Novel Approach for Image Binarization Using Genetic Algorithm

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Abstract

A grey scale image is converted into black and white image through the binarization method. Binarization is a major factor on which the result of OCR depends. Within character recognition, higher accuracy is achieved by high quality binarized image in comparison to the original image which includes noise in it. Finding out an appropriate binarization algorithm for all the images is the major concern. Since there is huge difference in the performance of various binarization algorithms on different data sets, it is very difficult to choose the most optimal binarization algorithm. In this research work, the technique of genetic algorithm is applied which define the threshold value for the image binarization. The proposed algorithm is implemented in MATLAB and results are analyzed in terms of PSNR, MSE and Thinning rate. It is analyzed that proposed algorithm performs well in terms of all parameters.

Keywords:

Image Binarization, Gray Scale, Erosion, Dilation, Genetic algorithm

Introduction

The process in which the quantitative analysis is performed by applying various algorithms on the digital image data is known as image processing. There have been various improvements made within the image processing techniques. Automation to a great extent is being provided within these approaches. Several individuals who can access the digital cameras and computers are using image processing on daily basis today [1]. The contrast can be improved edges can be detected and intensity can be quantified as well as various mathematical operations can be applied within the images with minimal cost. In order to understand the most common principles that are responsible for performing the most basic image processing routines the images are manipulated digitally by an average user. However, a degraded image is generated even though various individuals approve such manipulations. The results that would possibly be achieved by less knowledge of basic operations performed within an image processing system would provide better results as compared to these manipulations made by individuals [2]. A grey scale image is converted into black and white image through the binarization method. Binarization is a major factor on which the result of OCR depends. Within character recognition, higher accuracy is achieved by high quality binarized image in comparison to the original image which includes noise in it [3]. Finding out an appropriate binarization algorithm for all the images is the major concern. Since there is huge difference in the performance of various binarization algorithms on different data sets, it is very difficult to choose the most optimal binarization algorithm. The various historical document images have different contrast and illumination. Huge amount of background noise is generated by the Niblack's method. All types of images can apply this method. However, the unimportant information cannot be removed at the processing stage. For calculating the threshold of each pixel, the sliding rectangular window is implemented over a grayscale image [4]. For each pixel that existing within the window, the local mean and standard deviation are evaluated using threshold calculation. There are variable of characters that cause a problem within the Kim's method. However, the maximum input document images result in performing a good result. In scenarios where an image is known as a 3D terrain, a local adaptive threshold approach is proposed by this method. The background noise problems are overcome by the Sauvola's method. However, the thinned and broken characters are generated through this method. The Niblack's method is enhanced to generate this method. The problem of availability of huge amount of noise within the background regions is solved using this method [5]. The dynamic range of images gray-scale standard deviation is utilized to calculate the threshold value. However, in case when the text pixel value is near to the foreground image, certain issues are faced by this method. The Niblack method is improved to introduce Nick method. The most degraded document is handled by implementing Nick method. The presence of noise within white pages and low contrast issue are resolved using this method. The threshold value is shifted downward to achieve these goals. Countless defects are present within the binary images. Within few scenarios, the binary regions that are generated by simple threshold include noise and textures within them. The method that includes various image processing operations such that on the basis of shapes the images can be enhanced is known as morphology [6]. Within image processing, this approach is known to be highly useful. Various applications such as noise elimination, texture analysis, and boundary extraction include this technique. All these defects are eliminated and structure of image is maintained using morphological image processing. Only on the associated ordering of pixel values, the morphological operations are highly confident. However, if the light transfer functions are unknown, the grayscale images can be applied. Therefore, it is not important to consider the absolute pixel values. One of the basic operators of mathematical morphology is known as dilation. Both binary as well as grayscale images can apply this method. The objects grow in size due to the dilation. The boundaries of foreground pixels will be increased gradually due to the effect of this operation. Therefore, the size of that

region grows and the sizes of the holes within that region are minimized. The two parts are taken as data by dilation which includes the input image that is to be dilated and the structuring element which is known as kernel [7]. The manner in which the image is to be dilated is determined using the structuring element. The boundaries of object are made thick due to the dilation operation. Thus, filling the holes is the next step to segment the object. For filling the holes in the given input image, the most commonly known approach is the flood fill operation. The background pixels are changed into foreground pixels for binary images through this method. Further, the intensity level is made similar for the grayscale images, which means that the lighter areas are surrounded around the dark areas. There is a need to specify the boundaries of objects by connectivity within the binary and gray scale images. The specification of starting point is known for filling in binary images. The objects are shrunk or the size is made small through erosion. The boundaries of the foreground are eroded using erosion due to which the size of pixels is shrunk and the holes of those regions are increased [8]. Therefore, within few images the boundaries are mixed up once the dilution and filling of holes is done for the object. To achieve better output, the boundaries of objects are made thinner such that the boundaries erosion is separated.

Literature Review

Ranjit Ghoshal et.al (2018) proposed a natural scene text binarization technique. It tracks text boundary which is based on edge and information of gray level. The boundary map completes when the broken boundaries combined together. Adaptive threshold determines the boundary edge information so that it can binarize the images. The experiments were performed on various datasets like ICDAR 2003 Robust Reading Competition and many more, which provides satisfactory results [9]. In text identification method scene text image binarization is very important. The work and experiments performed by the author gives improved scene text and image binarization, in which both edge and variance information method was used. Hence, the researcher concludes that the proposed that it is very time and money saving approach. It is very effective in case when the natural scene images having very less difference, less resolution and noise.

Hubert Michalak et.al (2018) presents a highly recognized and high speed processing approach for image binarization. This paper is the extended version of the very famous Niblack thresholding algorithm [10]. This cannot be done without using global thresholding which is present due to local changes in intensity. Whereas the suing Pixel based methods are very time consuming and don not provide desired results. Optical character recognition usually requires uniformly illuminated images which are the results of flatbed scanners. As the advanced technologies increases the popularity of the image being captured using built-in-cameras of modern accessories like mobile phone, tablets and so on. Therefore, the author concludes that the proposed approach is effective, time- money saving and advanced.

Florian Westphal et.al (2018) proposed a recurrent neural network based algorithm using Grid Long Short-Term Memory cells and a pseudo F-Measure based weighted loss function for image binarization. The binarization and execution of the performance is evaluated for various footprint size, scale factor and functional loss [11]. Trade-off between times of binarization and footprint sizes has shown by the experiments performed by the researcher of this respective paper. There is no statistical difference while using different scale factors and different loss functions. Finally, the binarization performance is compared with the algorithm written in 2016. Therefore, researcher concludes that the proposed technique is effective, time saving, easy to use as compared with already existing a technique.

Tianjun Wu et.al (2108) proposed an Object-Based change detection technique for image binarization. It is used to identify detailed changes in land features by continuously observing the areas with high resolved images in different intervals [12]. This technique is completely based on Weibull mixture model, in which measured images are framed using a mixture of abnormal Weibull distribution. Therefore, the author concludes that the method allows better and stronger results than state-of-the-art threshold-based and clustering-based technique. So, the researcher proposed this technique to have better and good results as compared to other proposed technique. This is easy to use and handle, it provides easy and early results. Hence, image binarization is very important for partitioning changed and unchanged classes.

Arindam Da et.al (2017) presents his study on multi colored text binarization. Here component based approach is used in this work to combine the group of images and words inside the edge box. It uses dynamic thresholding if a pixel which gives good results when there is no variable intensity or does not have any variable intensity. The proposed technique works on every single pixel of the image [13]. The binarization of image requires more time as compared to previously proposed algorithm. The study of this algorithm concludes that it requires more time but it is very easy to work and handle. It also requires less human resources to cover this task. It provides good results during variable intensity of any frequency.

Research Methodology

In this research work, the technique of image binarization is applied to remove unwanted pixels from the image. To remove unwanted pixels from the image the procedure of Z-H Algorithm is followed with the genetic Algorithm. The genetic Algorithm defines the threshold value for the image binarization. There are two sub-iterations involved in the algorithm of image binarization. A parallel method is included in this algorithm which shows its dependency on previous value. In the initial iteration, the elimination of pixel I (I,J) is done once the conditions listed below are accomplished:
1. The connectivity number is found to be one.
2. The black neighbours involved must be at least two and six at maximum.

3. Amongst I(I,j+1), I(i-1, j) and I(i, j-1), at least one should be white.
4. Amongst I(I-1,j), I(i+1, J) and I(I,j-1), at least one should be white.

The steps 3 and 4 are modified within the second iteration.
1. The connectivity number involved should be one.
2. Minimum two and utmost six black neighbours are involved here.
3. Amongst I(i-1, j), I(I,j+1), and I(i,+1 j), at least one should be white.
4. Amongst I(I, j+1), I(i+1, J) and I(I,j-1), at least one should be white.
Throughout the image, a 3*3 window is moved down. For making decisions whether the window will stay on the pixel or not, calculations are performed at each pixel.

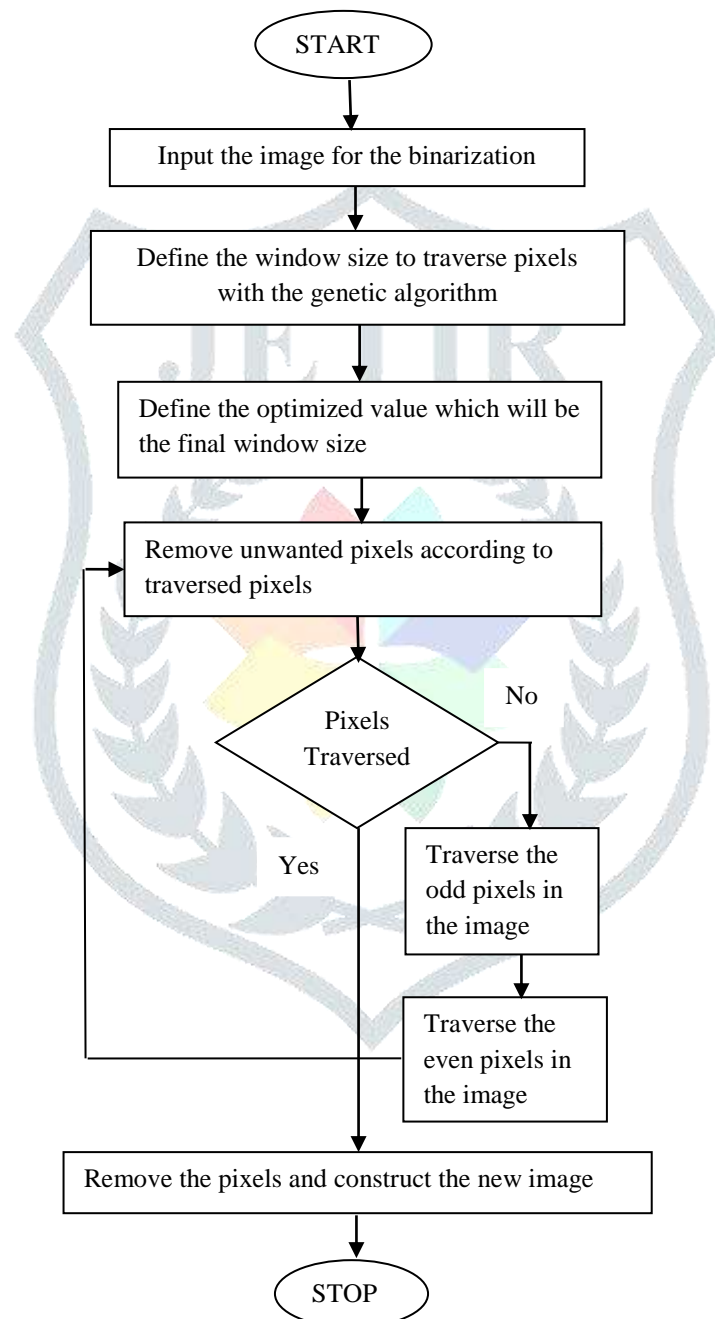Fig 1: Proposed Flowchart

Experimental Results

The proposed work has been implemented in MATLAB and the results are evaluated as presented below.
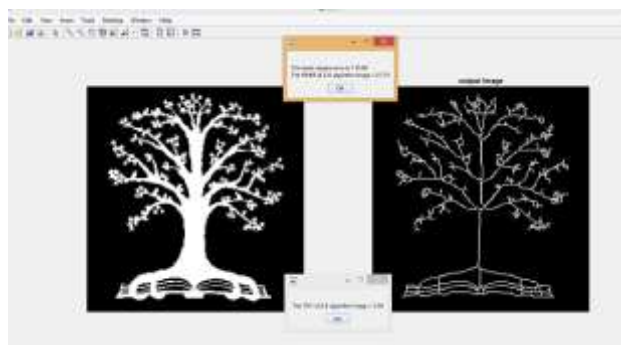
Fig 1: Image loaded

As illustrated in figure 1, the image is loaded with for the thinning. The thinning is technique of removing the unwanted data from image. To remove the unwanted data from the image thinning elements is used which will remove unwanted data. The zang and sang algorithm is used for thinning which gave output in terms of MSE, PSNR and thinning rate. The value of MSE is 109.58, value of PSNR is 27.78 and value of TR is 0.50.
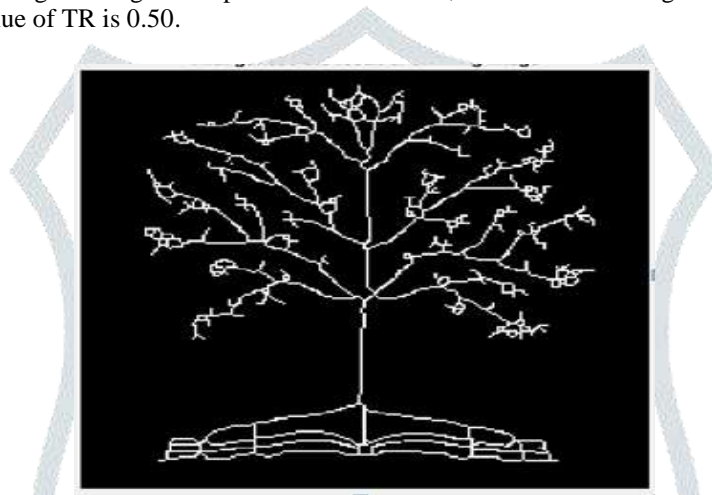

Fig 2: Apply of genetic algorithm

As shown in figure 2, to o better output of zang and sang algorithm in terms of PSNR, MSE and TR enhancement is proposed which will be based on genetic algorithm. In this figure genetic algorithm is executed with zang and sang algorithm. After applying the   genetic algorithm the output of the thinning is image is shown which has better results than existing one.

Fig 3: Apply of genetic algorithm

As shown in figure 3, to improve output of zang and sang algorithm in terms of PSNR, MSE and TR enhancement is proposed which will be based on genetic algorithm. In this figure genetic algorithm is executed with zang and sang algorithm. After applying the   genetic algorithm the output of the image is shown which has better results than existing one. The results after applying MSE, PSNR and TR values are 38.18, 32.35 and 0.62 respectively.

Conclusion

The process in which the quantitative analysis is performed by applying various algorithms on the digital image data is known as image processing. The 3D parametric maps are generated here and the replicable and rater-independent values must on the

calculated through this approach. There have been various improvements made within the image processing techniques. Automation to a great extent is being provided within these approaches. Several individuals who can access the digital cameras and computers are using image processing on daily basis today. The image binarization technique is applied to reduce size of the gray scale images. In this research work, technique of genetic algorithm is applied which is used to define threshold value. The pixels which have value above the threshold value will be removed from the image. The proposed algorithm is implemented in MATLAB and results are analyzed in terms of PSNR, MSE and thinning rate. The proposed algorithm performs well in terms of all the defined parameters.

References

[1] Prithwish Jana, Soulib Ghosh, Suman Kumar Bera and Ram Sarkar, "Handwritten Document Image Binarization: An Adaptive K-Means Based Approach," 2017, IEEE.

[2] Gaofeng Meng, Kun Yuan1, Ying Wu, Shiming Xiang, Chunhong Pan, "Deep Networks for Degraded Document Image Binarization through Pyramid Reconstruction," 2017, IEEE.

[3] Jialiang Peng and Bian Yang, "A novel Binarization Scheme for Real-valued Biometric Feature," 2017, IEEE.

[4] Egor Pugin and Arkady Zhiznyakov, "Histogram Method of Image Binarization based on Fuzzy Pixel Representation," 2017, IEEE.

[5] B.Vishnudharan and Mrs.K.Anusudha, "Reclamation of Information from Degraded and Damaged Document Images by Image Binarization Method," 2017, IEEE.

[6] Sabeenian R S, Paramasivam M E and Dinesh P M, "Appraisal of Localized Binarization Methods on Tamil Palm-leaf Manuscripts," 2017, IEEE.

[7] Fuxi Jia, Cunzhao Shi, Kun He, Chunheng Wang and Baihua Xiao, "Document Image Binarization using Structural Symmetry of Strokes," 2016, IEEE.

[8] Markus Diem, Fabian Hollaus and Robert Sablatnig, "MSIO: MultiSpectral Document Image BinarizatIOn," 2016, IEEE

[9] Ranjit Ghoshal, Ayan Banerjee, "An Improved Scene Text and Document Image Binarization Scheme," 2018, IEEE.

[10] Hubert Michalak and Krzysztof Okarma, "Region Based Adaptive Binarization for Optical Character Recognition Purposes," 2018, IEEE.

[11] Florian Westphal, Niklas Lavesson, Hakan Grahn, "Document Image Binarization Using Recurrent Neural Networks," 2018, IEEE.

[12] Tianjun Wu, Jiancheng Luo, Jianwu Fang, Jianghong Ma, and Xueli Song, "Unsupervised Object-Based Change Detection via a Weibull Mixture Model-Based Binarization for High-Resolution Remote Sensing Images," 2018, IEEE.

[13] Arindam Da, Sandipan Chowdhury, "Adaptive Method For Multi Colored Text Binarization," 2017, IEEE.