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COMPARISON OF TEXT DOCUMENT RESTORATION ALGORITHMS USING BINARIZATION AND THRESHOLDING

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Abstract- Segmentation of text from badly degraded text document images is a very challenging task due to the high variation between the document background and the foreground text of different document images. In this paper, binarization and thresholding are the two techniques used where, Binarization is the process of converting a pixel image to a binary image and Thresholding is the simplest method of image segmentation from a grayscale image, thresholding can be used to create binary images. Thresholding segments the image into the foreground image and background image. Here we are comparing different text documentation algorithms to find the efficient algorithm for text documentation.
Keywords– Binarization, Thresholding, Gray Scale Image, Binary Image.

1. INTRODUCTION

Text document restoration is the process of conservation and restoration of images and text documents, which is mainly concerned with the preservation and protection of items of historical and personal value made primarily from paper, parchment, and leather.

Paper-based items, such as books, scrapbooks, maps, deeds, newspapers, drawings, water colors, and postcards require unique concerns when it comes to care and conservation. Unlike works of art on paper, these items are often handled directly and repeatedly to access information.

Image or text Document restoration can be done using two ways:-

- Binarization
- Thresholding

Binarization is the method of converting a pixel image to a binary image. It is mainly used for things like digitalizing text or images. A binary image is a digital image which can have only two possible values for each pixel. The two colors used for a binary image are black and white. Color used for the objects in the image is the foreground color which is white, while the rest of the image is in black which is the background color.

Thresholding is the act image segmentation. Generally a grayscale image is converted to create a binary image which can be used for document restoration. Thresholding methods mainly replace each pixel in a grayscale image with a black pixel if the image intensity is less than some fixed constant or with a white pixel if the image intensity is greater than a given constant. [1]

2. COMPARISON OF ALGORITHMS

2.1 Phase Based Binarization –

Phase-based binarization algorithm is a post processing method, which helps to improve binarization method. It is developed for the antique documents. There are three features, the maximum moment of phase congruency covariance; phase preserved denoised image and a locally weighted mean phase angle. These features are obtained from the phase information of an input text document image that set up the core of binarization model. The phased-based binarization algorithm consists of three main stages: 1) pre-processing; 2) main binarization and 3) post-processing [3]. In the initial two stages, the properties utilized are primarily phase derived, while in the last stage, specialized adaptive Gaussian and median filters are utilized. One of the outputs of the binarization step, which gives good performance, is used in a proposed post-processing step to improve the performance of other binarization techniques. Finally, we come up with a improved generation tool, called PhaseGT, to simplify and improve the traditional generation process for antique document images. [2]

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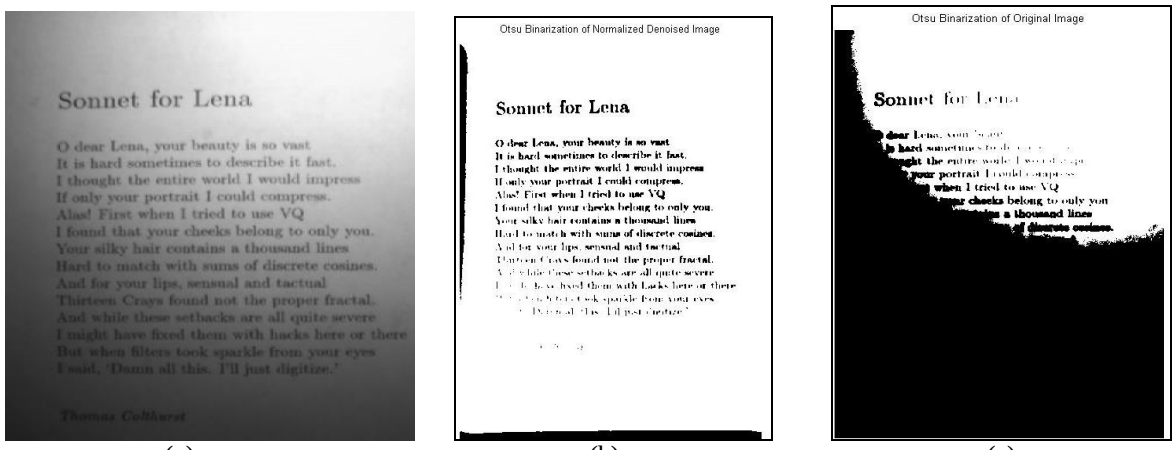
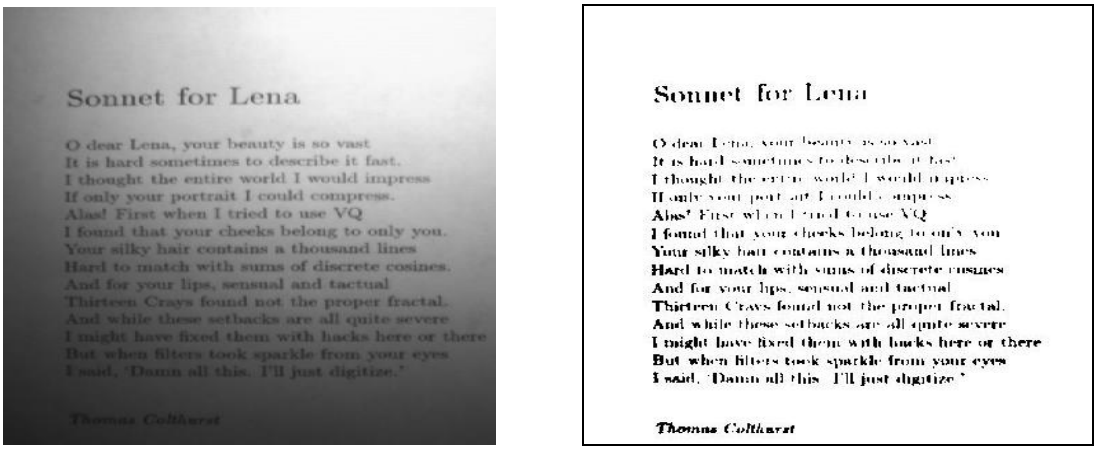


(a) (b) (c)

Figure 1. (a) Original image (pre processing) (b) Binarization of Normalized Denoised Image(c) Binarization of Original image (post processing)

2.2 Nick Local Image Thresholding –

In this algorithm there are three CUDA kernels for the computation-intensive Nick local image thresholding algorithm. These kernels adopt diverse strategies to manage the long memory inertness issue of this method. The main kernel loads and gets to all picture pixels from the global memory. The second portion utilizes both global and shared memory. At long last, the third piece, which stacks all picture pixels into the shared memory. Nick local image thresholding will create better speedup for the vast majority of the block size and window size configurations [2].CUDA is a GPGPU programming model created by NVIDIA. In CUDA, kernel goes about as general C function executed N times when called by N diverse GPU thread and it executes parallel [6]. In CUDA, host and gadgets (device) may have isolate memory spaces. All things considered, executing a kernel on a gadget (device) requires allotting global memory on the gadget (device) and exchanging information from the host memory to the apportioned device memory, this exchange is considered as one of the primary overheads of executing CUDA portions. At the point when a host code dispatches a kernel, the CUDA runtime framework produces a grid of threads sorted out in a two-level hierarchy. Every network is sorted out into a array of thread blocks. The quantity of threads in each thread blocks is indicated by the host code when a kernel is propelled. GPUs are sorted out into a array of highly threaded spilling multiprocessors (SMs). Strings are appointed to these SMs at granularity [3]. CUDA supports several types of memory. Consistent memory can be composed and perused by the host and backings short-latency, high-bandwidth, read-only access by the device. When we announce a device variable as consistent, it will be reserved when gotten to by the SMs. Shared memory and registers are on-chip recollections which can be gotten to at fast in a profoundly parallel way[2]-[3]. Since all memory gets to in this kernel are to long latency global memory, one may feel that it can't give much execution change in examination with the advanced sequential C version. Such as, in the experiment, the kernel can give more than 100x speedup because of the spatial and temporal locality feature of the Nick technique which permits to abuse caching of the most as often as possible utilized pixels in the SM L1 cache and the grid shared L2 cache [3].

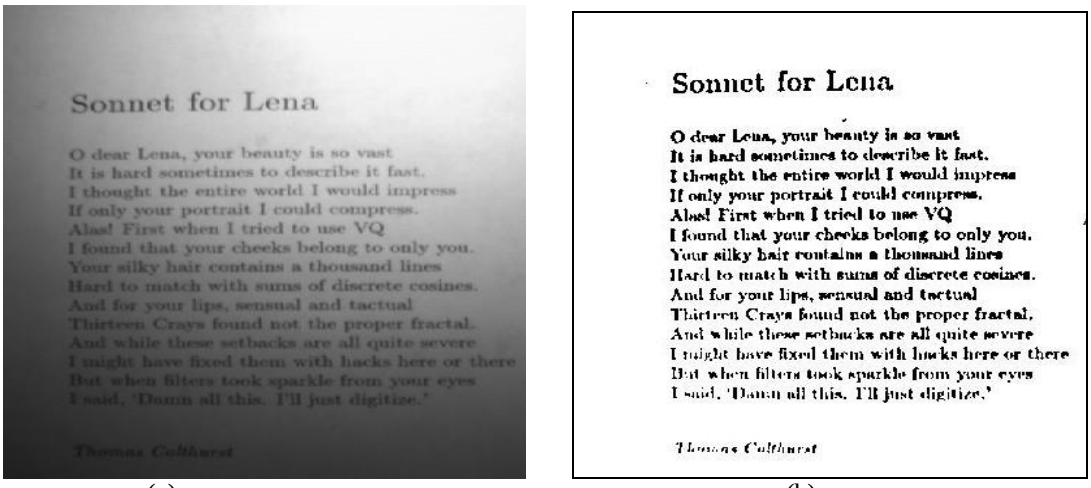


(a) (b)

Figure 2. (a) Original image (b)NICK local thresholding image .

2.3 Local Adaptive Thresholding Technique –

Thresholding turns into a basic yet successful device to isolate objects from the background. The result of the thresholding operation is a binary picture whose one state will demonstrate the foreground objects. that is, printed content, a legend, an objective, defective piece of a material, and so forth., while the correlative state will compare to the background. Contingent upon the application, the foreground area can be represent by gray level 0, that is, black for content, and the background by the most highest luminance for record paper, that is, 1 of every 8-bit pictures as white, or foreground by white and background by darkThis algorithm shows another method for figuring threshold for locally adaptive binarization scheme, it utilize necessary total image so the running time does not rely upon the local window size to figure mean in local windows, The proposed technique is quicker than Sauvola's strategy, and its running time approaches that of global binarization technique [4].The binarization systems for grayscale reports can be assembled into two general classes: worldwide binarization and local binarizationglobal binarization techniques, for example, one proposed by Otsu [7] attempt to locate a single threshold incentive for the entire document, At that point every pixel is relegated to page foreground or background in view of its gray value. global binarization strategies are quick and they give great outcomes for scanned document. For a long time, the binarization of grayscale reports depended on the global thresholding algorithm [4].



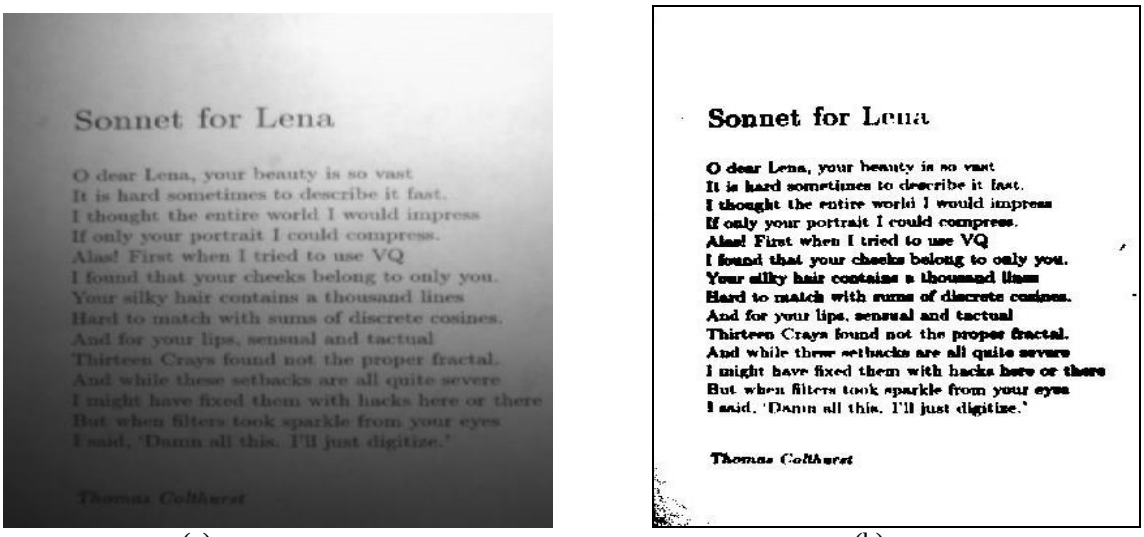
(a) (b)

Figure 3. (a) Original image (b) Adaptive threshold image

2.4 Wolf's Algorithm –

This algorithm in most cases exceeds its predecessors.However, downgrade is seen in its execution if there is a basic change in background gray values across the image.This is because of the way that the values of M and R are calculated from the whole image. So even a small noisy patch could significantly influence M and R values, thus eventually calculating misleading binarization thresholds[5]

Wolf Pack Algorithm (WPA) is another new technique proposed by Husheng et al [9], and Wu et al [10], as indicated by the wolf pack clever conduct, the specialists abstracted three intelligent behaviors: scouting, calling and besieging, and two intelligent rules, winner-take all generation rule of lead wolf and stronger-survive renewing rule of wolf pack. The tests demonstrate that WPA has better union and power, particularly for high-dimensional capacities. Advantageously, Tao et al. [8] proposed Gray Wolf Optimizer (GWO) propelled by grey wolves. The GWO algorithm duplicates the leadership hierarchy and chasing mechanism of grey wolves in nature. Four types of grey wolves such as alpha, beta, delta, and omega are utilized for recreating the organization progressive system. The three standard endeavors of hunting, searching for prey, encircling, and attacking are executed. Contrasted with understood heuristics. For example, PSO, GSA, DE, EP, and ES [9] – [12], the GWO [8] calculation demonstrates better global convergence and higher robustness. Additionally, the GWO has elite in taking care of testing issues in unknown search spaces, and the outcomes on semi-genuine and genuine issues likewise demonstrate that GWO can indicate superior on unconstrained issues as well as on obliged issues. This technique takes Kapur's entropy as objective function with the modified discrete grey wolf algorithm (MDGWO) as the instrument to tackle the ideal threshold issue, which can fill in as the reason for future fuzzy aggregation methods.

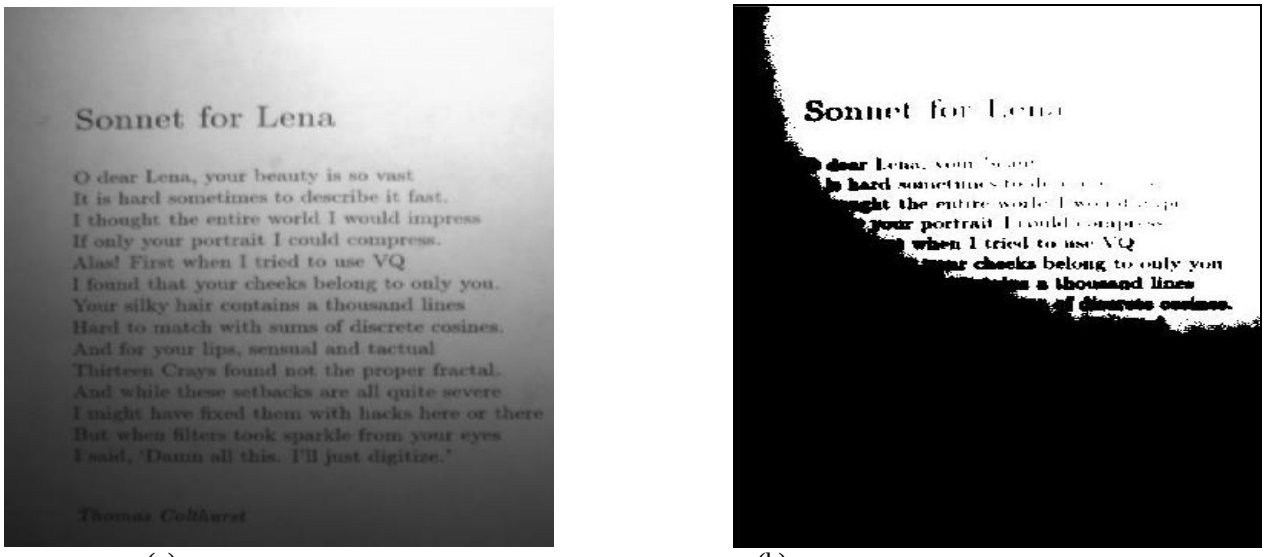


(a) (b)

Figure 4. (a) Original image (b) wolf's image

2.5 image thresholding using the Triangle Method–

The Triangle algorithm, a geometric technique, can't advise whether the information is skewed to some side, yet accept a most extreme peak (mode) close to one end of the histogram and inquiries towards the other side. This causes an issue without data of the kind of image to be handled, or when the most extreme isn't almost one of the histogram extremes (bringing about two conceivable threshold districts between that maximum and the extremes). Here the algorithm is stretched out to discover on which side of the maximum peak the information goes the furthest and looks for the threshold inside that biggest range. A line is produced between the most outrageous of the histogram on the diminish level axis and the slightest (or most hoisted depending upon context) regard an on the gray level axis where the histogram is greater than 0. The partition L customary to the line and between the line and the histogram is handled for all esteems from a to b. The level where the division between the histogram and the line is maximal is the threshold (level). This technique is particularly fruitful when the object pixels convey a frail peak in the histogram [5]. Thresholding does not need to be connected to whole image but rather can be utilized on a district by region premise. at hand.



(a) (b)

Figure 4. (a) Original image (b) Triangle method threshold image

3. EXPERIMENT AND RESULT

Peak Signal to Noise Ratio (PSNR) and Mean Square Error (MSE) are used to comparing the squared error between the original image and the reconstructed image. There is an inverse relationship between PSNR and MSE. So a higher PSNR value and lower MSE value indicates the higher quality of the image. If the PSNR value of an image is high than that image is considered as good quality image otherwise it is considered as low quality image. In Mean Square Error (MSE) two of

the error metrics used to compare the various image compression techniques are the Mean Square Error (MSE) and the Peak Signal to Noise Ratio (PSNR). The MSE is the cumulative squared error between the compressed and the original image, whereas PSNR is a measure of the peak error. The PSNR value greater than 20 is considered as good quality image.

Table -1 Experiment Result

SI no	Algorithm	MSE	PSNR
1	Phase Based Binarization (a) Binarization of Normalized Denoised Image	MSE: 18414.76	PSNR: 5.5131375
	Phase Based Binarization (b) Binarization of Original image (post processing)	MSE: 18484.10	PSNR: 5.4968152
2	Nick Local Image Thresholding	MSE: 1175.11	PSNR: 17.4640140
3	Local Adaptive Thresholding Technique	MSE: 18415.39	PSNR: 5.5129891
4	Wolf's Algorithm	MSE: 745.92	PSNR: 19.4378964
5	image thresholding using the Triangle Method	MSE: 18484.10	PSNR: 5.4968152

Table 1 show the peak signal to noise ratio and the mean square error of the image in all the alogorithms we compared in this paper.

4. CONCLUSION

According to the experiment result Wolf's Algorithm gives the best result, when compared to the other algorithm; A. Phase Based Binarization, B.Nick Local Image Thresholding, C.Local Adaptive Thresholding Technique, D.Wolf's Algorithm, E. image thresholding using the Triangle Method.so we consider Wolf's Algorithm is better algorithm because it has the high Peak Signal to Noise Ratio (PSNR) and low Mean Square Error (MSE).

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