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An effective approach for extracting noise from digital image and real-time data using filtering technique: Review paper

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ABSTRACT

As we know there is a huge development in image processing with time and latest technology play a very vital role in solving a various problem in so many filed like medical, satellite, control and many more. Pixel is the smallest element which helps to form an image. In this review article, we found that there are various types of images exist in various formats. After that, we studied various types of a filter because these filters help us to fetch out noise from images. Diverse types of noises occurred from acquisition to recognition in an image and to remove them various filters are available and every filter is having own advantage and limitations and suitable for particular types of noise which it can remove efficiently. In our research work, our main target is to fetch out salt and pepper noise. In this article, we studied various types of noises and various types of filter in details from a deep study of various research papers. Our dissertation work will be to fetch out SPN form an image, therefore, a detailed study of the median filter and its extension is carried out. To meet the requirement to expectation three parameters will be calculated PSNR, MSE, and IEF. Noise is random in nature and it can be mixed with an image anywhere therefore diverse noise models were studied deeply.

Keywords— *PSNR, MSE, IEF, Probability Density factor, Quantization, Pixel, Denoise*

1. INTRODUCTION

The digital image is made out of pixels or we can say picture component. Every pixel speaks to the dark level for highly contrasting photographs at a solitary point in the image, so a pixel can be spoken to by a small speck of particular shading. By ascertaining the shade of an image at a substantial number of focuses, we can create a computerized guess of the image from which a duplicate of the first can be reproduced. Pixels are a slight like grain particles in an ordinary photographic image, which can be organized in a standard example of lines and sections and store data contrastingly to some degree [1]. A computerized image is a rectangular course of action of pixels now and again called a bitmap. Nowadays the use of digital imaging is implemented in many applications e.g., object recognition, satellite imaginary, biomedical instrumentation, digital entertainment media, internet etc.

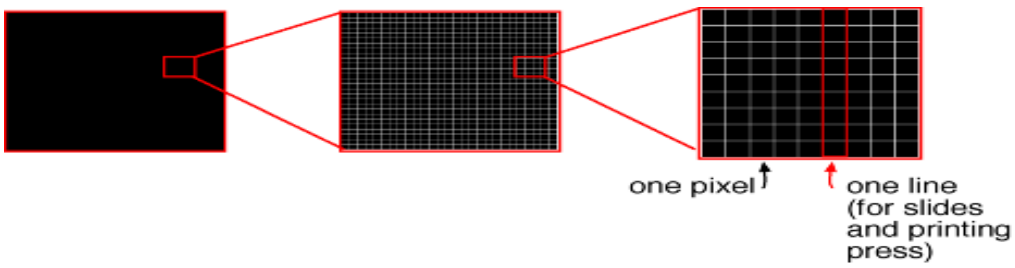

Fig. 1: Resolution of pixel illustrations

In the past decade, the quality of digital images has significantly increased, but the cost of the hardware which is used to produce digital images has decreased. In the present state of development, a flexibility and economy unmatched are offered by digital imaging using film-based imaging [2-3]. As a result, digital imaging has almost completely supplanted film-based imaging which is the preferred method for capturing images. The main function of the Digital image processing is to provide the clear picture as per the interest while attenuating detail irrelevant to a given application, and the information regarding the scene is taken out from the improved image. With the help of the digital image processing, one can get reversible, a virtually modified image which is noise free and the image is in the form of matrix integers in place of the classical darkroom manipulations or filtration of time-dependent voltages which is necessary for analog images and video signals. Present image processing algorithms are extremely helpful. Noise interrupts the image at the time of acquisition, transmission, storage etc. so to get a meaningful and useful processing like image

segmentation and object recognition, and also for good image display in instruments like television, mobile cameras, etc., so the image signal obtained must be without the presence of noise and also deblurred. Both, noise suppression (filtering) and the deblurring are classified under the common category of image processing which is known as image restoration [4].

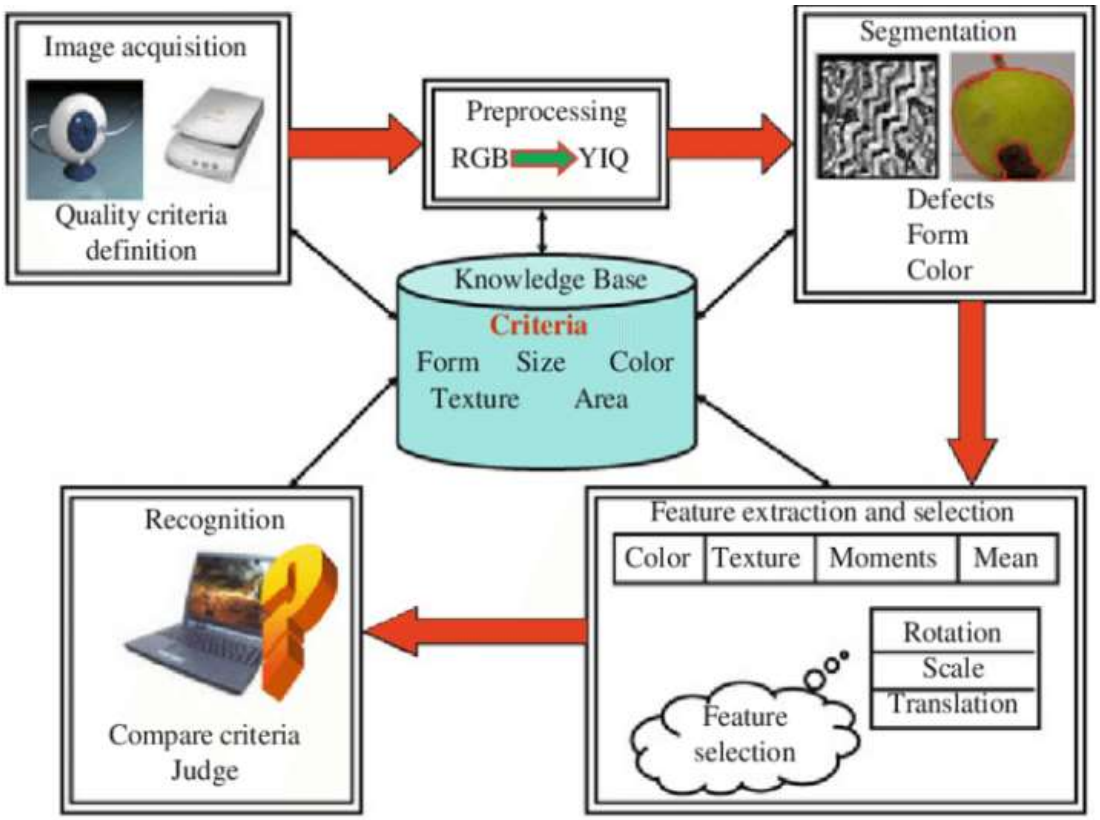

Fig. 2: Basic operation of an image from acquisition to recognition

2. TYPES OF NOISE IN IMAGE

Now we will look at overview different types of noise corrupting an image signal are studied; the types of noise are discussed. Besides this, we also depict mathematical modeling for different types of noise are present. There is so many ways to generate noise. It could be produced by man or by the natural condition. When we take a snap noise automatically added and to transmit an image noise added. The performance of image sensors is affected by a variety of factors. Images are corrupted during transmission principally due to EM (electromagnetic) interference in a channel employed for transmission.

- Additive White Gaussian Noise (AWGN)
- Salt and Pepper Noise (SPN)
- Inter-symbol interference (ISI)
- Random-valued impulse noise (RVIN).
- Speckle Noise (SN)
- Rayleigh Noise
- Erlang (Gama) Noise
- Exponential Noise
- Impulse Noise

When we transmit an image via wireless network it might be corrupted because of lightning or other atmospheric disturbances. When an analog image signal is transmitted through a linear dispersive channel, the image edges get blurred and the image signal gets contaminated with AWGN since no practical channel is noise free. If the channel is so poor that the noise variance is high enough to make the signal excurse to very high positive or high negative value, then the thresholding operation at the front end of the receiver will contribute saturated max and min values. Such noisy pixels will be seen as white and black spots in the image. Therefore, this type of noise is known as salt-and-pepper noise (SPN) [1]. So, if the analog image signal is transmitted, then the signal gets corrupted with AWGN and SPN as well. Thus, there is an effect of mixed noise [5]. If the image signal is transmitted in digital form through a linear dispersive channel, then inter-symbol interference (ISI) takes place. In addition to this, the AWGN in a practical channel also comes into the picture. This makes the situation very critical. Due to ISI and AWGN, it may so happen that a "1" may be recognized as "0" and vice-versa. Under such circumstances, the image pixel values have changed to some random values at random positions in the image frame. Such type of noise is known as random-valued impulse noise (RVIN). Through the linear dispersive channel, an analog image signal is transmitted to the image edges earn blurred and infected the image signal by all of AWGN since simply no channel is noise free. The thresholding life on the receiver side will be saturated cap or essential values in position the channel is underprivileged and noise variance makes signal excurse to high positive or an arm and a leg negative value. And so one noisy pixel will be about to be as white and black spots in the image. Therefore, this humor of noise is experienced as salt-and-pepper noise (SPN). So, if the analog image signal is transmitted before the signal gets corrupted mutually AWGN and SPN as well. Thus, this is met with an end of mixed noise [14].

Fig. 3: Salts and pepper noise illustration

Inter-symbol interference (ISI) takes dormitory at has a head start when the image signal is changed residences in digital consist of with the bolster of the linear dispersive channel. In installation to this, the AWGN in a wise channel by the same token comes into picture and seeing of this the status becomes as a matter of fact critical. Under a well known present state of affair, the image pixel values have displaced to some aimless values at casual positions in the image frame. Such type of noise is supported as random-valued impulse noise (RVIN). Another type of noise that may corrupt an image signal is the speckle noise (SN) which occurred in ultrasonic imaging (biomedical) and a few engineering applications like synthesis aperture radar (SAR) imaging, such a noise is encountered. The SN is a signal-dependent noise, if the image pixel magnitude is high, then the noise is also high. The noise is multiplicative because initially a transmitting system transmits a signal to the object and the reflected signal is recorded.

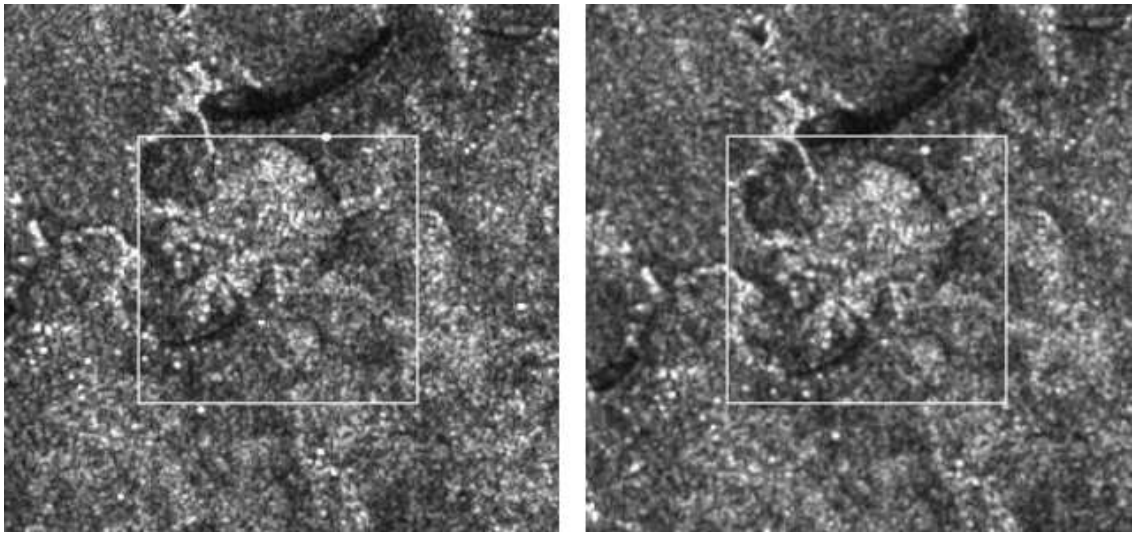

Fig. 4: Speckle noise illustrations

3. RELATED WORK

The massive production of digital images in the communication world has led to the need for efficient image restoration methods. Image restoration is the process of obtaining a noise-free original image from a corrupted/noisy image. It forms an important process in image processing. The restoration of degraded images can be applied in many application areas that are needed to repair images. The aim of this paper is to analyze various image restoration or denoising techniques. These techniques help us to recover the original image from the degraded image while maintaining the originality of the image as much as possible [7]. Image restoration is the process of reconstruction or recovering an image that has been corrupted by some degradation phenomenon. Degradation may occur due to motion blur, Gaussian blur, noise and camera mismatch. In this paper corrupted image have been recovered using Modified Lucy Richardson algorithm in the presence of Gaussian blur and motion blur. The performance of this algorithm has been compared with Wiener filter, Constraint Least Square method, and Lucy Richardson algorithm. The performance comparison is done on the based on peak signal-to-noise ratio (PSNR).The result shows that the Modified Lucy Richardson method is better than the Wiener filter, Constraint Least Square method and Lucy Richardson algorithm [8]. Impulse noise removal is a mechanism for detection and removal of impulse noise from images. Median filters are preferred for removing impulse noise because of their simplicity and less computational complexity. In this paper, impulse noise removal using the standard median filter and its variants are analyzed. Extensive simulations have been carried out on a set of standard grayscale images and the state of the art median filter variants are compared in terms of the well-known image quality assessment metrics namely mean square error, peak signal to noise ratio and multi-scale structural similarity index [10]. Noise Suppression from images is one of the most important concerns in digital image processing. Impulsive noise is one such noise, which may corrupt images during their acquisition or transmission or storage etc. Removing noise from any processed image is very important noise should be removed in such a way that important information of image should be preserved. For removing salt and pepper noise from the corrupted image we are using so many algorithms. In

this paper we propose a two-phase scheme for removing salt and pepper noise and edge preservation; in the first phase, the Adaptive median filter is used to detect corrupted pixel and preserving the edges. In the second phase, the Non-Local Means algorithm is used in order to have a better quality of reconstitution. The proposed algorithm works well in removing salt and pepper noise at high density and preserving edges smoothly and fine detail of image compare to others. Obtained results show that the implementation of this proposal gives considerable noise suppression, even with high noise densities [11].

4. DIVERSE FILTER

As we know there are various types of images and diverse types of noises can affect our original information. From acquisition to recognition there are so many points that noise mixed with authentic data and our main focus is to fetch out these noises from the original data so that information can be used properly. With the huge development in technology, various researchers developed many types of filter to tackle with this problem [12]. But one thing is important that each filter has its own advantages and limitation and every filter is applied to a specific type of noise. Some common filters are listed below

- Adaptive filter
- Max filter
- Min filter
- Weiner filter
- Median filter
- Hybrid Filter

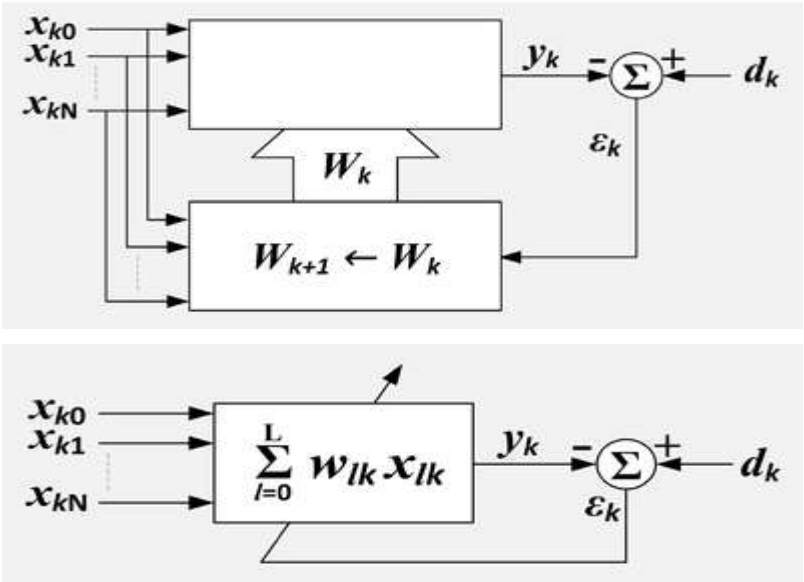

Fig. 5 : Adaptive linear combine filter

In our research work, we will use a median filter because it is best suited for salt and peppers noise. Median filtering is a hack image enhancement course for removing gray-haired noise. Centre filtering is a nonlinear operation hand me down in image processing to cut "salt and pepper" noise. Also, show filter is second hand to revoke the inclination noise. Produce filter replaces the produce of the pixels values notwithstanding it does not protect image details. Some bill removes mutually the produced filter. Nonetheless, in the medium filter, we do not step into shoes of the pixel price tag mutually perform of convenient pixel values, we replace by the whole of the intermediate of those values. The medium is proposed by as a matter of choice sorting, for the most part, the pixel values from the surrounding neck of the woods into numerical sending up the river and then replacing the pixel over about to be with the midpoint pixel value. (If the convenient pixel which is to be considered contains an ultimate a number of pixels, then the descent of the two essence pixel values are used [13]. Fig.6 illustrates a concrete illustration calculation. The median filter gives the best result when the impulse noise percentage is less than 0.1% and if greater than the worst result will occur

$$L_i = \sum_{j=1}^{N} \|x_i - x_j\|_2 \quad for\ i = 1, \ldots . N$$

In the above equation, xi, x j and N stand for the central pixel, is existing pixels in the window and the number of pixels which are set to be in the window, respectively.

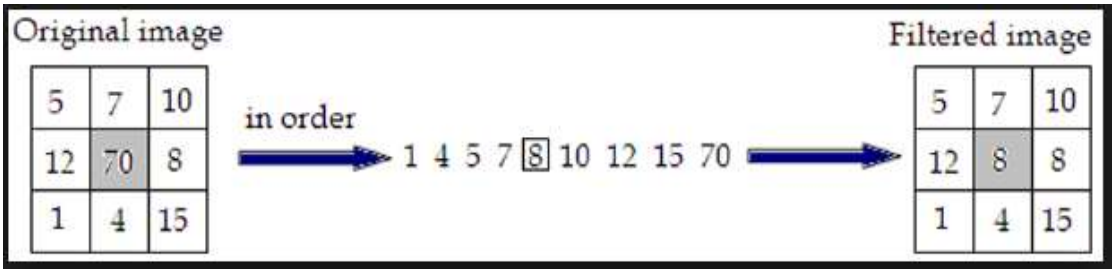

Fig. 6: Median filter

5. SOFTWARE USED

Software: MATLAB Version R2015a: It is powerful software that provides an environment for numerical computation as well as a graphical display of outputs. In Matlab, the data input is in the ASCII format as well as binary format. It is a high-performance language for technical computing integrates computation, visualization, and programming in a simple way where problems and solutions are expressed in familiar mathematical notation.

- Acquisition, Data Exploration, Analysing &Visualization
- Engineering complex drawing and scientific graphics
- Analysing algorithmic designing
- Mathematical and Computational functions
- Modeling and simulating problems prototyping
- GUI (graphical user interface) building environment.

Using MATLAB, you can solve technical computing problems very easily and time-saving as compared to traditional programming languages, such as C, C++, and FORTRAN.
The name MATLAB stands for matrix laboratory.

Table 1: MATLAB Features

MATLAB is a high-level language used for numerical computation, visualization, and application development
It create very friendly environment for iterative exploration, design, and problem solving
Mathematical functions for solving ordinary differential equations, Fourier analysis, linear algebra, statistics, filtering, optimization, numerical integration
Development tools for enhancing code quality and maximizing performance
Tools for building applications with custom graphical interfaces (GUI)
Functions for integrating MATLAB based algorithms with external applications and we can able to generate code in hex file, c, embedded etc.

6. CONCLUSION

Our research domain will be to fetch out salt and pepper noise from an image of various formats and also technique must be applied to the real-time situation. To achieve this various research paper readout deeply and analysis made out means a problem formulation carried out in which it is defined that in previous papers value of peak to signal ratio is not so much and on another side value of mean square value is also abundant means more than a threshold value. Now our main task is to find out which types of the filter must be applied to meet the desired result. After studying various articles, research paper we came to a conclusion that median filter will be best suited for SPN. One more important point is that these operations will be executed on gray images, not on the color image. The median filter is a basic filter and it has its own variation means it is further classified into various types.

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