International Journal of Advance Research in Science and Engineering
Volume No.08, Issue No.05, May 2019
www.ijarse.com
IJARSE
ISSN: 2319-8354

IMAGE AUGMENTATION USING SWITCHING MEDIAN FILTER

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ABSTRACT

Filtering is a vital part of any signal processing system, which entails estimation of signal degradation and restoring the signal satisfactorily with its features preserved intact. A new nonlinear filtering technique is introduced for enhancement of images that are highly contaminated by impulse noise is called switching median filter. The proposed filtering technique is more effective in eliminating impulse noise and preserving the image features. The filter replaces a corrupted pixel by the median value or by its processed neighbouring pixel value. So that the proposed filter output images are found to be pleasant for visual perception and also uncorrupted pixels are left undisturbed and preserving the edges and fine details satisfactorily. The performance of the filter is evaluated by applying it on different test images and the results obtained are presented. The proposed filter has been shown to out-perform other existing filters in terms of noise elimination and feature preservation properties. The proposed filtering performance is calculated using PSNR.

Keywords: SMFE, PSNR, Image Augmentation, Image Filtering.

I. INTRODUCTION

Filtering is a vital part of any signal processing system, which entails estimation of signal degradation and restoring the signal satisfactorily with its features preserved intact. Several filtering techniques have been reported in the literature over the years, suitable for various applications. Nonlinear filtering techniques are preferred for de noising images which are degraded by impulse noise. These nonlinear filtering techniques take into account for nonlinear nature of the human visual system. Thus, the filters having good edge and image detail preservation properties are highly desirable for visual perception.

The median filter and its variants are among the most commonly used filters for impulse noise removal. The median filters, when applied uniformly across the image, modify both noisy as well as noise free pixels, resulting in blurred and distorted features [1-2]. Recently, some modified forms of the median filter have been proposed to overcome these limitations. In these variants, namely, the switching median filters, a pixel value is altered only if it is detected to have been corrupted by impulse noise [3-5]. These variants of the median filter still retain the basic rank order structure of the filter. Salt-and-pepper noise is relatively considered for two intensity levels in the noisy pixels, that is, 255 and 0. The impulse noise is detected using decision mechanism with a pre-set threshold value [6] and the corrupted pixels alone are subjected to filtering. The window size is increased to achieve better noise removal. However, the increased window size results in less correlation between the corrupted pixel values and replaced median pixel values.

II. LITERATURE SURVEY

A lot of methods have been improved to eliminate noises. Filters are one of the most common tools which are used to eliminate noises. Many filters have been designed so far because of over plus of the noise varieties and differences between the properties of these noises. Generally, filters are divided into two groups as linear and non-linear. Linear filters have simple design and encoding and they are intended for general aim. These filters can be used to smooth the images or enhance the edges but they have weak capacity for noise elimination. Non-linear filters have been designed for specific aim and they produce better results. Non-linear filters are divided in many categories. Order statistic filter is one of the categories of non-linear filters. It is the most popular filter for noise elimination [3].

One of the most important stages of signal and image processing is noise elimination. Noise is an unwanted perturbation to a wanted analog or digital signal or image [1]. A noise can be categorized depending on its source, frequency spectrum and time characteristics. Depending on a source, the noises are categorized into six types: acoustic noise; thermal and shot noise; electromagnetic noise; electrostatic noise; channel distortions, echo and fading; processing noise. On the other hand, depending on the frequency spectrum or time characteristics, the noises are also categorized into six types: white noise; band-limited white noise; narrowband noise; colored noise, impulsive noise, transient noise pulses [2].

The subject of this study is to investigate and improve the noise eliminating methods related to digital images. Noise is unwanted pixels to be corrupted into digital images. The principal sources of noises in digital images arise during image acquisition (digitization) and/or transmission. The performance of imaging sensors is affected by a variety of factors such as bad focusing; motion and non-linearity of the sensors, etc. [1]. Type of noises has to be known for elimination of noises in digital image. If the noise type is unknown, the filter which will be applied to image can't be known. In such a case all filters are applied to images and each image is examined and then the filter which will produce the best result can be determined. The first problem occurs if it is unknown that there is noise in images or if the type of noises is unknown. This problem has not been solved yet.

III. BLOCK DIAGRAM OF PROPOSED SYSTEM

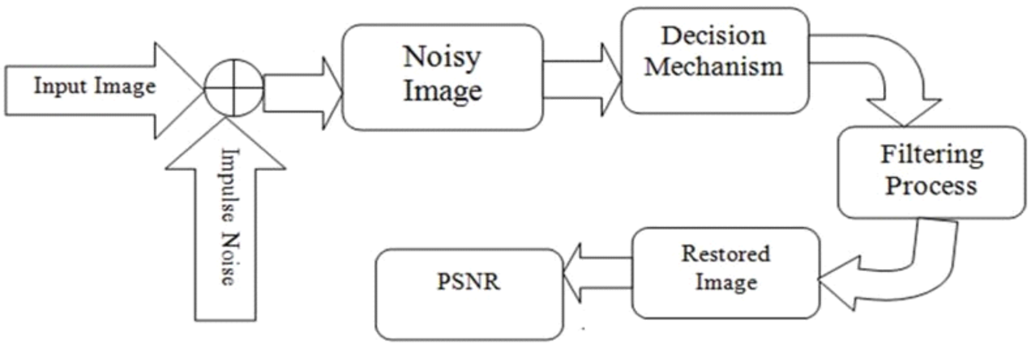

Fig1: Basic block diagram of SMFE.

SMFE mainly consists of 5 units they are:

International Journal of Advance Research in Science and Engineering
Volume No.08, Issue No.05, May 2019
www.ijarse.com
IJARSE
ISSN: 2319-8354

- Noisy image
- Decision mechanism
- Filtering process
- Image restoration
- PSNR calculation

The input is taken as a grayscale image and then adding a percentage of impulse noise i.e. salt and/or pepper noise to the original image due to addition of this noise we will get a blurred, corrupted image is called noisy image.

The filtering technique proposed in our project detects the impulse noise in the image using a decision mechanism. The corrupted and uncorrupted pixels in the image are detected by comparing the pixel value with the maximum and minimum values in the selected window. If the pixel intensity lies between these minimum and maximum values, then it is an uncorrupted pixel and it is left undisturbed. If the value does not lie within the range, then it is a corrupted pixel and is replaced by the median pixel value or already processed immediate neighbouring pixel in the current filtering window. Consider an image of size M×N having 8-bit grey scale pixel resolution. The steps involved in detecting the presence of an impulse or not are described as follows,

161	**162**	**159**	**163**	63
167	**255**		**255**	255
164	**255**	**255**	**255**	255
165	0	255	255	255
166	255	159	255	167

Fig 2: Sliding filter window of size 3 x 3 over noisy image.

Step 1: A two-dimensional square filtering window of size 3 x 3 is slid over a highly contaminated image as shown.

Step2) The pixels inside the window are sorted out in ascending order.

Step 3) Minimum, maximum and median of the pixel values in the processing window are determined. In this case, the minimum, maximum and median pixel values, respectively, are 0, 255 and 255.

Step 4) If the central pixel lies between minimum and maximum values, then it is detected as an uncorrupted pixel and the pixel is left undisturbed. Otherwise, it is considered a corrupted pixel value. In the present case, the central pixel value 255 does not lie between minimum and maximum values. Therefore, the pixel is detected to be a corrupted pixel.

Step 5) The corrupted central pixel is replaced by the median of the filtering window, if the median value is not an impulse. If the median value itself is an impulse then the central pixel is replaced by the already processed immediate top neighbouring pixel $\boldsymbol{A_{i-1,j}}$ in the filtering window. In the present case, the median value is also an impulse and therefore, the pixel is replaced by its already processed top neighbour pixel value 214.

The below Fig shows the replacement of corrupted pixel. In this figure impulse noise value **0** is replaced by **159**.

161	**162**	**159**	**163**	63
167	**255**	**159**	**255**	255
164	**255**	**255**	**255**	255
165	0	255	255	255
166	255	159	255	167

Fig 3: Replacement of corrupted pixel.

The performance of proposed filter is compared with that of IDBA by applying them on peppers, moon, cameraman images, corrupted with various densities of impulse noise.

The objective measures used for quantitatively evaluating the performance of the filters are Mean Square Error (MSE) and Peak Signal to Noise ratio (PSNR) and these metrics are defined in equation as follows,

$$PSNR = 10 \log_{10}$$

Where, x(i,j) and f(i,j) denote, respectively, the intensity of $(i,j)^{th}$ pixel of the original and filtered images. In order to prove the better performance of proposed filter, existing filtering techniques are experimented and compared with the proposed filter for visual perception and subjective evaluation on peppers, moon, cameraman images including the standard traditional Median Filter (TMF).

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www.ijarse.com
IJARSE
ISSN: 2319-8354

IV. RESULTS

In the first step we are going to choose the test image. Here we are having 3 test images shown are,

- Peppers
- Cameraman
- Moon

After display of this message choosing any one of the images at a time. Then checking the size of the image. The noise density is added in terms of percentage and its range is denoted by 0-100% as 0-1. For example, suppose the density of noise is 10% then it can be entered as 0.1.

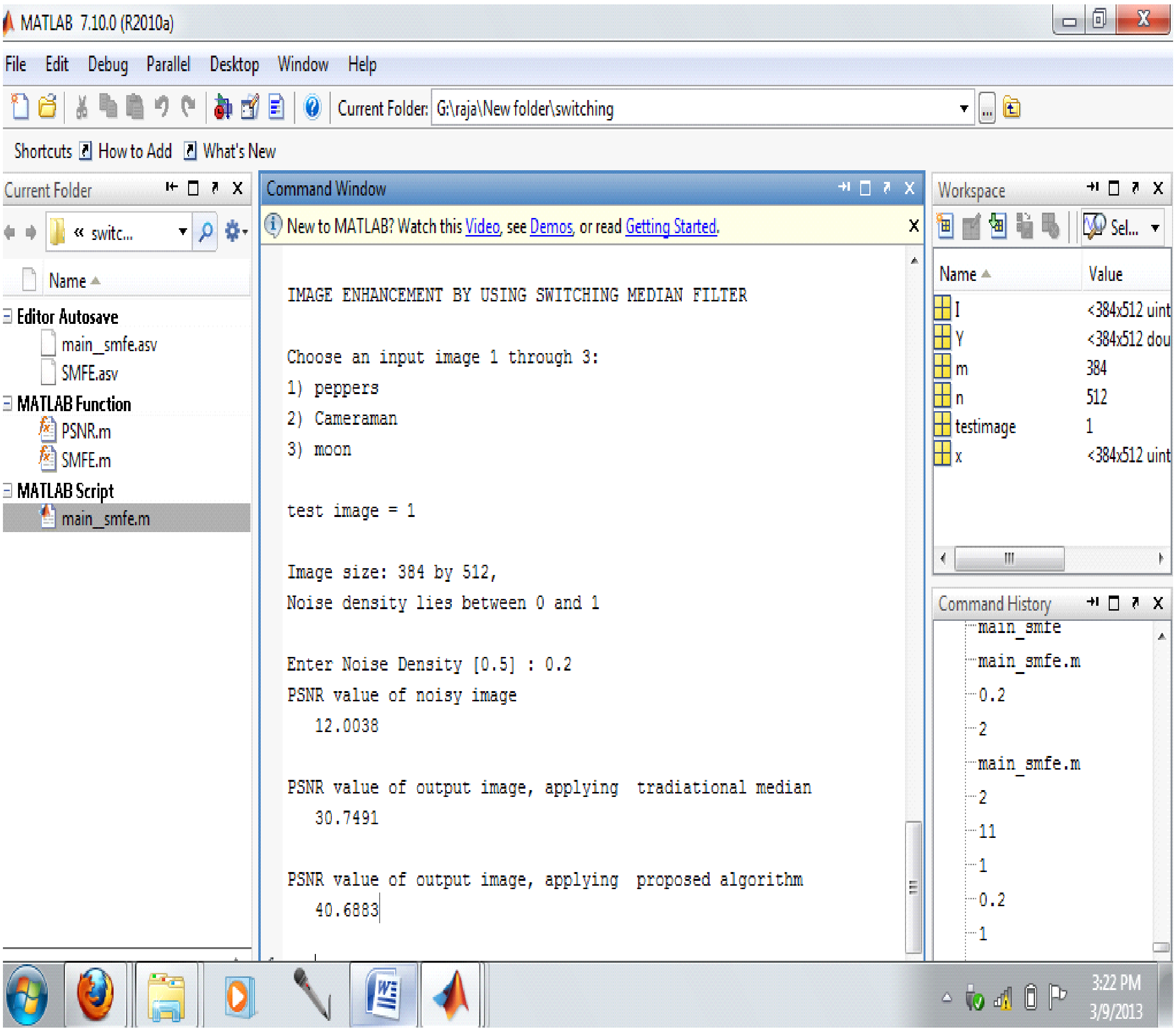

Fig 4: choose the test image.

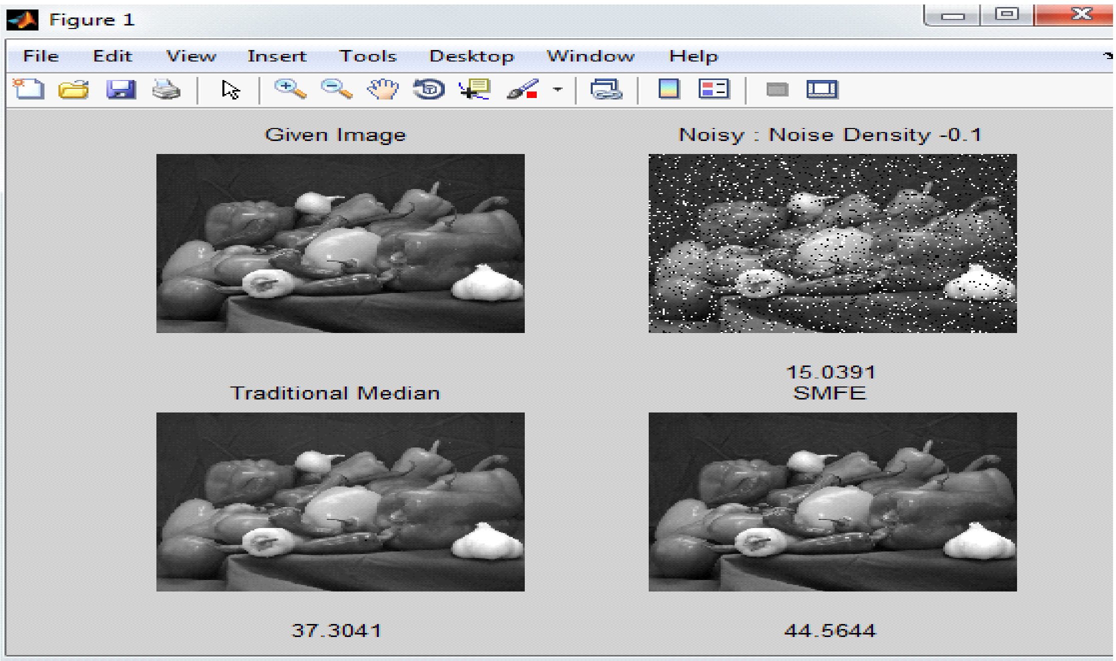

Fig 5: noise removal Performance of TMF&SMFE for 10% noise density in peppers image.

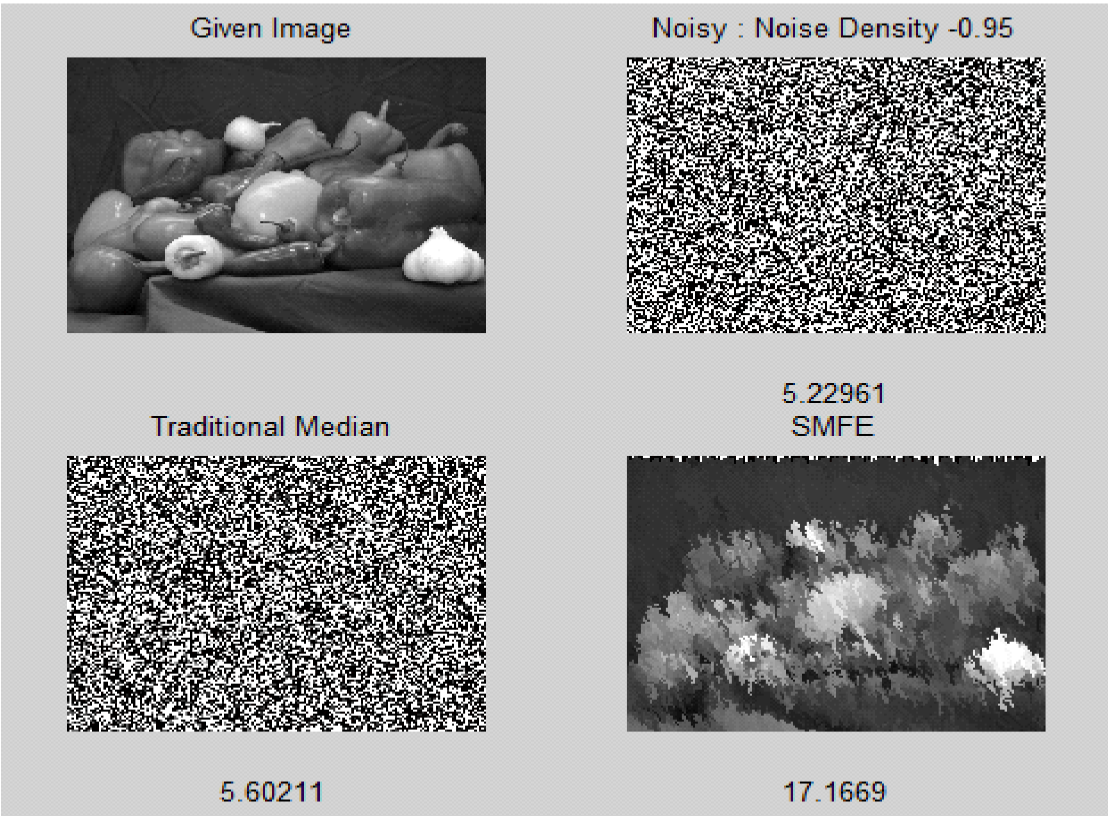

Fig 6: noise removal Performance of TMF&SMFE for 95% noise density in peppers image.

IJARSE
ISSN: 2319-8354

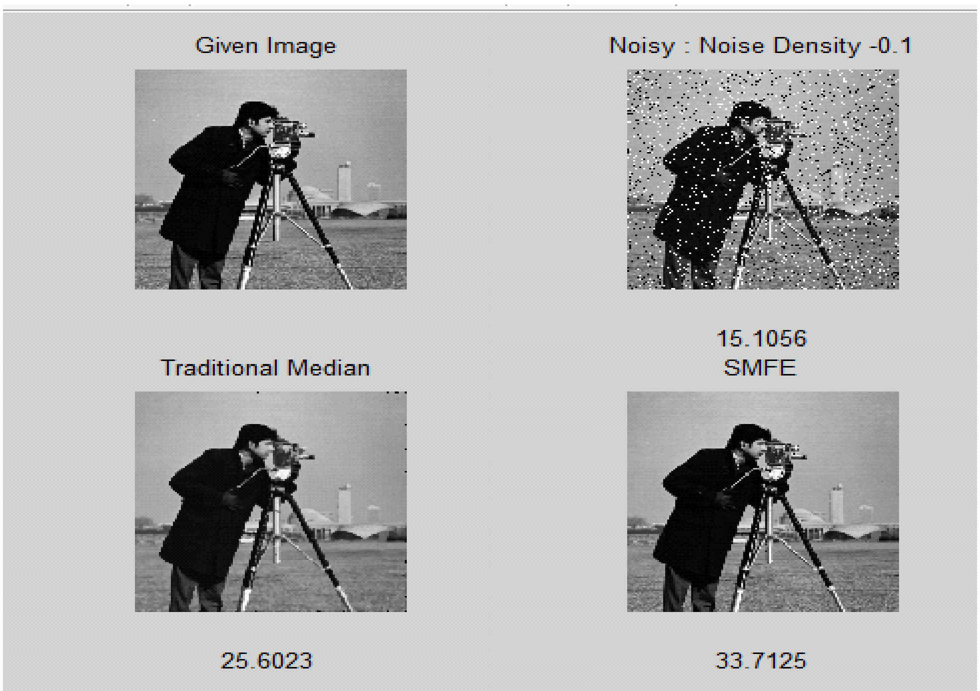

Fig 7: noise removal Performance of TMF&SMFE for 10% noise density in cameraman image.

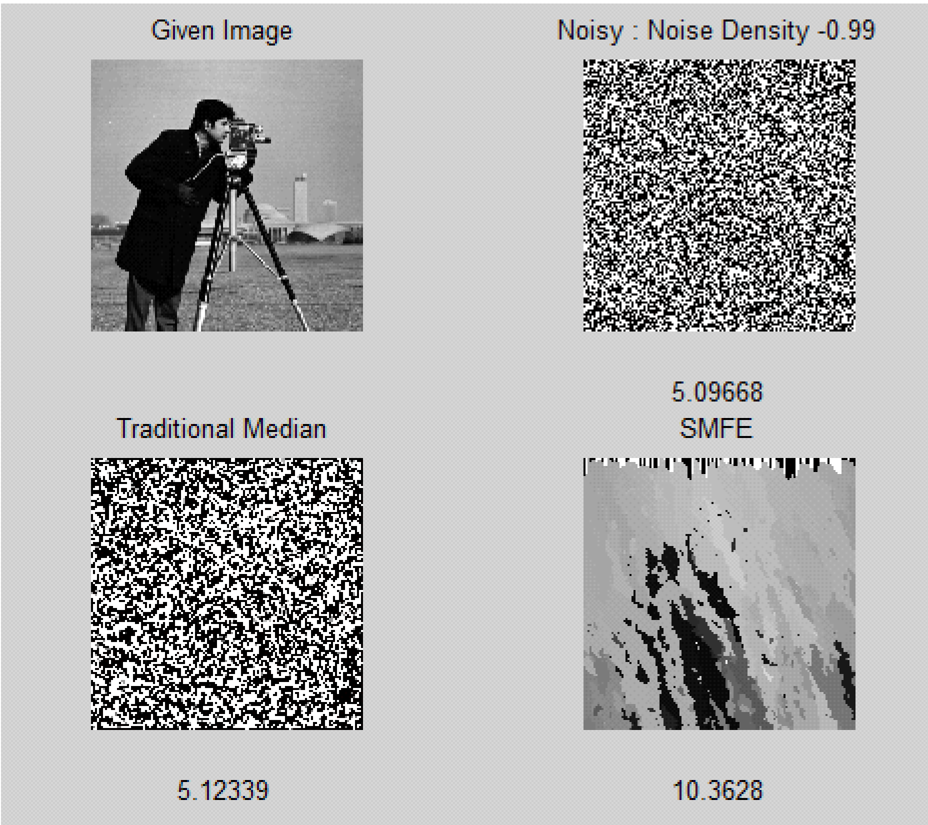

Fig 8: noise removal Performance of TMF&SMFE for 99% noise density in cameraman image.

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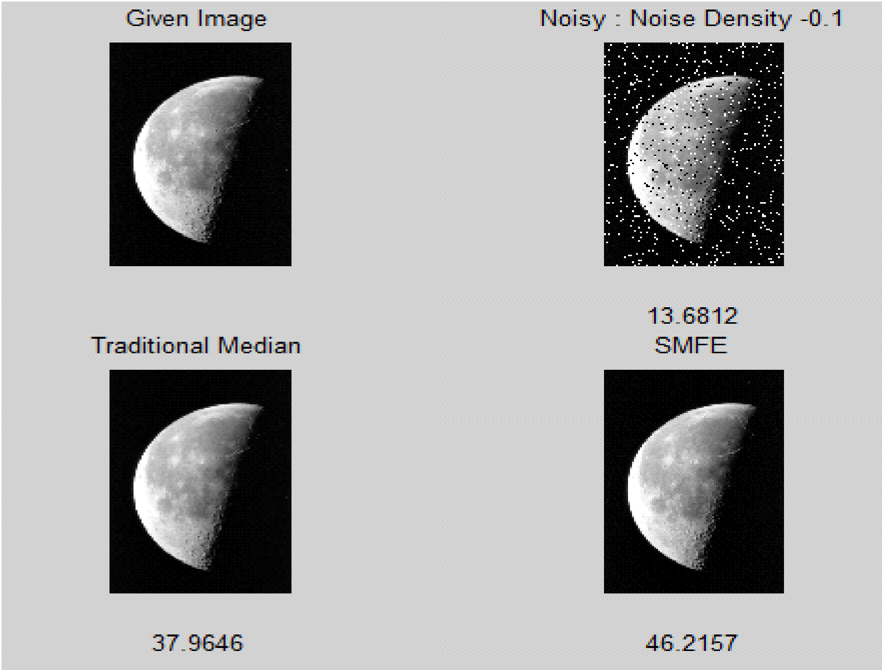

Fig 9: noise removal Performance of TMF&SMFE for 10% noise density in moon image.

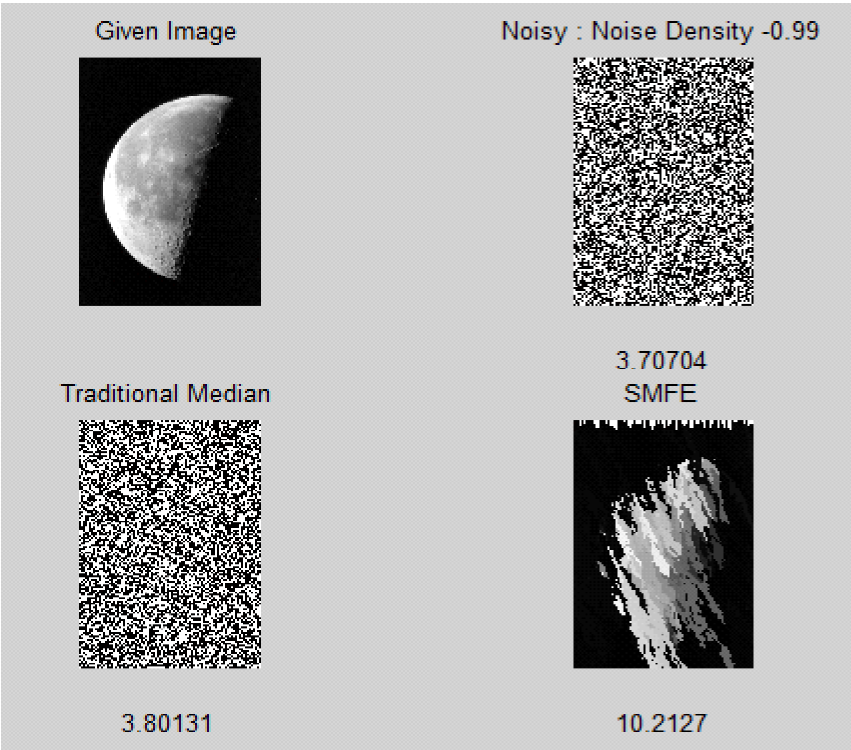

Fig 10 noise removal Performance of TMF&SMFE for 99% noise density moon image.

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The figures 5-6 shows the noise removal Performance of TMF&SMFE for 10%-95% noise density in peppers image, figures 7-8 shows the noise removal Performance of TMF&SMFE for 10%,99% noise density in cameraman image. and figures 9-10 shows the noise removal Performance of TMF&SMFE for 10%,90% noise density in moon image.

The values PSNR of objective measures obtained by applying the filters on peppers, moon, cameraman test image contaminated with the impulse noise of various noise densities are summarized.

V. MATLAB DESCRIPTION

MATLAB, which stands for Matrix Laboratory, is a state-of-the-art mathematical software package, which is used extensively in both academia and industry. It is an interactive program for numerical computation and data visualization, which along with its programming capabilities provides a very useful tool for almost all areas of science and engineering. Unlike other mathematical packages, such as MAPLE or MATHEMATICA, MATLAB cannot perform symbolic manipulations without the use of additional Toolboxes. It remains however, one of the leading software packages for numerical computation.

As you might guess from its name, MATLAB deals mainly with matrices. A scalar is a 1-by-1 matrix and a row vector of length say 5, is a 1-by-5 matrix. We will elaborate more on these and other features of MATLAB in the sections that follow. One of the many advantages of

MATLAB is the natural notation used. It looks a lot like the notation that you encounter in a linear algebra course. This makes the use of the program especially easy and it is what makes MATLAB a natural choice for numerical computations.

Some of the instructions used in this project are explained as follows.

CLEAR Clear variables and functions from memory.

CLEAR removes all variables from the workspace.

CLEAR VARIABLES do the same thing.

CLEAR GLOBAL removes all global variables.

CLEAR FUNCTIONS remove all compiled M- and MEX-functions.

CLEAR ALL removes all variables, global, functions and MEX links.

CLEAR ALL at the command prompt also removes the Java packages import list.

Clf clear the current figure

imread read the image

imwrite write the image

FPRINTF Write formatted data to text file.

INPUT Prompt for user input.

IMSHOW Display image in Handle Graphics figure.

VI. ADVANTAGES AND DISADVANTAGES

1.ADVANTAGES

- The filter has been shown to be quite effective in eliminating the impulse noise.
- The filtering operation is performed only on corrupted pixels, uncorrupted pixels are undisturbed, as a result, misclassification of pixels is avoided.
- The proposed filter output images are found to be pleasant for visual perception.
- The essential features of the images, namely, edges and fine details are preserved satisfactorily.

2.DISADVANTAGES

- This method not giving satisfactory result for completely white and dark images.
- As the noise increases performance decreases.

VII. APPLICATIONS

- This is method is used for estimation of signal degradation and restoring the signal satisfactorily with its features preserved intact.
- The filters having good edge and image detail preservation properties are highly desirable for visual perception.
- The switching median filters, a pixel value is altered only if it is detected to have been corrupted by impulse noise.
- This filtering technique detects whether a pixel is noisy or noise-free.

VIII. CONCLUSION

The filtering technique proposed in this project detects the impulse noise in the image using a decision mechanism. The corrupted and uncorrupted pixels in the image are detected by comparing the pixel value with the maximum and minimum values in the selected window. If the pixel intensity lies between these minimum and maximum values, then it is an uncorrupted pixel and it is left undisturbed. If the value does not lie within the range, then it is a corrupted pixel and is replaced by the median pixel value or already processed immediate neighbouring pixel in the current filtering window. A switching median filtering technique has been developed in this paper.

The filter has been shown to be quite effective in eliminating the impulse noise. The filtering operation is performed only on corrupted pixels, uncorrupted pixels are undisturbed, as a result, misclassification of pixels is avoided. So that the proposed filter output images are found to be pleasant for visual perception and also the essential features of the images, namely, edges and fine details are preserved satisfactorily. The proposed filter has been shown to out-perform other existing filters in terms of noise elimination and feature preservation properties. For a very high impulse noise contaminated image this filtering technique not completely removes the impulse noise still it will have impulses so it will be reduced in the future work by increasing the filtering window length and to achieve a higher peak signal to noise ratio.

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