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Introduction to image restoration and comparison of various methods of image restoration

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Abstract— In past two decades there are various techniques are developed to support variety of image processing applications. The applications of image processing include medical, satellite, space, transmission and storage, radar and sonar etc. This paper gives basic information about image restoration and noise in image. Also it gives comparison of various methods of image restoration. Each method has its own advantage and disadvantage. Every method tries to remove noise from image. Personal images captured by various digital cameras can easily be manipulated by a variety of dedicated image processing algorithms .Image restoration can be described as an important part of image processing technique. Image restoration has proved to be an active field of research in the present days. The basic objective is to improve the quality of an image by removing defects and make it look pleasing.

Keywords: Image Processing,Image Restoration,noise,Quality of image

I. INTRODUCTION

Noise is any undesired information that spoil image. In digital image noise arise during acquisition and/or transmission process. The performance of image sensor is affected by variety of factors such as environmental conditions during image acquisition and by quality of the sensing elements them- selves. For example, acquiring image with CCD camera light levels and sensor temperature are major factors affecting the amount of noise in the resulting image. Images are corrupted during transmission because of interference of channel used for transmission. For example, image transmitted using wire- fewer networks then might corrupt as result of lighting or other atmospheric disturbances. When the Fourier spectrum of noise is constant then noise is known as white noise

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II. TYPES OF NOISE

Following are different types of noise.
[1] Gaussian/Normal noise
[2] Rayleigh noise
[3] Erlang/Gamma noise
[4] Exponential noise
[5] Impulse/Salt and pepper noise
[6] Uniform noise
[7] Periodic noise

III. SOURCE OF NOISE

One source of a noise is camera shake. When a camera moves during exposure, it blurs the captured image according to its trajectory. We can mitigate the camera shake blur using mechanical image stabilization hardware. However, when a camera takes a long exposure shot of a dark scene and/or when a camera uses a telephoto lens, the camera shake can be too large for assistive devices to accommodate. Another source of noise is a movement of objects in the scene, and this type of noise is harder to avoid. Therefore, it is often desirable to remove noise computationally.

Figure 1: Noisy Image

Figure 2: Original Image

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IV. INTRODUCTION TO IMAGE RESTORATION

A common inverse problem in image processing is the estimation of an image given corrupted version. This problem is generally known as image restoration. One approach to this problem is to design a linear filter that predicts the desired image from the corrupted image. Image restoration is deals with improving the appearance of an image. It is different from image enhancement. Image en- Han cement is subjective while image restoration is objective. Image restoration based on mathematical or probabilistic models of an image while image enhancement is depending on human preferences.

V. REQUIREMENT OF IMAGE RESTORATION

There are many existing images of unique events that can- not be retaken that we would like to be able to. Another application in medical imaging: it is preferable to avoid retaking a blurred x-ray, in order to safeguard the patient's health. Cost is another argument for using restoration for many applications. High quality optics, sensing equipment, and hardware corrections are expensive.

Figure 3: Before restoration

Figure 4: After restoration

VI. VARIOUS METHODS OF IMAGE RESTORATION

There are many methods for image restoration available some of them are listed below.

[1] Image restoration by using intensities of nearest neighbour method

In this method of image restoration is based on the intensities of the nearest neighbours of a pixel. There is one method in which finding out the mean value of all the neighbours which come in a window (3x3) and there by calculating the probability of occurrence of each pixel value. The output image is better one to restore. The main drawback of this method is that it cannot be applied for the elements which are at boundaries. For this, we need to carry out certain edge detection techniques like Sobel Edge Detection Technique and Canny Edge Detection Technique. As future work, better results can be obtained for N>1 i.e. by increasing the size of the filtering window, using artificial intelligence techniques like fuzzy logic and artificial neural networks. Already, a lot of classical filters have been designed for image noise reduction. However, the performances of all these filers are not satisfactory. To cope with the drawbacks of classical filters, several fuzzifications can be constructed. By writing fuzzy rules, we can implement the same to make the entire system an intelligent system whose performance would be better than the classical ones.

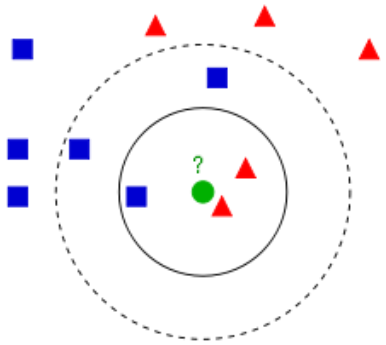

Figure 5: Nearest Neighbor

[2] Image restoration by quantization nearest neighbor algorithm

In this method, Original images and their degraded versions by the known degradation operators are utilized for design- ing the Quantization. The code vectors are designed using the blurred images. For each such vector, the high frequency information obtained from the original images is also avail- able. During restoration, the high frequency information of a given degraded image is estimated from its low frequency information based on the artificial noise. For the restoration problem, a number of

techniques are designed correspond- ing to various versions of the blurring function. Given a noisy and blurred image, one of the techniques is chosen based on a similarity measure, therefore providing the identification of the blur. To make the restoration process computationally ef- ficient, the Quantization Nearest Neighborhood approaches are utilized. By using this method it restores the sharp edges in the image without suffering from noise amplification. It also correctly identifies the blurring function. The main draw- back is that the mapping between high frequency informa- tion of the original images and low frequency information of the corresponding degrade one must established.

[3] Image denoising using tri nonlinear and nearest neigh- bor interpolation with wavelet transform

In this method nearest neighbor interpolation and Tri non linear interpolation is used for image denoising in wavelet domain. In contrast with existing methods, this method pre- serves the image detail at different noise density. The tri non linear interpolation scheme gives better PSNR as compared to the existing methods. Nearest neighbor interpolation technique has comparable good result. These methods do not introduce any blur in edges. These interpolation tech- niques applicable to all type of noise with different noise densities. If the noise density is increases nearest neighbor interpolation technique perform better as compared to the nearest neighbor.

[4] Image restoration using KNN variant of the mean shift

In this method, the image restoration problem is addressed in the variational framework. The focus was set on denoising. The statistics of natural images are consistent with the Mark- ov random field principles. Therefore, a restoration process should preserve the correlation between adjacent pixels. The proposed approach minimizes the conditional entropy of a pixel knowing its neighborhood. The conditional aspect helps preserving local image structures such as edges and textures. The statistical properties of the degraded image are estimated using a novel, adaptive weighted kth near- est neighbour (kNN) strategy. The derived gradient descent procedure is mainly based on meanshift computations in this framework.

[5] Impulse noise reduction filters

In this method, Decision Based median filtering algorithm is used for the removal of impulse noise from digital images. It replaces the impulse noise corrupted pixel by the median of the pixel scanned in four directions. The signal restora- tion scheme of this filter adapts to the varied impulse noise ratios while determining an appropriate signal restorer from a reliable neighbourhood. The filter is capable of producing recognizable, patches free outputs from images corrupted by higher levels of impulse noise

VII. CONCLUSION

This paper gives fundamental idea about the image restora- tion and noise in image. It will also give introduction about various methods for image restoration by removing noise from image. There may be several method exist for image restoration by removing noise, this paper contains some of them, so future work can be done on rest methods.

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