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Image Restoration by Using Hybrid Filling-in Technique

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***Abstract*— Image Restoration is defined as method to restore the degraded or corrupted images. There are many restoration methods available and implemented to recover the corrupted images. Filling-in of missing and corrupted information is very important technique in image restoration. When images are transmitted, if some of information is lost then reconstruction of the lost data using correlation between the lost block and its neighbors has been used. The basic idea is fill-in the missing block with information propagating from the surrounding pixels. This paper presented novel and efficient algorithm that combines the advantages of two filling-in techniques. In this paper, "Hybrid Filling-in technique for image restoration" is presented in which two filling-in techniques are used to restore the damaged image. In the hybrid technique first Probabilistic Recovery Filling-in technique is implemented to find out the distortion in the pixels. In this technique corrupted and missing pixels are founded according to low density of pixels and restored by using information from the surrounding pixels. After this approach the proposed filling-in technique is implemented to restore the noisy and distorted image in which GLCM is used to scan the properties of image. This research will provide better quality of results as compare to previous techniques. Then the results of Probabilistic Recovery and Hybrid Filling-in techniques are compared.**

***Keywords*— Density, Filling-in technique, GLCM, Image Restoration**

I. INTRODUCTION

An image is defined as a 2-D function f(x, y) where x and y are spatial coordinates. Amplitude of 'f' at any pair of coordinates is known as gray level of image. When the values of x, y and intensity f are finite and discrete, image is called digital image**.** Digital Image Processing (DIP**)** is a process of processing digital images by means of digital computer. Image processing basically includes the following three steps. - Importing the image with optical scanner or by digital photography, analyzing and manipulating the image which includes data compression and image enhancement and restoration[3] .Output is the last stage in which result can be altered image or report that is based on image analysis .

Image processing is a wide area including various applications in it. Since the early days of art and photography, filling-in and in-painting has been done by professional artist. Imitating their performance with semi-automatic digital techniques is currently an active area of research. The filling-in of missing information with applications including image coding and wireless image transmission (e.g., recovering lost blocks), special effects (e.g., removal of objects), and image restoration (e.g., scratch removal) is a very important in image processing [2].

Image Restoration is defined as process to restore a degraded/distorted image to its original content and quality. The main objective of restoration is to improve the quality of a digital image which has been degraded due to various kind of noise or blur added into it. Before the advent of computers and software, most photo restoration was done by restoration experts. Repairs were applied directly to the damaged photo and consisted mainly of air brushing over the damage. This is still the preferred method for valuable historical photos. This work is very expensive and not usually required by the average person wishing to repair old damaged family photos. Fortunately, it is now possible through the use of computers and software, to restore almost any photo at very reasonable prices. Instead of working directly on the damaged photo, a copy is made using a scanner [2]. Once all repairs are made to the copy using computer software, a new print can be produced. The final digital photo file of the repaired photo can be saved as an archival copy and replaces the need for a negative.

It is a good idea to restore your entire photo collection in order to stop the unavoidable destruction that will take place no matter how carefully the photos are stored. Once restored, the photos can be copied to CD or DVD for long term storage and safe keeping. Once you have digital copies you need not worry about further damage because digital images do not change at all [2].

The **Filling-In Technique** for restoration uses the information propagating from the surrounding pixels. Here the aim is to fill-in the gap of missing data in a form that is non-detectable by an ordinary observer and is known as in-painting [6]. This technique provides a means to restore damaged region of an image, such that the image looks complete and natural after restoration [4]. Filling-in missing data in digital images has a number of fundamental applications. They range from removing objects from a scene all the way to retouching damaged paintings and photographs[1]. Image in-painting provides a means to restore damaged region of an image, such that the image looks complete and natural after the in-painting process. Image in-painting could also be used to create special effects, for instance specific object removal. Digital image in-painting mainly aims at filling in missing pixels in an unknown region of an image in a visually plausible way [9].

II. PROPOSED WORK

In this paper hybrid filling-in technique is used to restore the corrupted or damaged images. In the hybrid technique first Probabilistic Recovery Filling-in technique is implemented to find out the distortion in the pixels. In this

density based approach, density of each pixel is measured. Low density pixels are considered as corrupted or missing pixels. Recovery Probability of each pixel is founded. For corrupted pixels, if probability of recovery pixel is <60% then matching of pixel from surrounding is done. For corrupted pixels, if probability of recovery pixel is >60% then matching is done from the remaining part of the pixel. If the pixel is missing, finding the missing block process is carried and matching with surrounding is done. Pixel matching is judged by color map and based on good observations. After this proposed filling-in technique is implemented in which GLCM (Gray level co-occurrence matrix) is used to scan the properties of image. First window size is set according to GLCM. Each pixel is traced in window block. Features of pixels are scanned and best matching pixels is founded through scanning. Values of corrupted pixel are replaced by best matching pixel. The research will provide better quality of image after recovery. This paper describes the benefit of using two filling-in techniques. There are some distortions left after applying Probabilistic Recovery Filling-in technique which is removed to large extent by implementing proposed filling-in technique.

III. METHODOLOGY

In the hybrid technique density based approach is implemented to find out the distortion in the pixels. After this approach the proposed technique is implemented to restore the noisy and distorted image.

First of all GUI window is created in MATLAB. Image is loaded in it. Then noise and blur is added into it. After adding distortion canny edge detection technique is implemented to detect the edges. Then hybrid filter is applied to remove distortion from image. Hybrid filter is combination of Median and Lee Filter. Median filter is better able to remove these outliers without reducing the sharpness of the image. Output of median filter is given to Lee Filter. Lee filter further filters the image. After filtration, Probabilistic Recovery Filling-in technique is applied. Low density pixels are considered as corrupted or missing pixels. Recovery Probability of each pixel is founded. For corrupted pixels, if probability of recovery pixel is <60% then matching pixel from surrounding is done .For corrupted pixels, if probability of recovery pixel is >60% then matching is done from the remaining part of the pixel. For completely missing pixels, finding the missing block process is carried and matching with surrounding is done. Pixel matching is judged by color map and based on good observations. After this proposed filling-in technique is implemented in which GLCM (Gray level co-occurrence matrix) is used to scan the properties of image. First window size is set according to GLCM. Each pixel is traced in window block. Features of pixels are scanned and best matching pixels is founded through scanning. Values of corrupted pixel are replaced by best matching pixel.

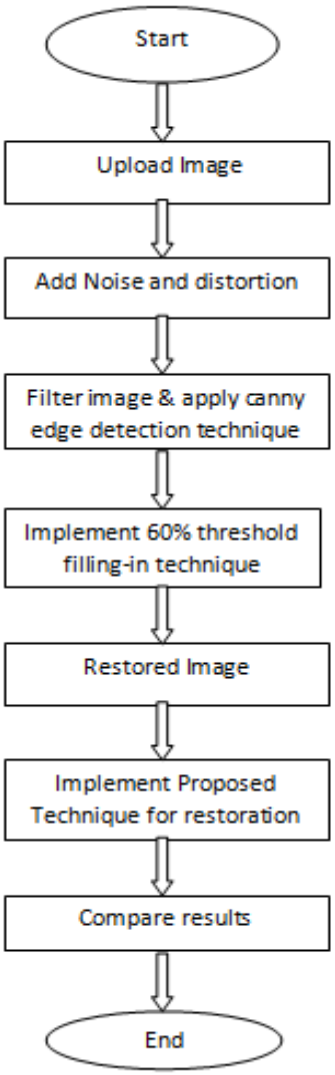

Fig.1 Flow Chart

IV. PRESENT WORK

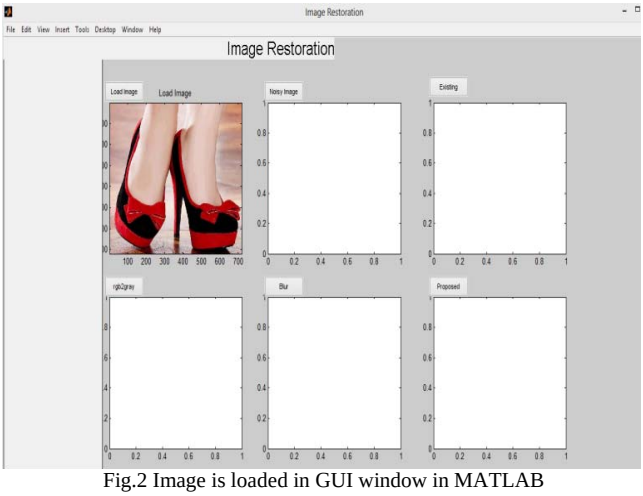

Fig.2 Image is loaded in GUI window in MATLAB

Fig.3 Conversion of RGB image to grayscale image

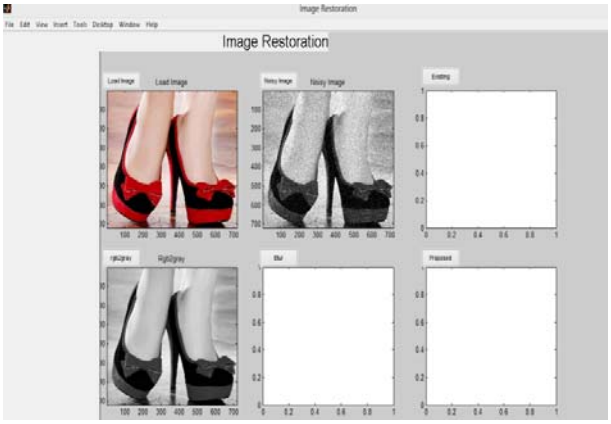

Fig.4 Addition of Noise in Image

Fig.5 Addition of Blur in Noisy Image

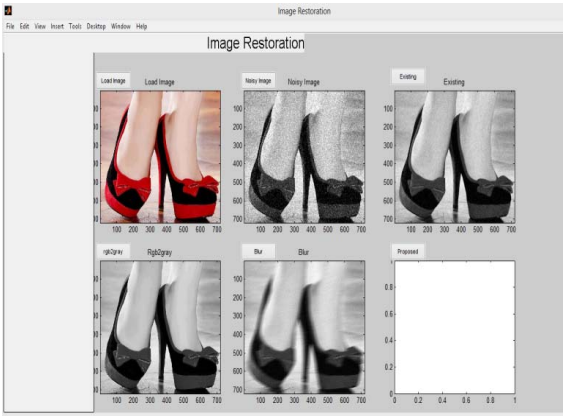

Fig.6 Restored Image after applying Probabilistic Recovery Filling-in technique

Fig.7 Restored Image after implementation of Proposed Filling-in technique

V. RESULTS

In this section, the comparative studies are explained & experiments are carried out for two filling-in techniques.

TABLE 1
Comparison of both filling-in techniques

Properties	Hybrid Filling-in Technique	Probabilistic Filling-in Technique
MSE	0.23	0.34
RMSE	0.12	0.23
PSNR	50	40
CONTRAST	30	26

In above table different properties such as MSE, RMSE, PSNR and Contrast are compared. It is clear from the table shown above that hybrid filling-in technique is more efficient as compare to probabilistic recovery filling-in technique for restoration of distorted images. This paper describes the benefit of using two filling-in techniques. There are some distortions left after applying Probabilistic Recovery Filling-in technique which is removed to large extent by applying proposed filling-in technique. Thus the combination of two techniques gives better results.

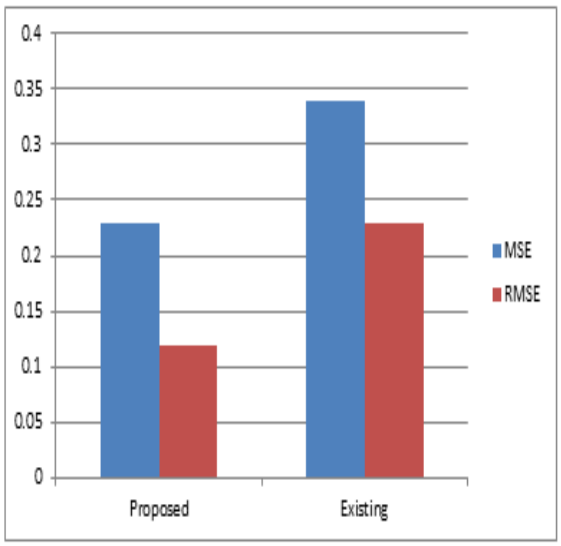

Fig.8 Comparison of MSE and RMSE of Hybrid and Probabilistic Recovery Filling-in techniques

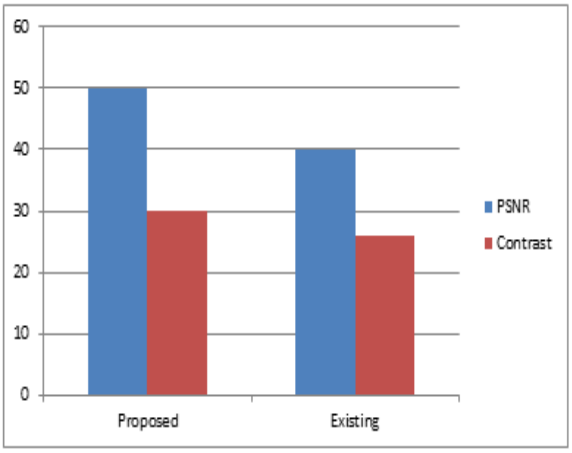

Fig.9 Comparison of PSNR and Contrast of Hybrid and Probabilistic Recovery Filling-in techniques

VI. CONCLUSION & FUTURE SCOPE

Image Restoration is the process of removal or reduction of degradation in an image through linear or non-linear filtering. Degradations are usually incurred during the acquisition of the image itself. The aim of image restoration is to bring the image what it would have been if it had recorded without degradation. In the current research the drawback of the existing restoration methods are reduced. In the proposed research the a method is developed for restoration in which the image can resist to the noise and any other distortion, so that it can contains the property that it possessed in the original stage. In the proposed research if any distorted image is uploaded then it restores the image to near to its original stage using the proposed thresholding concept. Using the defined approach the results are much better than that of existing approach as defined and validated in the results and discussion section. This paper describes the benefit of using two filling-in techniques. There are some distortions left after applying Probabilistic Recovery Filling-in technique which is removed to large extent by implementing proposed filling-in technique. Thus the combination of two techniques gives better results.

In the future scope the scalability of binary data can be tested in this research. Using this method the video or 3D images can be restores if distorted. On the other hand the accuracy and noise can be reduced in the binary data.

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