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Improved Degraded Document Image Binarization Using Guided Image Filter

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Abstract: ***Image binarization plays major role for document image binarization. Scanning and printing of documents can degrades their visibility that means it become difficult to understand them. This dissertation has focused on the different image binarization technique. Several techniques have been proposed so far for document binarization as shown in literature survey. Existing research has been shown that no technique is perfect for every case. Therefore still some research is required in this field of image binarization. Several researchers have used image filters to reduce the noise from the image however the utilization of the guided filter (best edge preserving filter) is not found. It may increase the accuracy of the present binarization strategies. Within the most of techniques the contrast enhancement is either done by tradition way or not done. Therefore adaptive contrast enhancement is required. Most of the strategies have neglected the utilization of edge map that has the capability to map the precise character in proficient manner. This paper has proposed a new technique which has the ability to binarized documents in more efficient manner. The proposed method has integrated the image gradients and the image contrast enhancement to improve the accuracy of document image binarization. The proposed technique also utilizes the guided image filter to improve the accuracy rate further. The comparative analysis has shown that the proposed algorithm provides quite significant improvement over the available algorithms.***

Index terms: Documents, Binarization, thresholding, binary image, guided image filter.

I. INTRODUCTION

Image binarization is the process of separation of pixel values into dual collections, black as foreground and white as background. Thresholding has created to be a well-known technique used for binarization of document images. Thresholding is further divide into the global and local thresholding technique. In document with uniform contrast delivery of background and foreground, global thresholding is has found to be best technique. In degraded documents, where extensive background noise or difference in contrast and brightness exists i.e. there exists many pixels that cannot be effortlessly categorized as foreground or background. In such cases, local thresholding has significant over available techniques. The main objective of this chapter is to evaluate the different image binarization techniques to find the gaps in existing techniques .A binary image [1] is a digital image that has just two feasible values meant for every pixel. Normally, two colors are used for a binary image i.e. black and white however any two colors can be used. The color used for the objects in the image is the foreground color while the rest of the image is the background color. Binary images [2] frequently occur in image processing as masks or as the outcome of some operations as segmentation and thresholding. A Few input/output devices, for example, laser printers, bi-level computer displays, are able to just handle bi-level images. Binary images are formed from color images by segmentation.

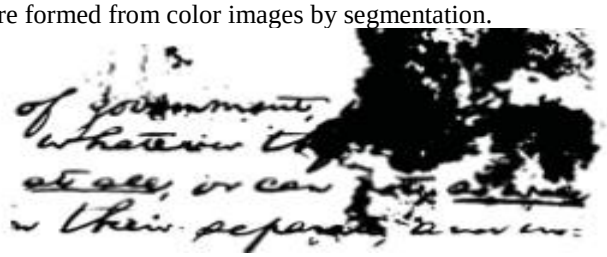

Figure 1: Input image (adapted from[3])

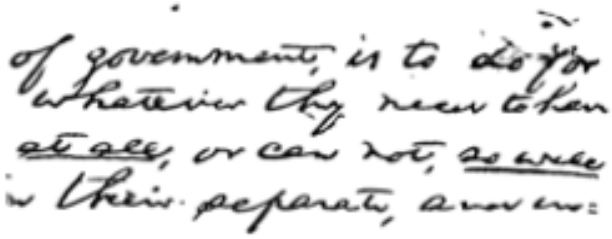

Figure 2: Binarized image (adapted from [3])

Figure 1 has shown the input image for binarization and figure 2 has shown the binary image for the same.Document image binarization is generally performed in the pre-processing phase of distinctive archive picture handling related requisitions, for example, optical character distiguishment (OCR) and report picture recovery. It changes over a light black scale record picture into a paired archive picture and likewise encourages the following assignments, for example, report skew estimation also report format examination. As more content records are checked, quick and exact report picture binarization is getting to be progressively critical. Despite the fact that archive picture binarization has been considered for a long time, the thresholding of debased record pictures is still an unsolved issue. This could be illustrated by the way that the displaying of the record foreground/background is extremely troublesome because of different sorts of report debasement, for example, uneven enlightenment, picture contrast variety, dying through, and smear. We attempt to create vigorous and productive report picture binarization methods which have the capacity to handle great effects for severely debased archive pictures. Generally, they can be classified into three major types: global binarization, local binarization and hybrid binarization methods.

II. RELATED WORK

Ioannis Pratikakis1 et al. (2013) [4] has discussed a contest. The general target of the contest is to distinguish current developments in document image binarization for both machine-printed and manually written record images utilizing assessment execution measures that obey document image investigation and recognition. Abdenour Sehad et al.(2013) [5] has present a capable scheme for binarization of ancient and degraded document images, grounded on texture qualities. The suggested technique is an adaptive threshold-based. Hossein Ziaei Nafchi et al.(2013) [6] 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. Jon Parker et al.(2013) [7] has studied that regularly documents of notable noteworthiness are ran across in a state of deterioration. Such archives are regularly examined to all the while history and announce a disclosure. Konstantinos Ntirogiannis et al.(2013) [8] has analysed that document image binarization is of incredible value in the document image examination and recognition pipeline as it disturbs further phases of the recognition procedure. Vincent Rabeux et al. (2013) [9] has an approach to expect the outcome of binarization algorithms on a known document image according to its situation of degradation. Documents having degradation which result in binarization errors. To characterize the degradation of a document image by using different features based on the strength, amount and position of the degradation. These characteristics allow us to build calculation models of binarization algorithms that are very accurate according to ***R2*** values and p-values. Djamel GACEB et al. (2013) [10] has studied a smart-binarization technique of the images. In this technique, considered different degradations document images.

The nature of every pixel is approximate using a hierarchical local thresholding in order to classify it as foreground, background or ambiguous pixel. The ambiguous pixels that represent the corrupted zones cannot be binarized with the same local thresholding. Marian Wagdy et al. (2013) [11] has implemented a quick and proficient document image clean-up and binarization technique depend on retinex hypothesis and global thresholding. This technique joins of local and global thresholding with concept of retinex theory which can efficiently improve the degraded and poor quality document image. Then, quick global threshold is utilized to change over the document image into binary form. Vassilis Papavassiliou et al. (2012) [12] has discussed an capable technique dependent upon mathematical morphology for extracting text regions from degradeddocument images. Bolan Su et al. (2012) [13] 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) [14] 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. Curvelet transform is used for eliminate difficult image background, white Gaussian noise and gives improved binarized document image.

III. PROPOSED ALGORITHM

This section contains the detail of the proposed image binarization technique.This work proposed a new algorithm for degraded image binarization. The proposed technique consists three parts: (1) this part will be responsible for applying the guided image filter to smooth and restore a degraded document. The part (1) will improve the visibility of and degraded image therefore will become solid justification to improve the binarization result. Now part (2) comes in action: in this part adaptive image contrast enhancement are going to be applied. The adaptive image contrast is a grouping of the local image contrast and the local image gradient that understands to text and background variation caused by dissimilar types of document degradations. At last part (3) is under action which can do the true binarization. The contrast map are going to be binarized using adaptive thresholding thus it will be integrated with Hybrid edge map (i.e. Canny's and Laplacian' edge map) to recognize the text stroke edge pixels. The document text is more fragmented through a local threshold that may be estimated upon the intensities of identify text stroke edge pixels within a local window. The proposed method is easy, robust, and includes least parameter tuning to create effective results than existing method.

	Proposed algorithm
Step 1:	First of all an document image will be taken for experimental purpose.
Step 2:	If the input image is a color image then it will be converted into a gray scale one.
Step 3:	Apply the guided image filter to smooth and restore the input document image.
Step 4:	Now adaptive image contrast enhancement will come in action in order to improve the contrast of the input image.
Step 5:	Now contrast map of the input image will be binarized using adaptive thresholding and it is integrated with Hybrid edge map to identify the text stroke edge pixels.
Step 6:	Apply Local threshold to convert the image into a final binarized image.

IV. EXPERIMENTAL RESULTS

This section contains the experimental results of the proposed and the existing technique. It has been clearly shown that the outcomes of the proposed techniques are quite effective than the existing techniques.

Figure 1 has shown the input image that is going to be binarized using the proposed and the existing technique.

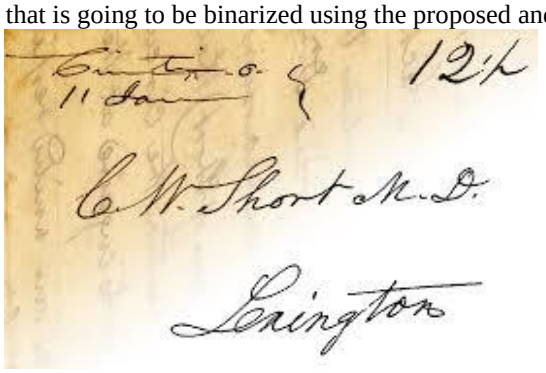

Figure 3: input image

Figure 4 has shown the results of the existing algorithm. It has been clearly shown that the results are not much clearer.

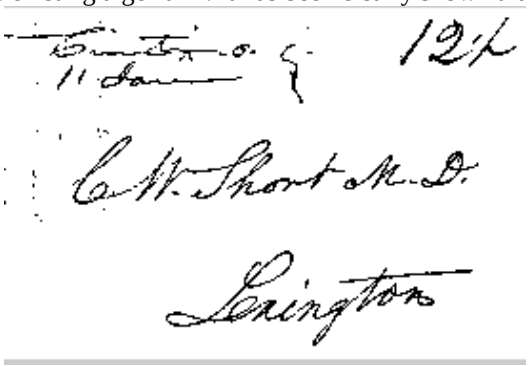

Figure 4: existing output

Figure 5 has shown the results of the proposed technique. It has been clearly shown that the results are quite clearer than the results shown in figure 4.

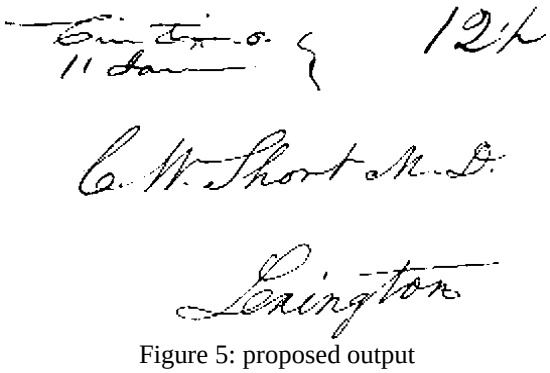

Figure 5: proposed output

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

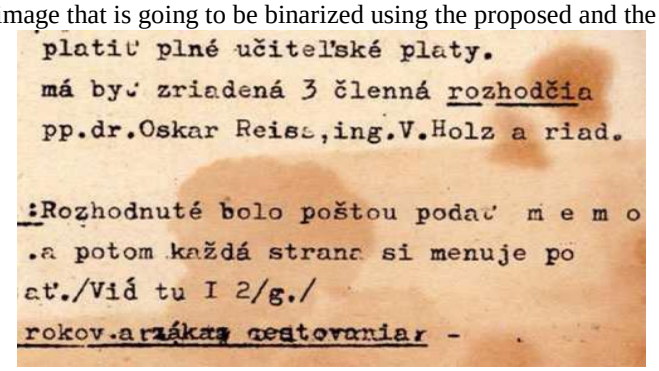

Figure 6: input image

Figure 7 has shown the results of the existing algorithm. It has been clearly shown that the results are not much clearer

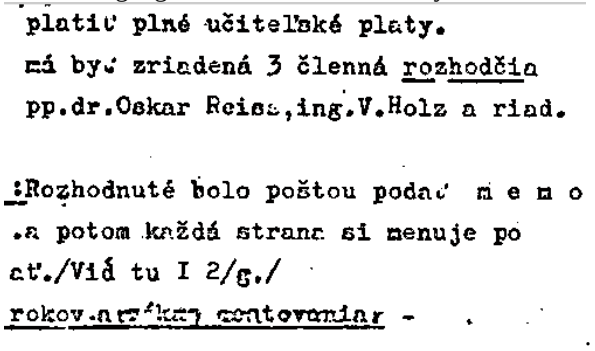

Figure 7: existing output

Figure 8 has shown the results of the proposed technique. It has been clearly shown that the results are quite clearer than the results shown in figure 7.

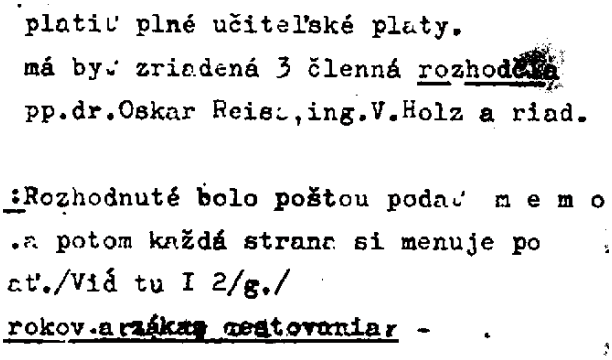

Figure 8: proposed output

V. PERFORMANCE ANALYSIS

Table 1 and figure 1 are showing the comparative analysis between the proposed and the existing technique. Precision in digital images retrieval is the fraction of the documents that are relevant to the query that are successfully retrieved. It lies between 0 - 1 or close to 1 means effective results. Table 1 has shown that the new technique is better than the existing as the Precision value is more in the proposed algorithm and proposed has value close to 1 value ; thus proposed has shown quite effective results.

Table1: Precision evaluation

Image Name	Old result	New result
1	0.87041	0.97979
2	0.97239	0.99242
3	0.98101	0.99419
4	0.72329	0.80525
5	0.64614	0.7933
6	0.86604	0.91685
7	0.95806	0.99344
8	0.83697	0.91874

9	0.95632	0.98823
10	0.81815	0.82580
11	0.91127	0.99335
12	0.96174	0.97629
13	0.96868	0.98568
14	0.94510	0.96561
15	0.97655	0.99293

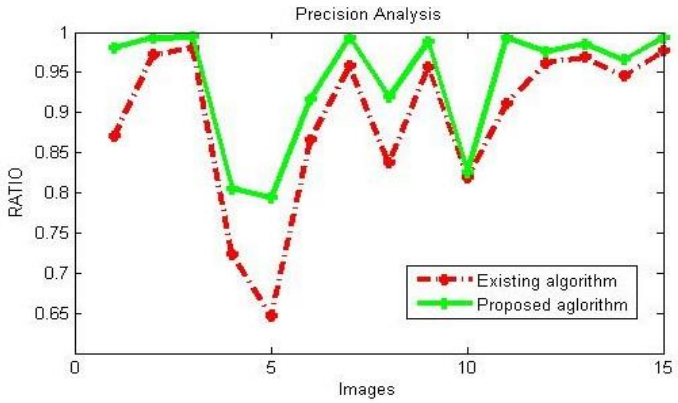

Figure 1 Precision evaluation

Table 2: F-Measure (%) analysis

Image Name	Old result	New result
1	93.07151	98.39377
2	98.60007	99.08034
3	99.04115	99.86730
4	83.94308	87.00931
5	78.50363	81.81240
6	92.82121	94.82202
7	97.85819	98.68126
8	91.12484	96.18136
9	97.76722	98.48186
10	89.99785	90.59282
11	95.357765	98.87510
12	98.04961	98.24248
13	98.40927	98.58422
14	97.17775	99.70799
15	98.81350	99.27162

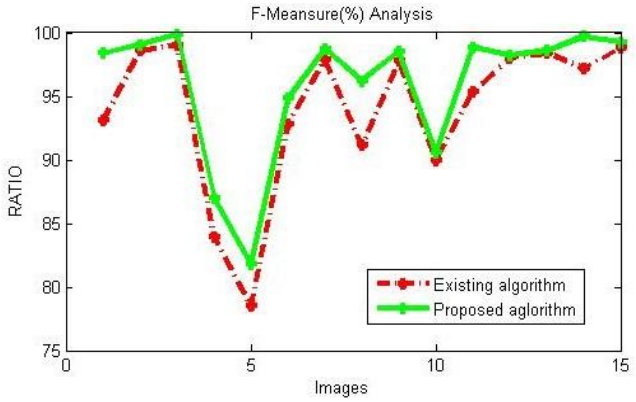

Figure 2F-Measure (%) analysis

Table 2 and figure 2 are showing the comparative analysis between the proposed and the existing technique with respect to. F-Measure needs to be maximized. Table 1 has shown that the new technique is better than the existing as the value is more in the proposed algorithm; therefore proposed algorithm has shown fairly effective outcomes.

Table3: Specificity

Image Name	Old result	New result
1	0.98654	0.99994
2	0.99678	1.00000
3	0.99900	1.00000
4	0.97936	1.00000
5	0.92591	1.00000
6	0.98366	1.00000
7	0.99370	1.00000
8	0.98440	1.00000
9	0.99451	1.00000
10	0.96346	1.00000
11	0.99035	1.00000
12	0.99238	0.93100
13	0.98971	0.93741
14	0.99635	0.94625
15	0.99620	1.00000

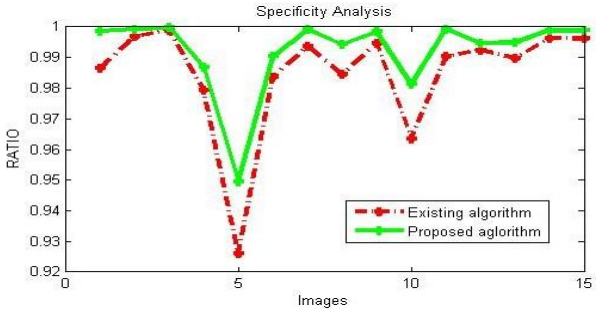

Figure 3 Specificity

Table 4: Geometric Accuracy

Image Name	Old result	New result
1	0.99325	0.99901
2	0.99839	0.99559
3	0.99950	0.99723
4	0.998963	0.99479
5	0.96224	0.99489
6	0.99179	0.99589
7	0.99684	0.99559
8	0.99217	0.99923
9	0.99725	0.99644
10	0.98156	0.98049
11	0.99516	0.99683
12	0.99618	0.96550
13	0.99484	0.96870
14	0.99817	0.97312
15	0.99810	0.99095

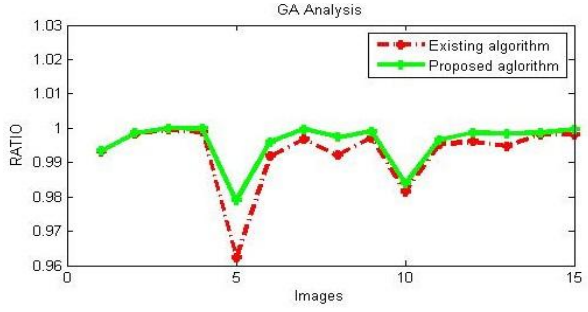

Figure 4 Geometric Accuracy

Table 5: PSNR

Image Name	Old result	New result
1	19.08579	27.42752
2	25.39382	20.76747
3	30.22909	24.63406
4	17.08159	22.96282
5	11.85342	22.00558
6	18.30244	21.03785
7	22.58941	20.76747
8	18.40458	28.31143
9	23.09457	21.66859
10	15.03338	24.28820
11	20.56526	22.16476
12	21.94032	23.93269
13	21.07754	20.26689
14	24.63718	25.43788
15	24.84380	17.64847

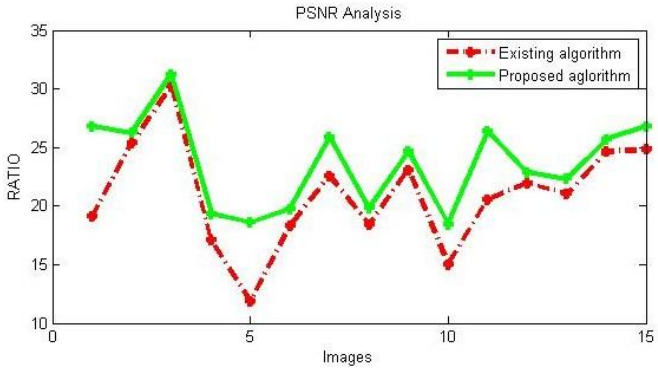

Figure 5 PSNR

VI. CONCLUSION

This paper has centred on the degraded document binarization technique. Document binarization is an chief application of vision process. The main aim of this paper is to evaluating the short comings of algorithms for degraded image binarization. It has been found that every technique has its own advantages and limitations; no technique is best for each case. The main limitations of existing employees are found that the images are noisy and low intensity. To beat the short comings of previous work a new algorithm has been planned during this paper; that has used additional reliable methodology to get better result of the work. The proposed algorithm has used the guided image filter to enhance the results for noisy images. The comparative analysis has shown that the proposed algorithm outperforms over the available methods. In near future we will use the proposed algorithm for real time applications like brain tumor detection.

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