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Enhancement of Old Historical Document by Image Processing from Gray scale to RGB Scale Conversion

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Abstract: *The enhancement of historical documents through image processing stands as a pivotal bridge between the past and the present. In this project, we embark on a journey to rejuvenate these treasured artifacts by utilizing cutting-edge techniques. Central to this endeavor is the conversion of grayscale documents into the vibrant realm of RGB, breathing new life into their visual presentation. The Nonlocal Mean Denoising algorithm takes center stage, diligently removing noise while preserving the document's authenticity. Accompanied by image division code, we break down these historical scrolls and manuscripts into comprehensible segments, ensuring efficient processing without compromising their essence. At the heart of our methodology lies the profound significance of image histograms. Through these histograms, we delve into the intricacies of pixel intensities, unearthing valuable insights into the document's characteristics. The outcome of our rigorous efforts is a transformation of these historical gems, making them not only aesthetically pleasing but also accessible to a broader audience, fostering a deeper appreciation of our cultural heritage. As technology and history intersect in this project, we highlight the transformative potential of image processing in preserving and reinvigorating the stories of the past. In an age where the digital realm converges with the analog, this endeavor reiterates the importance of ensuring that history remains alive and tangible for generations to come.*

Keywords: Gray scale, Red Green Blue scale, Nonlocal Mean Denoising algorithm, Image Histogram

I. INTRODUCTION

Across the globe, libraries curate collections of historical and ancient documents cherished for their profound scientific and cultural importance. To maintain the quality of the originals it is essential that the documents are transformed into digital form, by doing this scholars are provided with full access to the information. Degradation problems are quite common in these documents. A few factors that impede (in many cases may disable) the legibility of the documents are strains, big variations, uneven illumination, presence of smears, seepage of ink, etc.

Historical documents often deteriorate over time, and converting them to RGB scale can help preserve them digitally ensuring their accessibility for future generations RGB images provide better contrast and clarity, making text and illustrations in historical documents more legible. RGB scale allows for the restoration of original colors in documents. This is especially important for historical manuscripts with colored ink, illustrations, or watermarks, as it helps capture the document's true appearance. The process of converting to RGB can involve restoration techniques, which can also help repair and preserve the physical document itself. Addressing issues related to copyright and access to historical documents can motivate the development of standardized procedures for enhancing and sharing these materials in RGB. Making enhanced historical documents available to the public can generate interest and engagement in history, fostering a sense of shared cultural heritage. The digitization and enhancement of historical documents can foster international collaboration in preserving and sharing historical and cultural knowledge.

II. METHODOLOGY

Our methodology involved the systematic transformation of old historical documents from grayscale to RGB scale for enhanced accessibility and visual appeal. It encompassed data collection, preprocessing, image enhancement, text extraction, and algorithm evaluation. We also developed user-friendly tools and documented best practices. Practical

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applications were demonstrated Fast Non-Local Means Denoising (NLM): Think of NLM as a way to make noisy pictures look clearer. It works by comparing each part of the picture to other parts and then smoothing it out based on similarities. "Fast" NLM does this quickly by only looking at nearby parts of the picture instead of the whole thing. where f denotes the noisy image; m and n are the pixel values in the noisy image;

$$NL[f](m) = \sum_{n=I} w(m,n) f(n),$$

and w(m,n) is the distance weight that depends on the similarity of pixels m and n, satisfying the condition 0w(m,n) 1. The similitude between m and n is related to the similarity of the intensity of gray level vectors, v(km) and v(kn), where ki denotes the square-shaped kernel centered on pixel i.

$$\omega(m,n) = \frac{1}{Z(m)} \sum_{n} e^{-G_a(\lambda)\|\mathbf{f}(m+\lambda)-\mathbf{f}(n+\lambda)\|_2^2} d^2,$$

where Ga(λ) denotes the Gaussian distribution size, a2, for the number of pixels, λ, of the set kernel, and f(m+λ)f(n+λ)22 is the intensity difference between pixels m and n based on the Euclidean distance. The FNLM algorithm was shaped by substituting the two-dimensional distance weight calculation with a one-dimensional equation in its model. This alteration resulted in the formulation of the modified distance weight equation:

$$\omega^{\vee}(m,n) = \frac{1}{Z(m)} \mathrm{Si}\left(\mathbf{f}(m+P) - \mathbf{f}(n-P)\right),$$

$$\mathrm{Si}(p) = \sum_{\tau=0}^{p} e^{-\|\mathbf{f}(\tau)-\mathbf{f}(\tau+\lambda^{\vee})\|_2^2} d^2,$$

where P denotes the local patch size when the image is vectorized in one dimension and λˇ and p are defined as nm and m+λˇ, respectively. If the required operational quantity of the NLM algorithm is O(P)dimension, then the FNLM algorithm with the proposed equation is determined as O(2dimension). Modeling the FNLM algorithm based on the modified distance weight can improve the time resolution of image processing to reduce noise.

Gaussian Blur for Image Smoothing:

Imagine you have a picture that looks a bit messy with lots of tiny speckles. Gaussian blur helps clean it up. It's like gently smoothing the picture by averaging the colors of nearby dots. The closer the dots, the more they influence each other.

Image Division for Enhancing Features:

Image division is like a magnifying glass for specific things in a picture. You can use it to make some parts of the picture stand out. For example, if you divide a picture by a slightly smoothed version of itself, you emphasize the edges and differences between things in the picture, making them more noticeable. It's like using a special tool to highlight what's important in a picture, like finding the edges of objects or emphasizing areas with lots of contrast.

III. APPLICATION

Archives and Museums:

The curation of historical images and documents is essential for the preservation and presentation of valuable objects and their availability to researchers and the public. Historical Research: Recovered images help historians and researche rs understand the past more deeply, facilitating the study of the law of historical events, people, and cultures.

Education: Educational materials can use better images to help students connect with history and better understand its importance.

Cultural Preservation: This process is used to preserve cultural heritage for future generations, including old books, pain tings, and photographs.

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IV. CONCLUSION AND DISCUSSION

In this article we present the history of the visual development of the algorithm. This algorithm uses an approximation o f the "flatness" of the background. Normalizes the image by adjusting the pixel values according to the line plane approximation. Thanks to our experiments and evaluations, the algorithm successfully read old paper, crumpled paper, and camera images with irregular lighting.

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VI. TESTED IMAGE

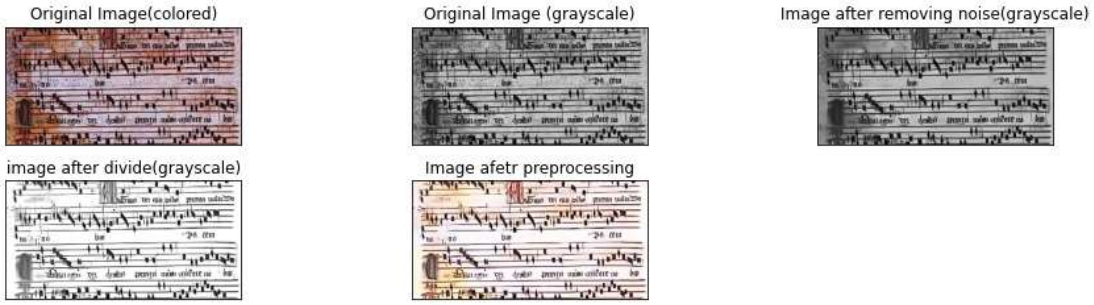

Fig 1. Enhancement of old Historical Image

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