Research on repairing historical photos of damaged scratches based on computer technology

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***Abstract*—Historical photographs record the true face of a moment in the development of human history, they have authenticity, vividness, and unique values. However, due to various factors, aging and damage will occur. With the development of computer technology, the restoration technology is more used in photo restoration and virtual restoration of cultural relics. This paper first analyzes the principle of repairing photo archives based on computer technology, and then uses the combination of statistics and computer image processing technology to detect and repair the scratches in historical photographs. And the paper establishes a model repair framework, which provides a new idea for the repair of such historical photos. The experimental results show that the method has a significant repair effect.**

Keywords-repair frame;scratches; Variance distribution detection;

I. INTRODUCTION

Archival records and reflects the true face of human society's practical activities, which is the true evidence of history. Photo archives are an important part of archival resources and are characterized by strong image and strong evidence. Historical photographs, as part of a photo archive, carry a country's cultural heritage and human unique memories and have unique values. However, historical photos are subject to aging and damaging during the long-term preservation process, affected by the environment and their own materials. F. Stanco et al[1] divide photo damage into mechanical damage, chemical damage and deposits. How to better restore these historical photos, photo restoration methods play an important role. The traditional methods of repairing historical photographs use physical and chemical methods and copying photographs to produce a new frame[2]. The former can observe the change of specific components in the paper from the perspective of photo paper composition, and it is more in line with the original ecological restoration, but it needs to be operated on the original. A slight operation will increase the risk of the original price being damaged. The latter operation is more convenient and more shared, but there is a risk of photo quality degradation during the copying process. These two repair methods have limited effectiveness and high risk to some extent. With the development of computer technology, computer repair technology has also been successfully applied to photo restoration, virtual restoration of cultural relics and so on. For example, Wang Zhan et al elaborated on the concept and significance of digital image restoration technology in the virtual restoration of cultural relics, and showed some repair results [3]. Zhang Mei fang introduced the repair of Photoshop in damaged photos, which provided a reference for the application of digital repair technology in archives[2].Scratches is an important type of historical photo damage, which is repaired and will provide a variety of repair methods for the restoration of damaged historical photos, enriching the means of photo restoration. At present, the use of computer technology to deal with scratches is mainly through Photoshop software. Although Photoshop has achieved good results in repairing damaged photos to a certain extent, it requires operators to have familiar operation techniques, which requires a lot of time and requires operators. Subjective judgment, there is a certain degree of misjudgment and the possibility of operational errors. This paper first analyzes the principle of computer-based photo archives, and then uses the combination of statistics and computer image processing techniques to solve the above problems, and proposes a repair model framework for scratches and provides a new idea on historical photos. The model framework can detect the specific location of the damaged area of the scratch, and the repair effect is good, and the operator does not need to have skilled technical and subjective judgments, and is relatively simple and has low error.

II. PRINCIPLES FOR REPAIRING PHOTO ARCHIVES BASED ON COMPUTER TECHNOLOGY

Based on computer technology to repair photo archives, it first uses scanning technology and digital photography technology to convert damaged photo files into digital archive photos, and then uses computer technology, digital image processing technology, OCR technology to repair damaged photo files [4].The method of repairing photo files based on computer technology does not need to consider factors such as photo material, environmental conditions, damage degree, etc., it only need to select different methods for different types of damaged areas, and the operation object is a digitized photo, avoiding the original risk of damage. Due to the advantages of computer technology in repairing files, there are numerous applications in this area. Yuan Ke, Yu Honggui et al used chemical technology, computer technology, chemistry and computer technology to repair faded blue and black ink characters[4]. The scientific restoration principle provides a certain standard for photo file restoration, which will improve the efficiency of photo file restoration

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work and repair the quality of photos, and plays an important role in photo restoration work. The use of computer technology to repair photo archives should follow the principles of old as old, complete, minimal intervention, and artistic. The specific content is to maintain the original photo face when computer technology repairs the photo file. Zhang Mei fang[2] mentioned that keeping the original appearance was the basic principle of photo restoration, that was, the old principle is the old one, that was , the authenticity. While repairing damaged areas, the quality of other areas cannot be reduced, and the information of each area has its uniqueness and irreplaceability. And you need to ensure the integrity of the repair, you cannot miss any area. However, when repairing, the area that is not damaged should be avoided as much as possible, and only the damaged area should be repaired, that is, the least intervention. Finally, the finished product should be artistic. Artistic, that is, the restored photos give people an intuitive feeling, that is, color matching, flatness, and so on. Artistic requirements for the photos before and after the restoration of the intuitive experience of the whole is unchanged.

III. HISTROCIAL PHOTO REPAIR MODEL FRAMEWORK

In this paper, based on the combination of statistics and computer image processing technology, a historical photo restoration model for scratched areas is constructed. The model mainly includes photo preprocessing, judging the type of damaged area, and obtaining the restored photos. First, pre-treatment of damaged photos, such as dusting and copying, is required before repair to avoid affecting the repair results and to prevent further damage to the photos. Then judge the damaged area and judge by the classification algorithm mentioned by E. Ardizzone et al[1]to determine the type of scratch and prepare for subsequent repair. Finally, the variance distribution of the damaged area of the scratched photograph is detected, and then the scratch is removed, and finally the restored photograph is obtained. The model is shown in Figure1.

A. Photo preprocessing

A certain amount of processing is required before the photo is repaired, and the photo preprocessing process ensures the accuracy of the subsequent detection and repair process. Such as sterilization, scanning, dust removal, leveling and so on. It is necessary to remove the dust, impurities, mold, etc. before the photo is repaired to avoid interference. When dusting, it mainly uses sheep pens and other soft pens. After dusting, entering the digitization process, scanning the damaged photos, outputting them to the computer and repairing them. The resolution when scanning should not be lower than 600dpi and should not be higher than 1200dpi[5]. Scanning should not degrade the quality of the photo. During this process, the photo should be kept flat.

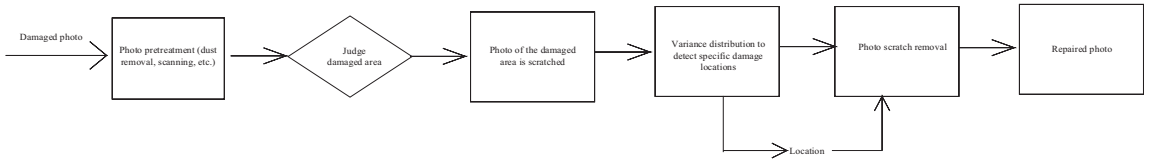

Figure 1 Historical photo repair model frame diagram

B. Determine the type of damaged area

Pre-processing is performed when the original damaged photo is input, the type of the damaged area is first judged. At present, it is mainly judged by manual and simple machine equipment, and there is a certain error. E. Ardizzone et al[1]designed a knowledge-based architectural photo virtual restoration framework that automatically identified the type of damaged area of the photo with high accuracy. In view of the type of damaged area, this paper uses the method in the virtual repair framework proposed by E. Ardizzone et al to automatically identify the type of damaged area. In the subsequent stage, the specific location of the damaged area is detected for repair. This paper deals with the detection and repair of scratches from damaged areas scratches.

A scratch can be defined as a portion of the width of several columns of the color gray scale information in the image that is completely lost[7]. This article examines the scratches in the photo from a statistical point of view and does not delve into the density of the scratch.

1) Scratch detection-variance distribution detection Selection

Current treatments for scratch detection are primarily through the density of scratches. The density of the scratches is different, and the color exhibited on the photo is also different. Hu Wen Jing et al [8] used wavelet analysis to detect the vertical scratches appearing in Thangka images, and achieved good detection results, but the effect on short scratch detection was not satisfactory. The position of the scratched area is detected by the scratch density value, and the length, weight, and weight of the scratch will affect the detection. The variance value of the scratch is based on the statistical distribution of the gray level of the image. The self-feature of the scratch does not affect the detection, and the specific position information of the vertical scratch can be well detected, and the detection effect is robust. In this paper, the vertical scratch is detected by the method of variance distribution detection. From the original photograph, the variance distribution is generated and its behavior is analyzed. The candidate scratch line is identified by the column with local fluctuation of variance. Steps for detecting variance distribution:

a) The variance is weighted by the proportion of each pixel in each column.

b) In the variance distribution function,ax and bx respectively represent the fluctuations of the first column and the last column, a1 and b1 represent the corresponding variances, and c represents the maximum value of the variance within [ax,bx]. The variance distribution function f(x) of the candidate scribe line is compared with its function mean to see if the absolute value is greater than the standard deviation, and if the absolute value is greater than the standard deviation, the column identifier is marked as a scratch. Figure 2 shows a column variance plot with scratches.

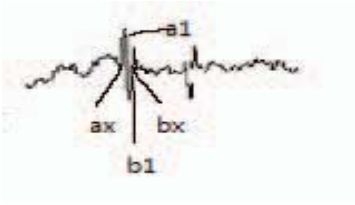

Figure 2 Distribution of variances with scratches

2) Scratch removal

Through the detection of the variance distribution in the previous stage, the specific position of the scratch can be accurately detected. Next, the scratch removal is performed. At present, Meng Qing li applied the differential equation to the repair of vertical scratches[8]. The effect is better and less time is used, but when using image gradient diffusion, the noise is too large to affect the diffusion. The direction, which in turn affects the repair results. The GA algorithm avoids the effects of noise, assigning gray level values that satisfy the fitness function based only on color information to each pixel on the scratch. The fitness function is based on the variance value, and the purpose is to reduce the difference between the scratch and the rest of the image, so that the error in the gray value assignment process is reduced.

In the gray value assignment process, the selection of the optimal value is dependent on the GA algorithm, and the GA starts by linearly interpolating from adjacent pixels to give colors to the pixels in the scratch. The GA is initially filled by a two-dimensional sequence of pixels within a set of scratches and pixels outside of the adjacent scratches. The GA framework was proposed, which used genetic algorithms to study the unknown environment in V. DiGesa et al 's Experiments on concurrent artificial environment[9].

IV. HISTROCIAL PHOTO REPAIR APPLICATION BASED ON COMPUTER TECHNOLOGY

In order to ensure the authenticity of the historical photo repair process in this paper, the design experiment is verified. The operating system of the experiment is windows7, and the operating software used is MATLAB 2013b. The experimental selection is the scratch history photo as the research object, and the photo size is 256×256. Figure 3 shows the repair process of the damaged photo, where Figure a is the source history photo, and Figure b is the detected damaged area, and Figure d is the restored photo.

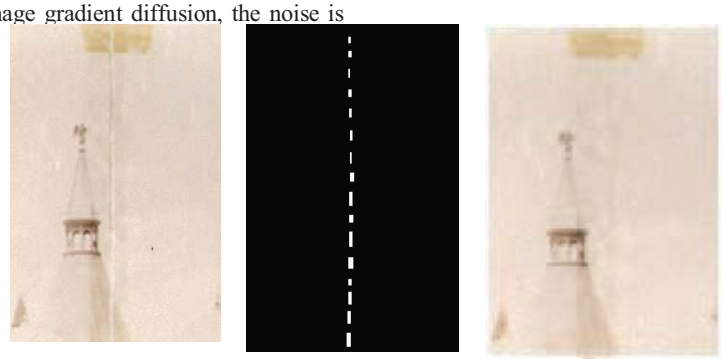

Figure3 the repair process of the damaged photo

The quality of the restored photos and the original damaged scratches are evaluated. At present, the image quality evaluation is mainly subjective evaluation and objective evaluation. The subjective evaluation is mainly based on the human visual effects. The objective evaluation is mainly to establish a mathematical model. As can be seen from Figure 5, the scratches in the photo after the repair are obviously removed, and a good repair effect is obtained. The variance distribution map can well show the column identification with scratches, and the quality of the restored photos is detected by the variance distribution map. Figure 4 and Figure 5 show the variance distribution of the damaged scratch photo and the repaired scratch photo. It can be seen that the variance distribution of the restored photos is more balanced and uniform than the variance distribution of previously damaged photos. In summary, this scratch removal achieves good results.

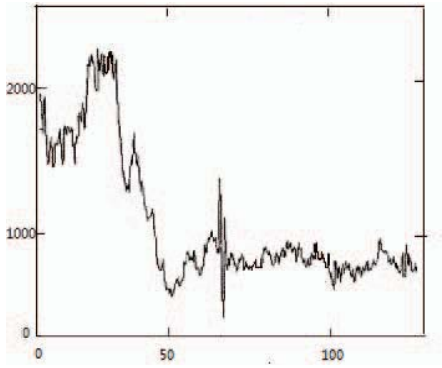

Figure4 variance distribution of the demaged scratch photo

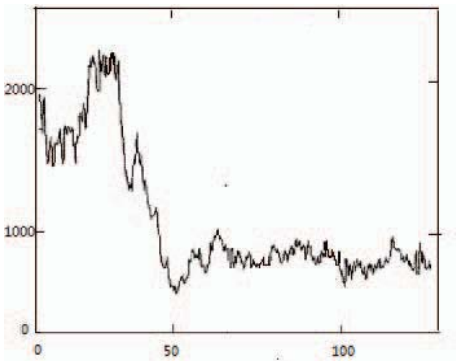

Figure5 variance distribution of the repaired scratch photo

V. IN Conclusion

The author first analyzes the principle of repairing photo files based on computer technology, and then uses the combination of statistics and computer image processing technology to repair the damaged type of scratched historical photos, and establishes a repair model framework of historical photos. It provides a new way to repair historical photos. It can be seen from the variance distribution map of the scratched photograph that the repair model has achieved good results. However, the research in this paper is limited, and only a repair frame is provided from the photos with vertical scratches. For other types of damaged photos, further research is needed. In summary, computer technology provides a new possibility for the repair of damaged photos, and it is more repairable and simpler. With the rapid development of computer technology, photo file repair based on computer technology will be greatly improved, and the operation is more convenient and efficient.

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