

# **SURVEY ON BINARIZATION TECHNIQUE FOR TEXT DOCUMENT RESTORATION**

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**Abstract-** Development in a degraded document images is one of the challenging research. Image get degraded due to unbalance illumination spread over document. Image document binarization technique is used to perform in document analysis at the pre-processing level, to extract and segment out the fore text from the document flipside. Numerous binarization techniques are proposed, none of them is suitable for all types of degradation. Whereas various binarization approaches are used to enhance the degraded image with advantage and disadvantages. This paper accomplishes the survey of better binarization techniques using the help of pythons scikit-learn package to implement the thresholding algorithms for binarization.

**Keywords -** Image processing, Document analysis, sklearn, thresholding, greyscale

## **1. INTRODUCTION**

Textual content report recovery is the operation of taking a corrupt/noisy photograph and estimating the easy, unique photograph. Corruption might also come in many forms such as motion blur, noise and digital mis-attention.[1] photo restoration is completed by means of reversing the system that blurred the photograph and such is carried out via imaging a point source and use the point supply to the photo, which is referred to as the factor unfold function (psf) and is used repair the photograph facts lost in the blurring process. In general, scanned documents encompass textual content, line-drawings and graphic areas. It can also be taken into consideration as mixed type documents. In many realistic programs, we want to understand or improve the content material of the record. In such instances, it's far superior to transform the documents into a binary form. For that reasons, photo binarization plays a key position inside the area of photograph processing. Binarization is a process of remodelling a grey scale photograph to a binary picture which contains handiest two set of pixels which is white as background and black as foreground. Classification is performed with a separation intensity value referred to as threshold. Thresholding is a simple however effective tool to separate objects from the background. Examples of thresholding programs are report photo evaluation, where-in the intention is to extract published characters, logos, graphical content,: map processing, where strains, legends, and characters are to be found scene processing, wherein a target is to be detected and best inspection of substances where defective parts should be delineated. The binarization techniques for grayscale documents can be grouped into two wide categories: worldwide thresholding binarization and local thresholding binarization [2]. Global methods find a unrelated threshold cost for the complete document. Then each pixel is assigned to page foreground or heritage based on its grey cost comparing with the threshold fee.

## **2. BINERIZATION TECHNIQUE FOR DEGRADED IMAGE**

### *2.1 Niblack's Techniques*

The local threshold value  $T(x,y)$  for this method at  $(x, y)$  is calculated within a window of size  $w \times w$  as:

$$T(x, y) = m(x, y) + k * \delta(x, y)$$

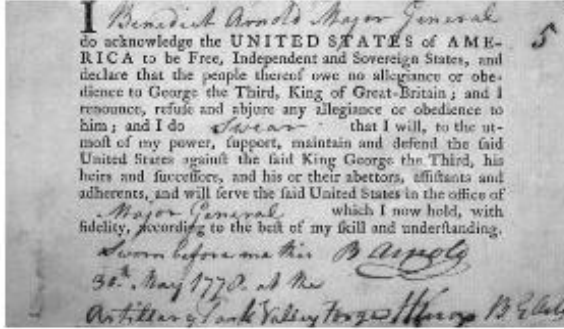
Where local mean and standard deviation of the pixels inside the local window is  $m(x, y)$  and  $\delta(x, y)$ .  $k$  is a bias. Set as  $k = -0.2$  and local window size is  $w=25$ . The threshold value is adapted as the local mean  $m(x, y)$  and standard deviation  $\delta(x, y)$ , according to the contrast in the local neighbourhood of the pixel. The bias  $k$  controls the level of adaptation varying the threshold value. Here pixel = (pixel > mean +  $k * \text{standard deviation}$ )

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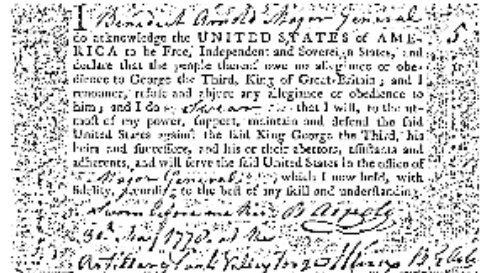
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Original



Niblack Threshold



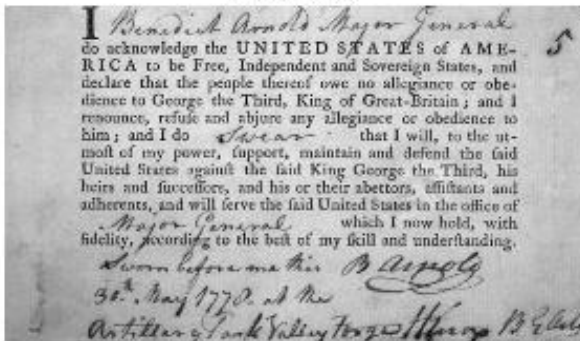
2.2 Sauvola's Technique

In this method the mean  $m(x, y)$  and standard deviation  $\delta(x, y)$  are computed for the pixel intensities in a  $w \times w$  window centered around the pixel at  $(x, y)$  to estimate the threshold  $T(x, y)$  and is express as:

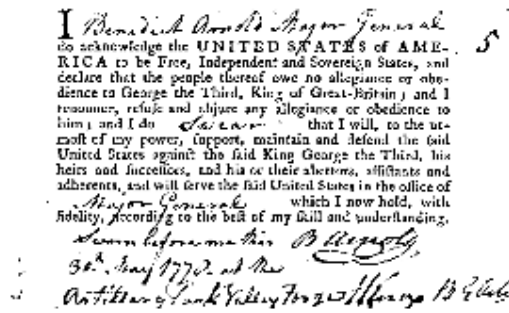
$$T(x, y) = m(x, y) [1 + k (\ )]$$

standard deviation results helps in estimating an R value ( $R=128$  for a grayscale document), and  $k$  is a parameter which takes positive values in the range  $[0.2, 0.5]$ . Here  $\text{pixel} = (\text{pixel} > \text{mean} * (1 + k * (\text{standard deviation} / r - 1))) ? \text{object} : \text{background}$  contrast is high in some region of the image,  $\delta(x, y) \sim R$  which results in  $T(x, y) \sim m(x, y)$ . This is the same result as in Niblack's method. But when the neighbourhood contrast is quiet low, we are able to notice a difference. The cases where threshold  $T(x, y)$  goes below the mean value thereby successfully removing the closely related dark regions from the background [1]. In order to compute the threshold  $T(x, y)$ , local mean, standard deviation have to be estimated for each pixel and its computational complexity is  $O(n^2 \times w^2)$  in a pre-existing way for an image of size  $n \times n$  [3]. This means that its computational complexity depends on the window size. T.R Singh proposed window size independent technique of thersholding using integral sum image as prior process.

Original



Sauvola Threshold



2.3 Local Thresholding Technique

A threshold  $T(x, y)$  is calculated for each pixel in the case of alocal thresholding technique which are based on some local statistical computationssuch as range, variance, or surface-fitting parameters of the neighbourhood pixels within a local block of size  $w \times w$ . Considering a grayscale document image which  $I(x, y)$  has an intensity of a pixel at location  $(x, y)$ , In a local adaptive thresholding techniques, threshold  $T(x, y)$  for each pixel is computed using the following flow

If  $I(x, y) > T(x, y)$

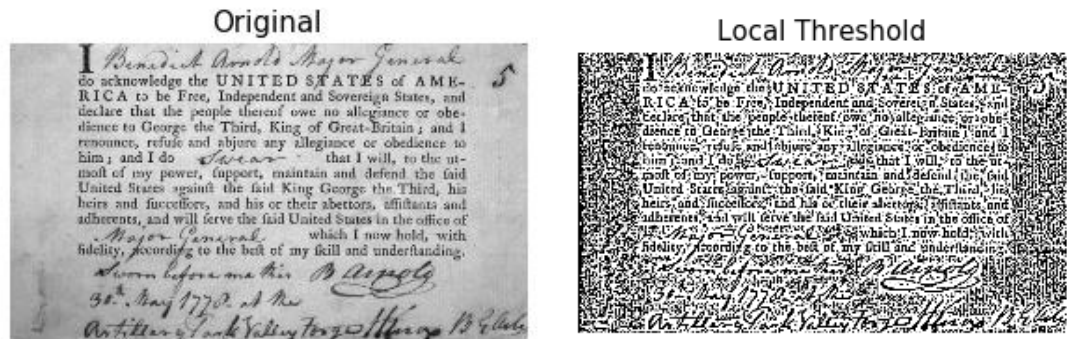
Then

$$b(x, y) = 1$$

Else

$$b(x, y) = 0$$

Where  $b(x, y)$  is the binarized image and  $I(x, y) \in [0, 1]$ , intensity of a pixel at a given location  $(x, y)$  of the given image [1]. A threshold is calculated for each pixel in local adaptive technique, based on some local statistics such as range, variance, or surface-fitting parameters of the neighbourhood pixels.



### 3. METHODOLOGY

The results were obtained using matplotlib, scikit-image, numpy and openCV2 packages in python and uses the threshold\_niblack, threshold\_local, threshold\_sauvola, threshold\_adaptive algorithms from the sikit-image package.

[7]Scikit-image (formerly scikits.image) is an open source image processing library for the Python programming language which includes algorithms for segmentation, geometric transformations, color space manipulation, analysis, filtering, morphology, feature detection, and more, designed to interoperate with the Python numerical and scientific libraries NumPy and SciPy.

[8]Matplotlib is a plotting library for the Python programming. It provides an object-oriented API for embedding plots into applications using general-purpose GUI toolkits such as Tkinter, python, Qt, or GTK+. There is also a procedural "pylab" interface based on a state machine (like opengl), designed to closely resemble that of MATLAB, its use is discouraged. Scipy makes use of matplotlib.

[9]NumPy is a library for Python programming language it adds support for large, multi-dimensional arrays and matrices, along with a large collection of high-level mathematical functions to operate on these arrays

[10]OpenCV (Open Source Computer Vision) is a programming functions library which mainly aimed at real time computer vision which was developed by Intel and then later supported by Willow Garage and now maintained by Itseez. The library is open sourced free library available to developers. OpenCV supports the Deep Learning frameworks TensorFlow, Torch/PyTorch and Caffe

The Niblack's algorithm focuses on the Mean and standard deviation using which the local mean and of local standard deviation are determined. Pixel-wise threshold by sliding a rectangular window over the gray-level image, the limitation is that noises exist in non-text regions, so some pre, post processing methods are required.

The Sauvola algorithm focuses on Local mean and standard deviation using which The computation of local threshold (i.e. for each pixel separately) is found, the limitation is that it is computationally slow reactive to selection of window size.

The local thresholding algorithm which uses the mean to compute the threshold with the help of minimum and maximum intensities of a pixel in a window, limitation is that It does not perform well with a complex background.

The comparison is done using two functions mse() used to find the minimum squared error of the two images and then the structural similarity function compare\_image(). The binarized image was compared with the actual grayscale image.

### 4. EXPERIMENTAL RESULT

Image binarization step was carried out with the help of mainly two thresholding methods and the results are as follows, are based on the squared mean error and structural similarity

MSE: 0.02, SSIM: 0.61

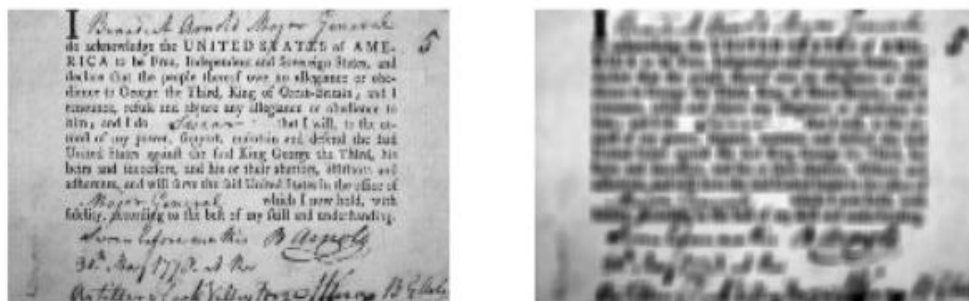


Fig1: Comparison with Niblack's algorithm

MSE: 0.03, SSIM: 0.63

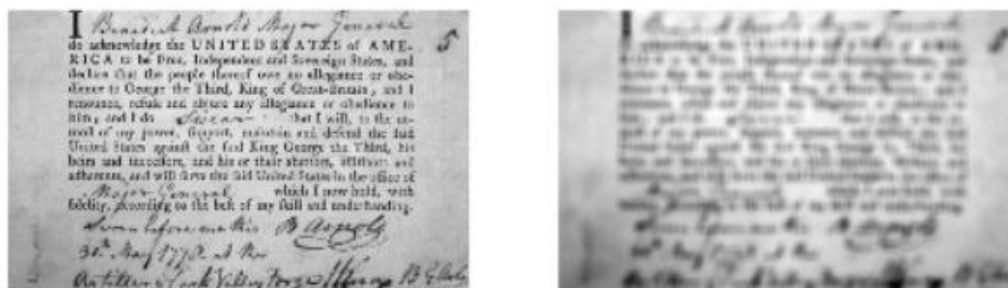


Fig2: Comparison with Sauvola's algorithm

MSE: 0.01, SSIM: 0.71



Fig3: Comparison with local thresholding algorithm

## 5. CONCLUSION

Image binarization employs thresholding methodology for converting the image into its binary format, and this paper gives a comparison on employing Niblack's, Sauvola's and local thresholding algorithms for binarization of images. In the experiments carried out to find the Square Mean Error (SME) and the Structural Similarity(SSIM), we can conclude that local thresholding is the most effective method, and for visualization Sauvola's seems to have a better efficiency. But, again considering the fact of structural similarity the local thresholding algorithm gives a better result and could be considered as a good practice in the document restoration process.

## 6. REFERENCE

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