and uncertain pixels established binarization method. C. Patvardhan et al. (2012) [7] has studied that images may contain difficult background i.e. shading or a denoising. Binarization method of document images creates them suitable for OCR using discrete curvelet transform.

III. PROPOSED ALGORITHM

This section contains the proposed binarization technique. The proposed technique consists of three parts: .In first part the filtering techniques are applied to the input image for removing the noise and restore it .It will improve the visibility of the input image.. In second part the local image contrast and local image gradient techniques are applied to the restored image for balancing the image variation within the images. In last part true binarization is done. The contrast map are going to binarized through using global thresholding method it will be integrated with canny edge detection to recognize the text stroke edge pixels. The proposed method is easy, robust and creates significant result over existing technique.

Step1. First of all images will be taken for experimental purpose.
Step2. If the input image is a color image then it will be converted into gray scale one.
Step3. Apply the different filtering techniques for removing the noise, making it smooth and restoring the image
Step4. Now apply the local image contrast.
Step5 Now apply the local image gradient.
Step6. The contrast map of the input image will be binarized using global thresholding method with canny edge detection to identify the text stroke edge pixels.

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Step7. The simulation parameters are calculated.

IV. EXPERIMENTAL RESULTS

This section contain the experimental result of the proposed and the existing techniques.Through experimental results is has been shown that proposed technique are quite effective and significant over existing one .Figure 3 has shown the input image to be binarized using proposed and the existing techniques.

Figure 3: Input image

Figure 4 has shown the result of existing algorithm. It is clearly shown that results are not much clear.

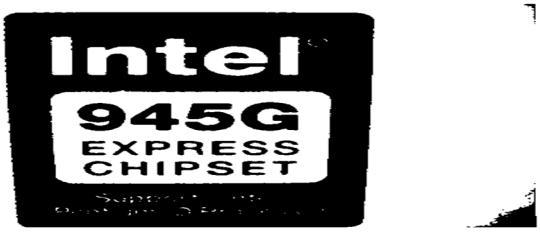

Figure 4:Existing Output

Figure 5 has shown the result of proposed algorithm. It is clearly shown that results are quite clear than the result of existing algorithm.

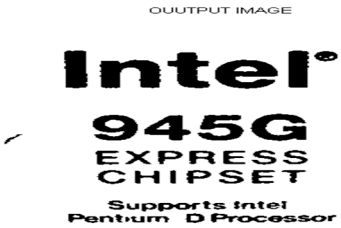

Figure 5: Proposed output

Figure 6 has shown the input image that is going to be binarized using proposed and existing technique.

Figure 6: Input Image

Figure 7 has shown the result of existing algorithm. It is clearly shown that results are not much clear.

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Figure 7: Existing Output

Figure 8 has shown the result of proposed algorithm. It is clearly shown that results are quite clear than the result of existing algorithm

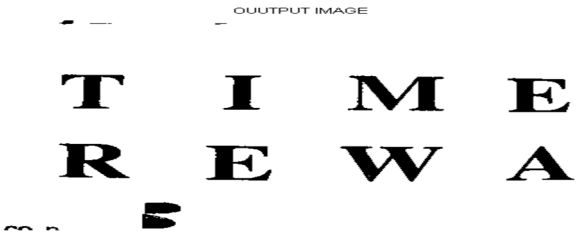

Figure 8: Proposed output

Figure 9 has shown the input image that is going to be binarized using proposed and existing technique.

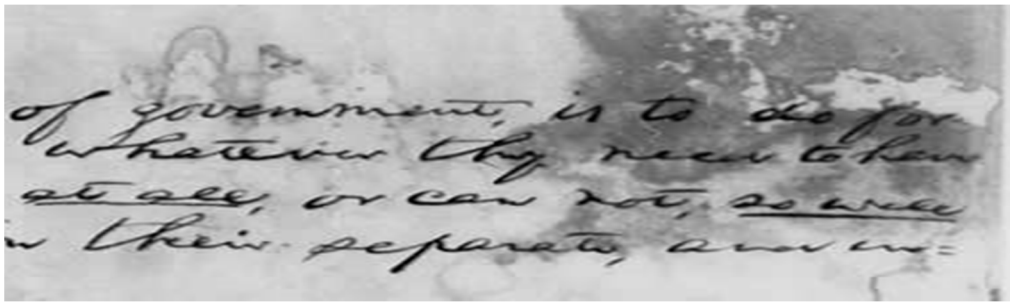

Figure 9: Input Image

Figure 10 has shown the result of existing algorithm. It is clearly shown that results are not much clear.

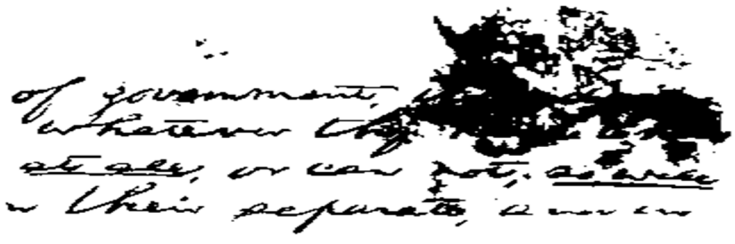

Figure 10: Existing Output

Figure 11 has shown the result of proposed algorithm. It is clearly shown that results are quite clear than the result of existing

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algorithm

Figure11: Proposed Output

V. PERFORMANCE ANALYSIS

A. MSE (Mean Square Error)

The MSE is the average of the square of the difference between the desired response and the actual system output (the error). The mean square error (MSE) is one way to evaluate the difference between an estimator and the true value of the quantity being estimated.

$$MSE = \frac{1}{MN}\sum_{i=1}^{M}\sum_{i=1}^{N}(x(i,j) - y(i,j))^2$$

B. PSNR (Peak Signal to Noise Ratio)

The term peak signal-to-noise ratio (PSNR) is an expression for the ratio between the maximum possible value (power) of a signal and the power of distorting noise that affects the quality of its representation.

$$PSNR = 10\log_{10}\frac{(2^n-1)^2}{\sqrt{MSE}}$$

C. NCC (Normalized Cross-Correlation)

For image-processing applications in which the brightness of the image and template can vary due to lighting and exposure conditions, the images can be first normalized.

$$NCC = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}x(i,j)*y(i,j)}{\sum_{i=1}^{M}\sum_{j=1}^{N}(x(i,j))^2}$$

D. NAE (Normalized Absolute Error)

The large the value of NAE means that image is poor quality.

$$NAE = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}|\,x(i,j)-y)(i,j)|}{\sum_{i=1}^{M}\sum_{j=1}^{N}|x(i,j)|}$$

Table 1 and Figure 12 are showing the comparative analysis between proposed and the existing one in terms of PSNR for input image figure 3.

Filters ⟶	Wiener	Wavelet denoising	Average	Medium	Trimmed
Existing	50.6416	50.6256	50.6324	50.664	50.6276
Proposed	50.7586	50.7263	50.8201	50.7458	50.7993

Table: 1

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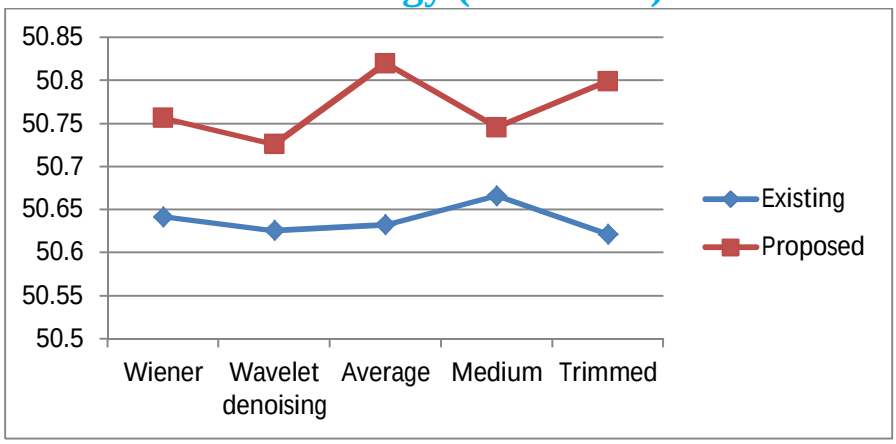

Figure: 12

Table 2 and Figure 13 are showing the comparative analysis between proposed and the existing one in terms of MSE for input image figure 3.

Filters →	Wiener	Wavelet denoising	Average	Medium	Trimmed
Existing	0.5644	0.563	0.5621	0.5577	0.5639
Proposed	0.546	0.5501	0.5384	0.5476	0.5409

Table:2

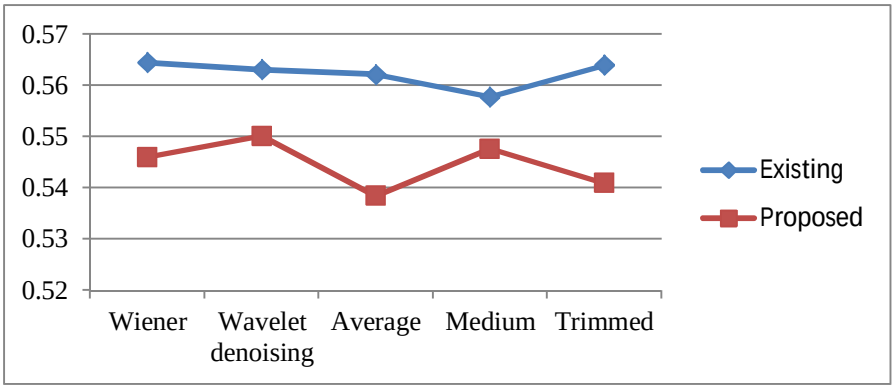

Figure:13

Table 3 and Figure 14 are showing the comparative analysis between proposed and the existing one in terms of NCC for input image figure 3.

Filters →	Wiener	Wavelet denoising	Average	Medium	Trimmed
Existing	2.499	2.5046	2.487	2.4297	2.4892
Proposed	2.4598	2.4822	2.43	2.4566	2.4436

Table: 3

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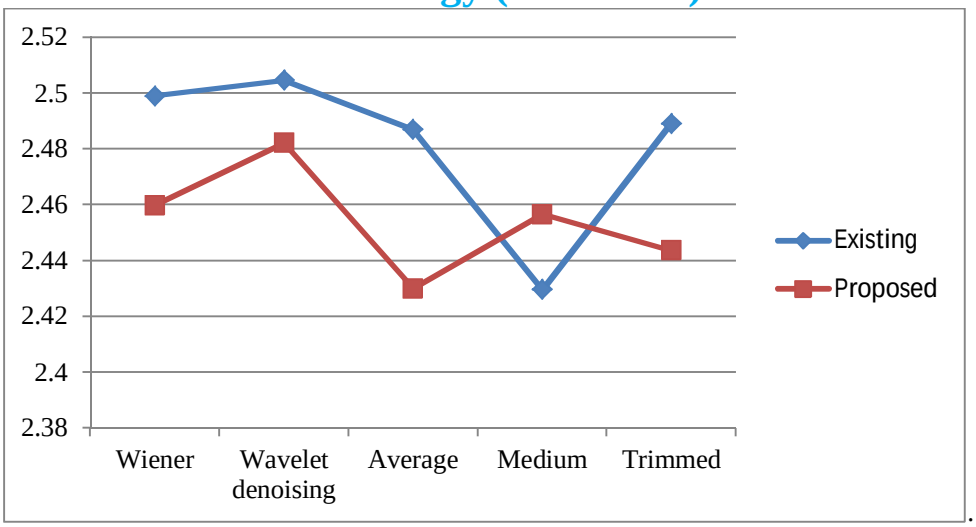

Figure: 14

Table 4 and Figure 15 are showing the comparative analysis between proposed and the existing one in terms of NAE for input image figure 3.

Filters →	Wiener	Wavelet denoising	Average	Medium	Trimmed
Existing	2.7976	2.7922	2.7885	2.7711	2.7944
Proposed	2.7291	2.7451	2.7003	2.7336	2.7099

Table: 4

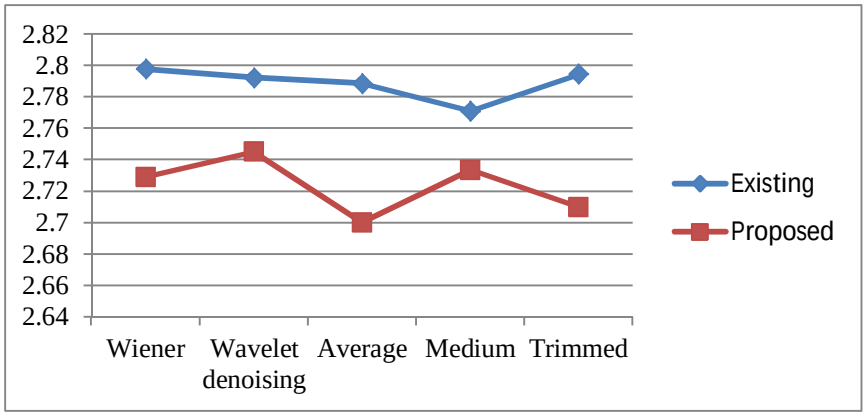

Figure: 15

Table 5and Figure 16 are showing the comparative analysis between proposed and the existing one in terms of PSNR for input image figure 6.

Filters →	Wiener	Wavelet denoising	Average	Medium	Trimmed
Existing	53.9473	53.9818	53.9739	53.9322	53.9764
Proposed	53.9481	53.9766	53.9909	53.9884	53.9754

Table: 5

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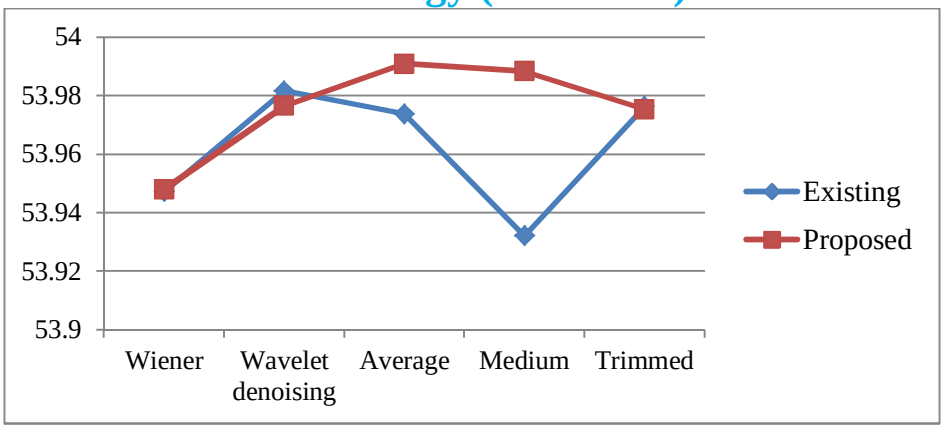

Figure: 16

Table 6 and Figure 17 are showing the comparative analysis between proposed and the existing one in terms of MSE for input image figure 6.

Filters →	Wiener	Wavelet denoising	Average	Medium	Trimmed
Existing	0.262	0.26	0.2604	0.2629	0.2603
Proposed	0.262	0.2603	0.2594	0.2596	0.2603

Table: 6

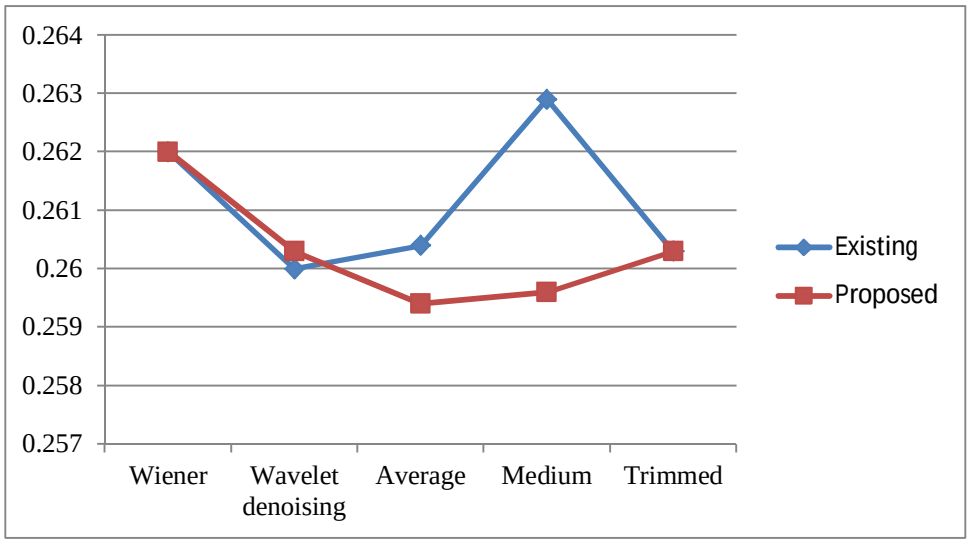

Figure: 17

Table 7 and Figure 18 are showing the comparative analysis between proposed and the existing one in terms of NCC for input image figure 6.

Filters →	Wiener	Wavelet denoising	Average	Medium	Trimmed
Existing	1.7553	17524	1.7456	1.7641	1.7502
Proposed	1.7319	1.744	1.7226	1.7321	1.7288

Table: 7

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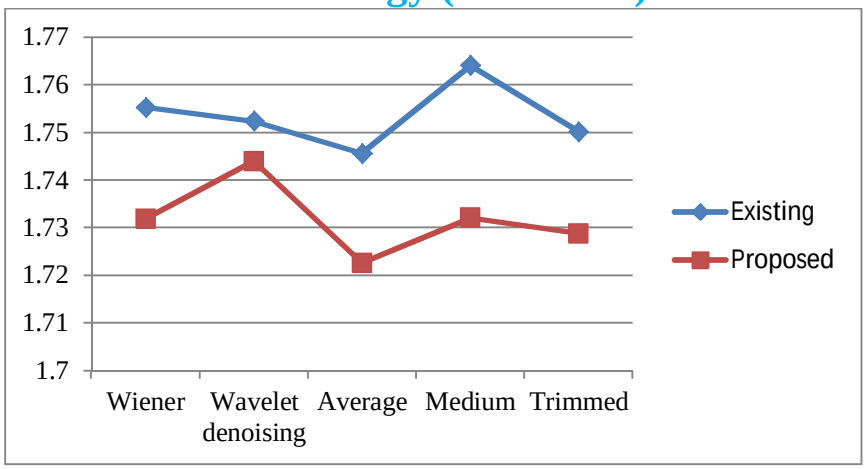

Figure: 18

Table 8 and Figure 19 are showing the comparative analysis between proposed and the existing one in terms of NAE for input image figure 6.

Filters →	Wiener	Wavelet denoising	Average	Medium	Trimmed
Existing	0.9528	0.9486	0.9494	0.9537	0.9493
Proposed	0.9504	0.9476	0.9451	0.9451	0.9471

Table: 8

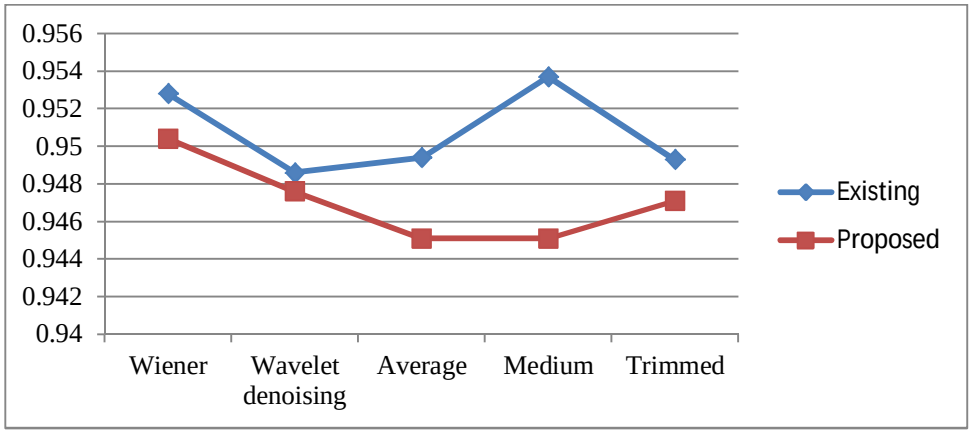

Figure: 19

Table 9 and Figure 20 are showing the comparative analysis between proposed and the existing one in terms of PSNR for input image figure 9.

Filters →	Wiener	Wavelet denoising	Average	Medium	Trimmed
Existing	56.5778	56.4238	56.5942	56.5998	56.5651
Proposed	56.4339	56.3978	56.3622	56.4654	56.4708

Table: 9

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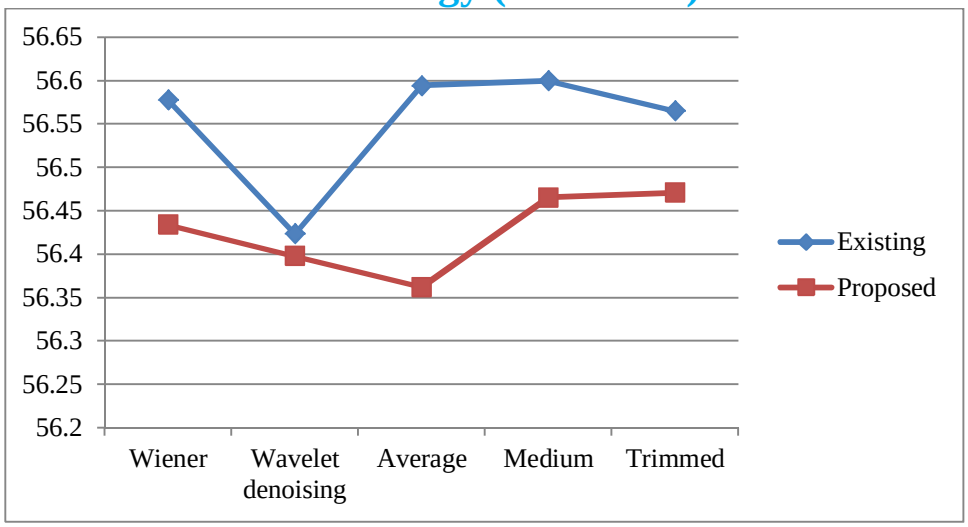

Figure: 20

Table 10 and Figure 21are showing the comparative analysis between proposed and the existing one in terms of MSE for input image figure 9.

Filters ⟶	Wiener	Wavelet denoising	Average	Medium	Trimmed
Existing	0.143	0.1481	0.1424	0.1423	0.1434
Proposed	0.1478	0.149	0.1503	0.1467	0.1466

Table: 10

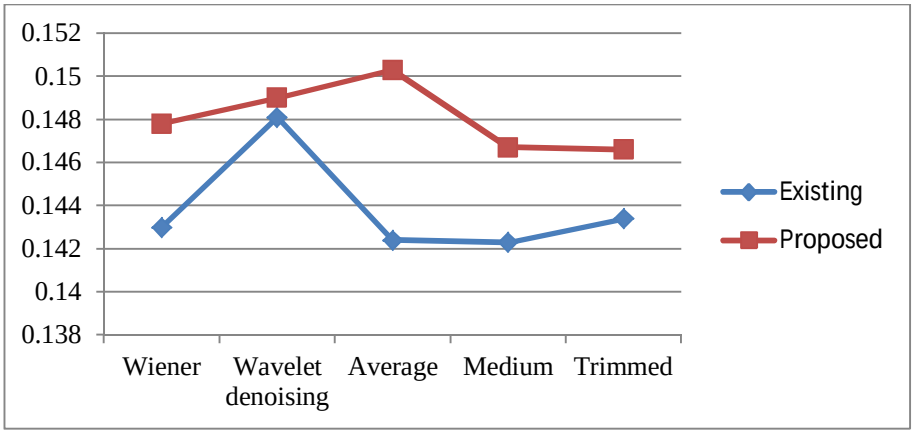

Figure: 21

Table 11 and Figure 22 are showing the comparative analysis between proposed and the existing one in terms of NCC for input image figure 9.

Filters ⟶	Wiener	Wavelet denoising	Average	Medium	Trimmed
Existing	1.3372	1.3195	1.3457	1.3279	1.3396
Proposed	1.3416	1.3153	1.3149	1.3399	1.3432

Table: 11

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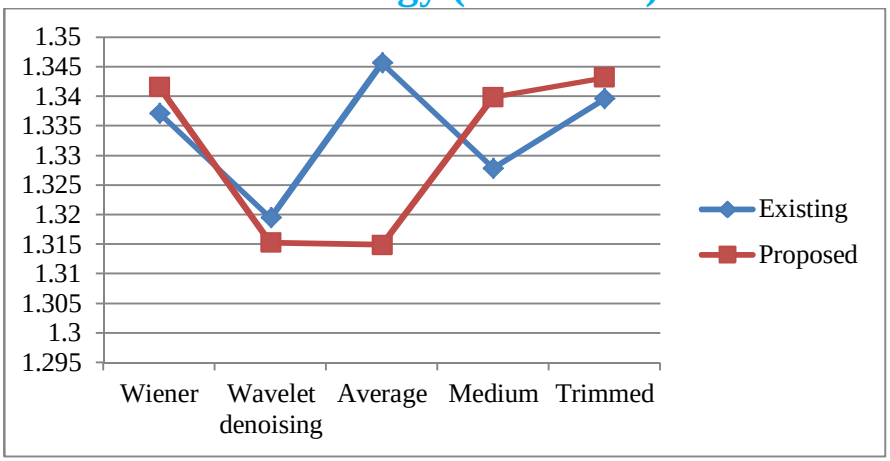

Figure: 22

Table 12 and Figure 23 are showing the comparative analysis between proposed and the existing one in terms of NAE for input image figure 9.

Filters ⟶	Wiener	Wavelet denoising	Average	Medium	Trimmed
Existing	50.6416	50.6256	50.6324	50.6664	50.6216
Proposed	50.7568	50.7263	50.8201	50.7458	50.7993

Figure: 12

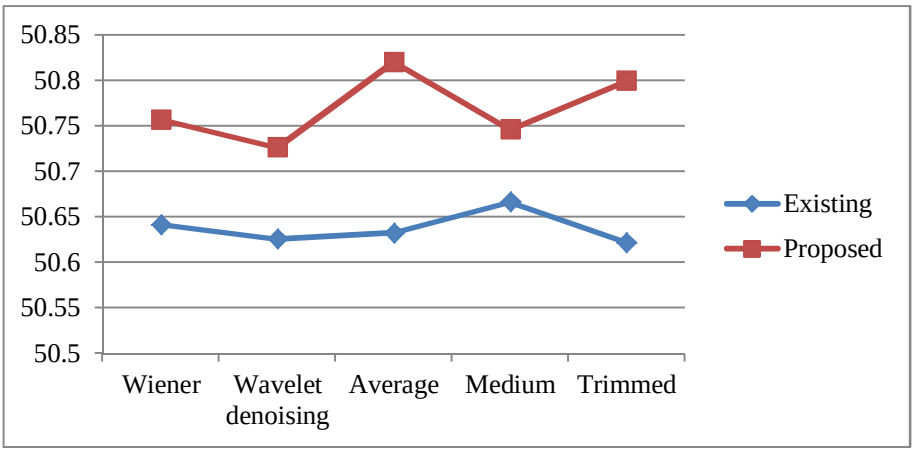

Figure: 23

VI. CONCLUSION

It has been found that every technique has its own advantages and disadvantages. Each case requires its own method of binarization for text extraction form images. The main limitation of existing technique is found that images are noisy and low intensity. The different filtering has been applied to the existing and proposed algorithms. The comparative analysis has shown that the proposed algorithm outperform over the existing method.

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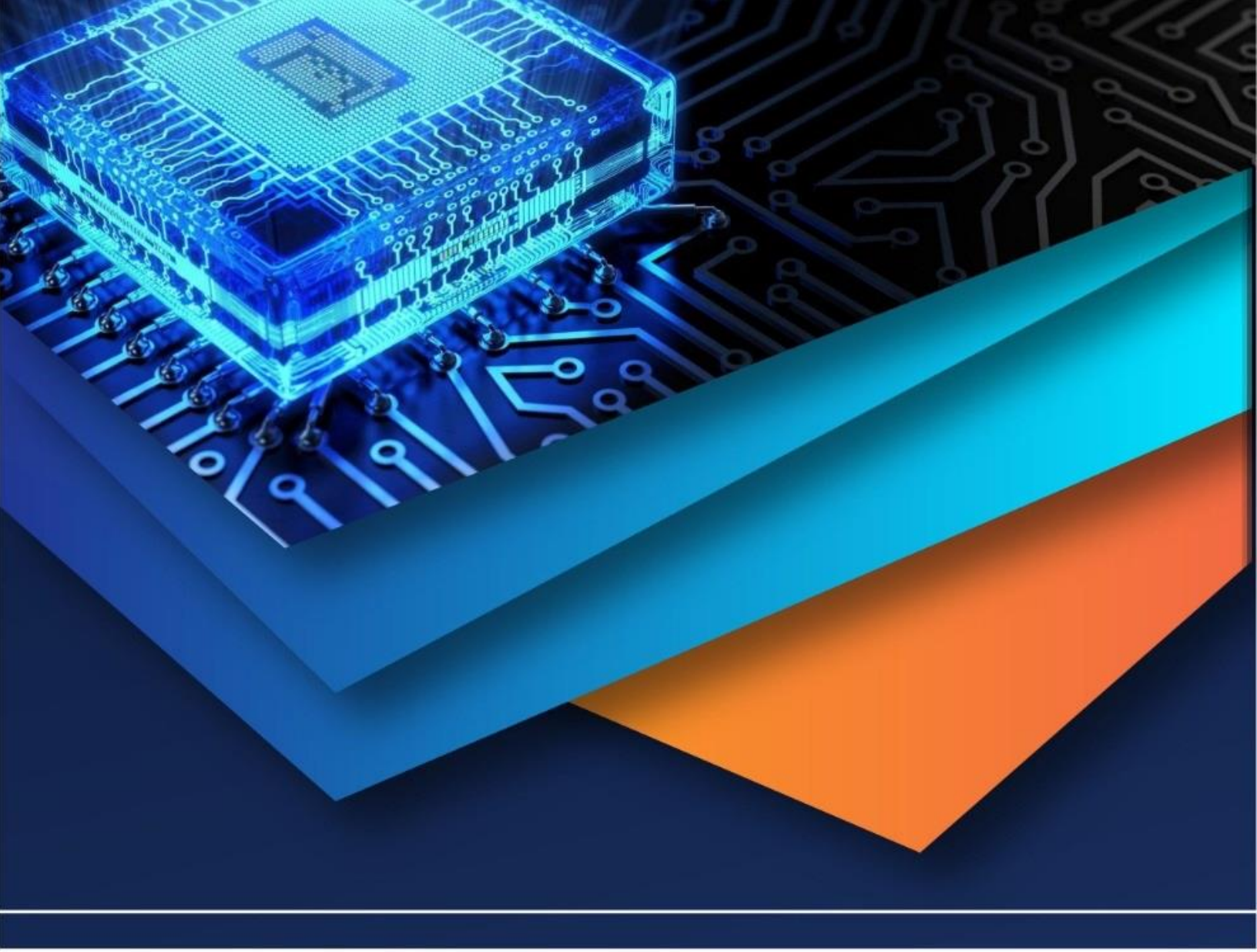

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