IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 3, Issue 5, Oct -Nov, 2015
ISSN: 2320 – 8791 (Impact Factor: 2.317)
www.ijreat.org

Document Image Enhancement Using Sauvola Operator

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ABSTRACT:image enhancement is the process for enhancing quality of the image. In the quality of the resolution of the image has to be enhanced. In the purposed work scanned document images has been used for enhancement so that content from particular images can be retrieved. In the purposed work image has been enhanced by using different morphological operations and using global threshodiing with sauvola operator. Sauvola operator divides the image into different image parts for detection of objects available in the image content. After this image part has been enhanced by using the segmented parts threshold value that increases the vulnerability of the image so that content from the image can be easily extracted. Various parametes have been evaluated for performance evaluation.

Keywords: Threshold, GT, Sauvola, Dilation, Erosion and Morphological

INTRODUCTION

1.1 Document Image Enhancement: Document imaging is a data innovation classification for frameworks equipped for repeating records normally utilized as a part of business. Document imaging frameworks can take numerous structures including microfilm, on interest printers, copy machines, copiers, multifunction printers, archive scanners, computer output microfilm (COM) and chronicle authors. Document Imaging means the change of paper documents (of any size or depiction) or microfilm/ fiche to computerized images.

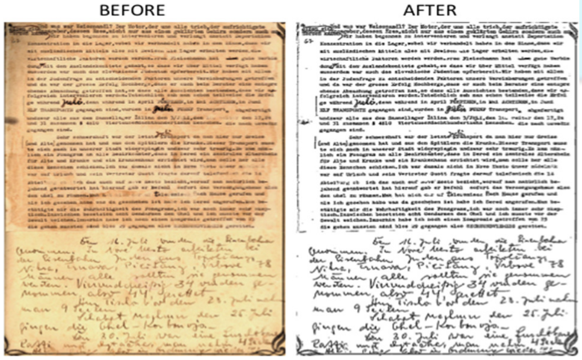


Figure 1: Document image enhancement

Document image binarization is typically performed in the preprocessing phase of diverse Document image preparing related applications, for example, optical character recognition (OCR) and document image recovery. It changes over a dark scale document image into a binary report picture and as needs be encourages the resulting assignments, for example, record skew estimation also record design investigation. As more content documents are checked, quick and exact archive picture binarization is getting to be progressively critical.

Despite the fact that document image binarization has been examined for a long time, the thresholding of corrupted archive pictures is still an unsolved issue. This can be clarified by the way that the displaying of the report forefront/foundation is extremely troublesome because of different sorts of record debasement, for example, uneven enlightenment, picture contrast variety, dying through, and smear. We attempt to create hearty and effective document image binarization systems which have the capacity to deliver great results for gravely corrupted document images.

1.2 Techniques of Document Enhancement

1.2.1 Deskewing: In a production scanning set up, document pre-processing is the most time consuming step. One objective of this step is to arrange the documents correctly by rotating (incorrectly filed documents) and aligning them together. The De-skew facility in production capture applications helps to reduce this effort by automatically de-skewing misaligned images. The De-skew process can straighten pages which were misaligned during the document feeding process, within a specified range of degrees.

1.2.2 Black border cropping & removing: Cropping refers to the removal of the outer parts of an image. In document scanning, black border cropping is one technique that is used to remove the unnecessary black colour borders from an image. Border cropping removes black borders from the image completely also resulting in the reduction of image height and width. However this does not reduce the resolution of the image.

1.2.3 De-speckling / Noise reduction: When scanning old documents we usually get unwanted dots (speckles) in the background. This could be in two forms; black speckles in a white background as well as white speckles in a black background. Whatever the form, this affects the image compression and increases the file size. De-speckling (also known as noise reduction) is the process of removing such unwanted speckles from the image background.

1.2.4 Color drop out: Color dropout is a proven useful technique for forms processing applications such as census projects. The idea is to discard the text boxes and lines of a scanned image. This will increase the recognition rate of OCR. Earlier scanners used specific colored lamps to achieve this.. Now this has been improved and is achieved by software. Colour drop out accuracy directly depends on the printing quality of the forms. Only selected colors (shades of red, blue and green) can be dropped, which depends from scanner to scanner. Therefore it is essential to use the recommended color pantone

1.2.5 Thresholding: Thresholding is a technique used when scanning gray scale images and saving as Black & white. A gray scale image will have 16 bits per pixel (representing 65,536 shades of gray) and a black & white image will have 1 bit per pixel (representing either black or white). When converting from gray scale to black & white each pixel having a different shade of gray should be converted in to either black or white. This point of separation is called the threshold. By changing the threshold value the output image quality will change

1.2.6 Line Removal: Line removal is a very useful feature especially for OCR applications. This feature is used to remove unwanted lines from scanned images. These lines could be either actual content or noise. Most application forms such as credit cards, account opening etc. consist of text boxes.

1.3 OPERATORS USED

OSTU & SAUVOLA:OSTU method is implemented to refine the quality of the image. This OSTU method divides the image into different regions and on the basis of the threshold value these regions are manipulated for the refinement of the image. The pixel values greater than the threshold values are considered and lower than that threshold are changes to zero. After this the canny edge detection and SAUVOLA operator is used for the output results of the image. After the process of the morphological operations the parameters of the image are measure. The parameters measure are Peak signal Noise ratio and F-measure.

1.4 ALGORITHMS USED:

PSNR: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. Because many signals have a very wide dynamic range, (ratio between the largest and smallest possible values of a changeable quantity) the PSNR is usually expressed in terms of the logarithmic decibel scale.Image enhancement or improving the visual quality of a digital image can be subjective. Saying that one method provides a better quality image could vary from person to person. For this reason, it is necessary to establish quantitative/empirical measures to compare the effects of image enhancement algorithms on image quality.

F-Measure: F-measure, sometimes known as F-score or the F1 metric is a weighted harmonic mean of Recall & Precision (R & P). There are several motivations for this choice of mean. In particular, the harmonic mean is commonly appropriate when averaging rates or frequencies, but there is also a settheoretic reason we will discuss later. The most general form, F, allows differential weighting of Recall and Precision but commonly they are given equal weight, giving rise to F1 but as it is so ubiquitous this is often understood when referring to F-measure.

2. RELATED WORK

Bhattacharya, S [1] "Localized image enhancement", Picture improvement is an entrenched field in picture handling. The principle goal of picture improvement is to expand the perceptual data contained in a picture for better representation utilizing some transitional steps, in the same way as, complexity upgrade, de-blurring, de-noising and so on. Among them, differentiate improvement is particularly essential as human eyes are more touchy to luminance than the chrominance segments of a picture. The greater part of the differentiation improvement calculations proposed till now are worldwide routines. The real downside of this worldwide methodology is that in handy situations, the complexity of a picture does not decay consistently and the yields of the upgrade methods achieve immersion at fitting difference focuses. That prompts data misfortune. Actually, to the best of our insight, no non-reference perceptual measure of picture quality has yet been proposed to quantify restricted improvement.

Suprijanto et al [2] "Image contrast enhancement for film-based dental panoramic radiography", The dental surrounding radiography is one of dental imaging that used to picture the whole of the maxilla and mandible jaws on the one picture planes. In spite of the fact that the immediate computerized surrounding radiography has been accessible, however film-based surrounding radiography is still utilized on the generally dental center and lab in Indonesia. The nature of film-based picture has noteworthy impediment because of compound handling and picture upgrade isn't possible if needed. In this way, digitized film-based picture to computerized picture was obliged to permit picture improvements so as to enhance the interpretability nature of data in the picture. Digitized film-based picture is performed utilizing a flatbed scanner on transmission and reflection mode. In this paper, the differentiation nature of computerized picture that checked utilizing both modes is assessed focused around measurement picture trademark. The results demonstrated that the nature of digitized picture utilizing transmission mode is superior to utilizing reflection mode. Notwithstanding, if immediate computerized imaging is utilized as a highest level, picture upgrade on digitized picture is still needed. Four techniques, i.e. difference extending, HE, AHE, and CLAHE are utilized to endeavor enhance the quality digitized picture.

Hasikin, K et al [3] "Enhancement of the Low Contrast Image Using Fuzzy Set Theory" This paper shows a fuzzy gray scale improvement system for low difference picture. The corruption of the low difference picture is mostly brought about by the deficient lighting amid picture catching and in this way in the end brought about non uniform enlightenment in the picture. A large portion of the created difference improvement strategies enhanced picture quality without considering the non-uniform lighting in the picture. The fuzzy gray scale picture improvement system is proposed by expanding fluffy measures contained in the picture. The enrollment capacity is then altered to upgrade the picture by utilizing force law change and immersion administrator. The subjective and quantitative exhibitions of the proposed system are contrasted and alternate routines. The proposed strategy created better quality improved picture and obliged least preparing time than alternate strategies.

Wang Xianghong et al [4] "An Effective Method to Color Medical Image Enhancement" Image enhancement innovation assumes an essential part In picture transforming. By upgrading some data and controlling other data specifically, it can enhance picture visual impact. Shading medicinal picture is getting to be more noteworthy in restorative judgment. In this paper, an upgrade math utilized for shading therapeutic picture is examined. After the improvement in view of wavelet investigation, the shading space change strategy is connected to the shading therapeutic picture. The system can enhance the picture sharpness and make the picture attributes more clear. The upgrade result is valuable for further investigation.

Zhang Xiao-Guang et al [5] "Generalized fuzzy enhancement of image for radiographic testing weld" Since radiographic testing weld picture has a few inadequacies, for example, terrible complexity proportion, tight scope of gray scale and fluffy picture, normal improvement strategy can't enhance contrast degree and in the meantime safeguard edges well. Fluffy upgrade does not alter pixel gray level in the fluffy gimmick space much the same as histogram and can acquire top quality picture yield. In this paper, on the premise of investigating burdens of conventional fluffy upgrade calculation a summed up fluffy improvement calculation is advanced. This calculation can outline picture to the summed up fluffy space through including the idea of summed up fluffy set. In the meantime, subsection sine capacity is picked as fluffy enrollment. Utilizing the attributes of summed up fluffy move with huge extent, picture can acquire attractive upgrade impact through preparing the radiographic testing picture with summed up fluffy improvement calculation.

Shu Yang et al [6] "A new Approach of Image Enhancement Based on Multi-scale Morphological Reconstruction" In this paper, another strategy for image enhancement, which just relies on upon the distinction of dim estimations of nearness level zones of a picture, is proposed by hypothesis of morphological reproduction. As a matter of first importance, a non-idempotent associated administrator which can be the paradigm for multi-scale upgrade is characterized and the foundation is a key to improvement of a picture. In this manner, the dark values in same the basic associated zones of a picture are upgraded general so the way can keep the steadfastness of the picture shape. Finally the associated zones of a picture and their relations are portrayed and the method for the multi-scale morphological remaking improvement for a picture is executed by utilizing most extreme tree or least tree structure.

Hong Zhang et al [7] "Multi-scale image enhancement based on properties of human visual system" The logarithmic image processing (LIP) model is a scientific structure which has been turned out to be reliable with a few laws and fit qualities of the human visual framework. In this paper, we both use this LIP display and consider attributes of the human visual framework (HVS) to propose another multi-scale improvement calculation. At that point another measure of improvement taking into account JND model (Just Noticeable Difference, JND) of human visual framework is proposed and utilized as an apparatus for assessing the execution of the upgrade system. At last, the proposed calculation's execution is contrasted quantitatively with a few well known picture upgrade calculations, and test results demonstrate that the propose calculation can change the picture element extent, improve the picture points of interest and attain to an additionally satisfying and agreeable picture.

3. PROBLEM FORMULATION

Image enhancement is the process for enhance the quality of the image for extraction of the features and proper visualization of the image content. In the image enhancement procedure various approaches have been used for reduction of noise from the documents images. The main issue in the enhancement of the old scanned document image is that due to implementation of different filters on the image the content available on these Images may get erode. Due to erosion of the content the proper data from the image can be retrieved. Scanned documents from different books contain valuable information that must be utilized for digitization. Due to presence of shadow, dust or noise in the sensing apparatus the content available get erodes cannot be read by the users correctly. To read the particular content in such a manner so that each word can be read easily images have to be preprocessed and enhanced using different image enhancement approaches.

4. Purposed Work

In the purposed work different handwritten document and printed document image has been used for enhancing quality of the text available in the images. To enhance the quality of the image different filters have been implemented on the image for resolution enhancement. In the purposed work printed and handwritten document degraded images dataset has been used for quality enhancement. Due to availability of the noised available in the image different filter have been implemented on the image for removal of the noise available in the images. These filters break down the image in different frequency bands and on these different bands different image filters like Gaussian noise filter have been implemented that remove the noise.
The input image that is colored is input for the system. The colored image has been decomposed into three true colors that are red green and blue.

$$A = \sum_{\substack{0 \le i \le m \\ 0 < j < n}} P(i,j) \qquad (1)$$

In the purposed work color images have been used for image enhancement that firstly converted into gray scale format using the conversion scenario. This color image is combination of all the true colors that are red, green and blue. The image is decomposed into three different colors. This decomposition of the image has been done for conversion of the image into three different colors.

R=A (: ,: , 1) (2)

G=A (: ,: , 2) (3)

B=A (: ,: , 3) (4)

These equations have been used for decomposing of the colored image into three different images that contain luminance and pixel value for red, green and blue color intensities.

After the extraction of three colors the conversion has been done that converts RGB images to grayscale by eliminating the hue and saturation information while retaining the luminance.

$$I=0.2989 * R + 0.5870 * G + 0.1140 * B \qquad (5)$$

After the conversion of the image from RGB to gray scale format image undergoes the process of noise removal using Gaussian filter. Gaussian filter remove the Gaussian noise from the image and enhance the quality of the image.

After implemented Gaussian filter enhanced image undergoes the process of dilation.Dilation is process that changes the pixel value for output pixel value on the basis of neighbor pixel values. The neighbor pixel is higher than that is replaced with the particular pixel value. After the process of dilation morphological operation of the close is implement which get the closer pixel group according to the different disk values.

After the process of dilation erosion has been done to the dilated image that completers the filling part of the image. After this image is erodes using morphological fundamental step that provides the enhanced image. Erosion processes use the hole filling operation and speed up the dilation process.

After the process of erosion the estimated background is subtracted from erodes image and the threshold value based the OSTU method is implemented to refine the quality of the image. This OSTU method divides the image into different regions and on the basis of the threshold value these regions are manipulated for the refinement of the image. The pixel values greater than the threshold values are considered and lower than thatthreshold are changes to zero. After the process of

IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 3, Issue 5, Oct -Nov, 2015
ISSN: 2320 – 8791 (Impact Factor: 2.317)
www.ijreat.org

segmentation based on thresholds image edges have been detected to prevent the image quality degradation.

After the process of image segmentation using OSTU method the resultant image undergoes SAUVOLA process. The sauvola operator divides the image into different scales. These scales have been used for detection of the object and the after detection of the object the scales threshold value has to be optimized. The scales of the image have been recombined to reconstruct the original image. As the original image has been reconstructed then using optimized threshold value image has to be segmented. That operator provides enhanced document image that content can be easily extracted.

5.Results

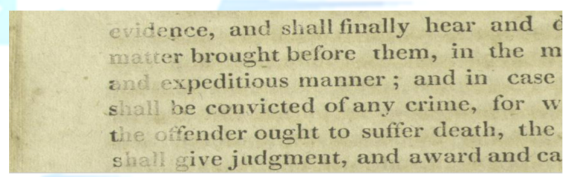
Noisy documented or hand written material images has to be enhanced by using different morphological operations. These operators implemented on the image have been used for the enhancement of the image on the basis of different parameters. These operators divide the image into different regions and enhance the quality of the image by using threshold based OSTU method. The OSTU operator enhances the quality of the image on the basis of different parameters that has been selected by using particular threshold value for particular region. The results of the purposed system are explained below.

Fig 5.1 Database Hand Written Images for image enhancement Process

This figure represents the handwritten document images for image enhancement process. In these images the content that has been written by the writer can't be proper read with naked eyes. These image have been undergoes the process of image enhancement for removal of the noise and dirt available on these image so that content can be easily readable and convertible to digital information.

Fig 5.2 Database printed Images for image enhancement Process

This figure represents the printed or scanned document images for image enhancement process. In these images the content that has been written by the writer can't be proper read with naked eyes. These image have been undergoes the process of image enhancement for removal of the noise and dirt available on these image so that content can be easily readable and convertible to digital information.



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and expeditious manner; and in case
shall be convicted of any crime, for w
the offender ought to suffer death, the
shall give judgment, and award and ca

Fig 5.3 Original Image used for image enhancement

This figure represents noisy document image that has been used for enhancement. The image used for enhancement is colored in format. The content available cannot read properly.

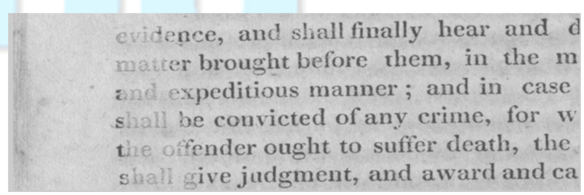

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Fig 5.4 Gray scale converted Image from original RGB Image

The original image has been converted from color image to gray scale format by decomposed into three true colors that are red green and blue.

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Fig 5.5 Adjustment of Gray scale Image

The gray scale image intensity has been adjusted by using 1% increment or decrement of the intensity value so that image visualization can be changed. The image visualization changes can easily use for image enhancement process.

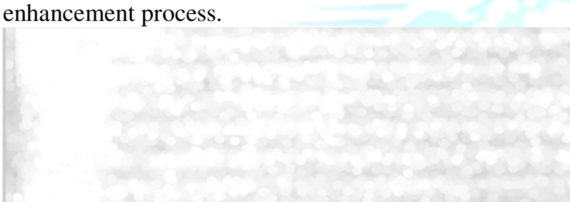

Fig 5.6 Dilation Process for image enhancement

This image represents dilation process which changes the pixel value for output pixel value on the basis of neighbor pixel values.

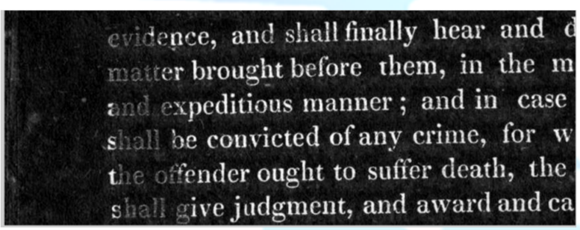

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Fig 5.7 Erosion Process for image enhancement

After the process of dilation of the image the erosion has been done to the dilated image that completers the filling part of the image.

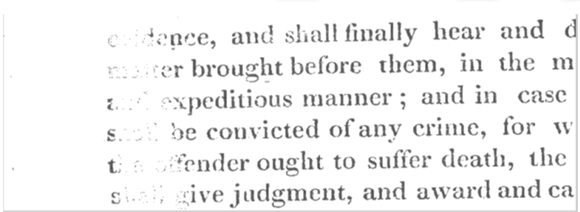

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Fig 5.8 Image segmentation by using OSTU Segmentation

After the process of erosion the estimated background is subtracted from erodes image and the threshold value based the OSTU method is implemented to refine the quality of the image. This OSTU method divides the image into different regions and on the basis of the threshold value these regions are manipulated for the refinement of the image.

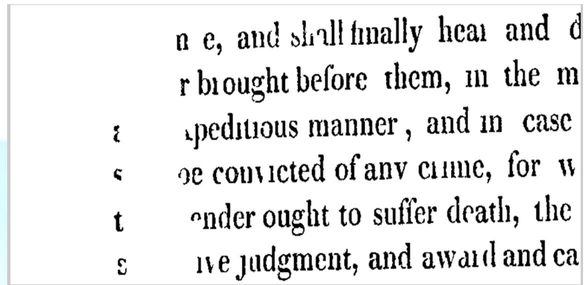

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Fig 5.9 SAUVOLA operator for image enhancement

After the process of image segmentation using OSTU method the resultant image undergoes SAUVOLA process. The sauvola operator divides the image into different scales. These scales have been used for detection of the object and the after detection of the object the scales threshold value has to be optimized. The scales of the image have been recombined to reconstruct the original image.

In the purposed work different parameters have been evaluated for performance evaluation of purposed work. On the basis of these parameters validation of purposed work can be done. In the purposed work PSNR, F-measure and MSE has been evaluated. These parameters have been evaluated for both Hand written document images and printed document images.

Image Name	PSNR	F-Measure	MSE
PR1	17.26	94.14	0.0188
PR2	13.23	82.22	0.0475
PR3	15.84	92.51	0.0269
PR4	22.36	78.36	0.585
PR5	14.46	87.40	0.0358
PR6	13.19	79.34	0.0523
PR7	10.79	37.06	0.0833
PR8	13.19	79.34	0.0479
HW1	18.03	93.82	0.0569
HW2	20.53	89.53	0.0863

Table 5.1 PSNR, F-measure and MSE values for Printed and handwritten document images

This table represents the values of PSNR and F-measure computed for different images. These different images that have been used are of hand written documents and printed documents.

6.Conclusion

Image enhancement is the field of digital image processing. In the process of the image enhancement resolution, quality of the images has to be enhanced for proper visualization of the image.In the purposed work handwritten document images and printed document images have been utilized that content noise in their content part. In the processing of image enhancement procedure different morphological operations have been implemented. Segmentation has been done by using the OSTU's segmentation operator. This operator divides the image into different segments and computes a threshold values from the different bins of the pixels intensity. On the basis of threshold image has been converted to black and white for reduction of background from the image. After segmentation sauvola operator implement that divides image into different regions and on the basis of the regions objects from different regions have been identified. After object detection different levels of the image has been merged to form an enhanced image. From the output image content can be easily retrieved.

In the purposed work different parameters have been evaluated for performance evaluation. These parameters are PSNR, F-measure and MSE. By analyzing values of these defined parameters one can conclude that purposed work provide much better results than previous one.

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