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An Improved Approach of Image Enhancement Using Fusion Technique

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Abstract- **De-noising is a concept which is used to enhance the images to their original form [1]. De-noising need occurred when the transfer of signal started over the network; signal could be of any type like Text, Image, Audio, Video, etc. When transfer happens some undesirable value or signal is modulated in the original one, due to it noise or distortion occurs which make the information irrelevant, and of no use. In this paper we introduce a way of de-noising named as Fusion Filter (hybrid technique) to overcome the problem. Our approach is feasible for the both type images gray-scale as well as RGB color images.**

Keywords- Image Enhancement, Fusion Filter, De-noising.

I. INTRODUCTION

Image Enhancement came into existence due to the overloaded use of the images to express emotions and feeling and messages over internet. Communication media is dependable on images rather than text. Visualization gives and easiness to understand things more preciously. During the communicational transfer of data (images) over internet sometimes images get blurred or become unreadable and unrecognizable. This happens due to some extra element involvement in the original image pixels; known as noise.

A. What is an Image?

When an object like, person, thing, scene, etc are presented in visual form known as image. Images could be 2D or 3D depending on the frames captured and projections are maintained [3]. 2D images are still images and 3D images are combination of many 2D images at many projection levels and angles.

B. What is a Digital Image?

When images are processed in computer they are considered as digital images, they could be colored or gray scale images. Each image is made up of pixel which is equal to the product of height and width. Every pixel has an integer value of which demonstrates the intensity or visibility of that pixel; this value varies between 0-255 [3]-[4].

C. Types of Digital Images

1) Binary Image

Binary representation are determined like a 2D array, normally by 1 bit per pixel, where a 0 ordinary indicate "black" and a 1 represents "white" (even if here is no worldwide contract on that). The most important benefit of this image generally appropriate for picture restraining easy graphics, passage or line painting is its tiny amount.

2) Gray Image

Gray-level (as well referred toward like monochrome) representations are too determined like a 2D arrangement of pixels, generally through 8 bits per pixel, wherever a pixel impact of 0 write to "black," a pixel impact of 255 denotes "white," with the moderate standards designate unreliable darkness of gray. The entire quantity of gray intensity is better than the person illustration scheme supplies (which, into the majority of cases, cannot understand some enhancements outside to 64 gray altitudes), creating this design a superior cooperation involving personal illustration worth and comparatively solid illustration and storage.

3) Color Image

Color image representation is more difficult and different. The two mainly common methods of accumulate color picture enclose are RGB symbol inside which every pixel is typically constituted through a 24-bit integer surrounding the quantity of its red (R), green (G), and blue (B) mechanism as well as indexed account anywhere a 2D arrangement include index to a color light.

a) RGB Color pictures (24-bit)

Color picture capable of symbolize via three 2D array of equal amount, single used for every color sound: red (R), green (G), and blue (B). Every collection of element holds an 8-bit rate representative the quantity of red, green, or blue at so as to position in a [0, 255] range. A reserve symbol use 32 bits for each pixel with consist of a fourth channel, known as the alpha channel to facilitate supply a evaluate of simplicity used for every pixel and is commonly worn in picture editing property [5].The blend of the three 8-bit standards keen on a 24-bit digit permits 224 (16,777,216, generally submitted to like 16 million or else 16 M) color arrangement.

II. NOISE IN DIGITAL IMAGES

Unwanted signal which gets embedded in the original signal is known as noise [1]. In images the undesired value in the intensity of pixel is added is considered as noise. Noise can blur the images or can increase the contrast of the image, which is not desirable in the original image and image transfer.
Noise at any pixel can be shown with the below specified formula:
N=IPN-IPO

Here PO for the Pixel Original and PN for the Pixel Noised Image and I denotes the intensity at that particular pixel

Noise is a scalar value which is randomly generated and can't be calculated before the generation of it. This value is measure in the form of SNR, MSE, and PSNR and plotted in graph, histogram using the Probability Density Function [3]-[4].

Noise may be positive or negative depending upon the variation occurred between noised and original image [1].

A. *Type of Noise*

- Gaussian Noise
- Salt & Pepper Noise
- Speckle Noise
- Poisson Noise

III. NOISE REMOVAL METHODS

As we all know that noise is an unwanted signal or scalar value which is not considerable; so removal of noise is compulsory. Many techniques are already developed in past decades. They are mainly divided into two domains [2].

1. Spatial Domain De-noising
2. Transform Domain De-noising

Here we have taken 3 Spatial Domain filters and after their review we have designed a new image filter using the spatial domain [1]-[4].

a. Mean Filter
b. Median Filter
c. Wiener Filter

A. Mean Filter

Mean Filter is also known as Average Filter or Arithmetic Mean Filter [3]. It operates on (M X N) image matrix with a square matrix (R X Q) sliding window by calculating the average of all pixel values in side sliding window. Mathematics representation is as follows:

Here (x1.....xn) is image pixel range and N is no of pixels in image [1].

Mean Filter comes under spatial domain filter techniques in sub type liner filtering [2]. It is basically used for the removal of grain noise as its functionality gives a boom to it. All the neighbouring pixels are settled to an average value which makes the image smooth but this type of filter is not good for finding the edge because it makes all the pixels of similar type so becomes difficult to differentiate edges clearly.

B. Median Filter

Median Filter comes under the sub category Non-liner filtering of spatial domain filtering techniques [2]. This filter also works on the same condition on which Mean filter works. It also uses a sliding window of (R X Q) size to process an image of size (M X N). Here these sizes represent the no of rows and columns generated in the matrix of the image. Instead of taking the mean or average of the pixel values of the sliding window pixel it uses the median of them; to find the median first all the entries are sorted in ascending order and then (N/2 + 1) element is chosen as the median value in case of odd entries in the sliding window but in the case of even number of values in the sliding window average of the elements N/2 and (N/2 + 1) is considered as the median value. Median filter is used for the edge detection, smoothing the picture, to remove the effect of the input noise. It is a robust filter technique used for the filtering purpose of the image. The mathematical representation is as follows:

$$y(t) = \text{median}((x(t-T/2), x(t-T_1+1), \ldots, x(t), \ldots, x(t+T/2)).$$

Here t is the size of the window and x is the matrix. y(t) gives the median value which could be among three conditions above mentioned in the formula[1]. Median filter is used as a pre-processing step image de-noising and other filters could be embedded with it.

C. Wiener Filter

Wiener Filter comes under the sub category liner filtering of the spatial domain filtering techniques [2]. It came in existence in the 1942 under the name of Mr. Norbert Wiener. It is based on statistical approach. It can operate on different angles and different frequencies. It basically removes the out noise which is embedded in the original signal and corrupts it. It is designed to de-noise the images using the image restoration solution. These images are degraded by a fix pattern or degradation function. The worst case noise is removed using this technique. It calculates the error in the restored image and then the error is minimized to calculate the mean error to fit to the model and restored image for de-noising. It has three characteristics [1]-[3]:

- Assumption that signal and the noise are stationary,
- Requirement of physically realizable filter,
- Performance high when the PSNR value becomes high.

Mathematical Representation:

$$R(u,v) = \left[\frac{1}{H(u,v)}\frac{|H(u,v)|^2}{|H(u,v)|^2 + K}\right] G(u,v)$$

Here H (u, v) Degradation function [1]

IV. PROBLEM STATEMENT

Image enhancement using De-Noising came into existence due to the overloaded use of the images to express emotions and feeling and messages over internet. Communication media is dependable on images rather than text. Visualization gives and easiness to understand things more preciously. During the communicational transfer of data (images) over internet sometimes images get blurred or become unreadable and unrecognizable. This happens due to some extra element involvement in the original image pixels; known as noise.

This noise may be positive or negative depends on the behavior of it on original image and required to be removed. Although there are many techniques developed for the sake of de-noising. In this dissertation we will put light on Average Filter, Median Filter and Weiner Filter. These are of spatial domain filters.

V. PROPOSED SOLUTION

This paper proposes solution using fusion technique that is designed to combining previous used approaches such that mean, median and wiener filter. Mean filter is used to average the pixel values and it is very much used to blur the image. In most of experiments with grey images mean filter is used to smoothing grey images. Median filter is also frequently used to filter images. It produces good result with grey scale images. Instead of mean and median filter winner filter produces good result.

Proposed technique utilized the properties of all these three filters mean, median and wiener and designed a fusion technique which gives better results in the terms of PSNR(Peak signal noise ratio) and MSE(Mean square error). This technique may also be called hybrid technique for the purpose of image de-noising.

A. Algorithm of proposed solution

Step1. Get noised colour image as input stores in a variable called noi.
Step2. Differentiate Red, Green, and Blue component from image noi.
Step3. Create a mean filter of taking window size 3x3 called mean
Step4. Filter Red component of image noi using filter mean and stores in matrix rci.
Step5. Filter Green component of image noi using filter mean and stores in matrix gci
Step6. Filter Blue component of image noi using filter median and stores in matrix bcim
Step7. Filter bcim component of image noi using filter wiener and stores in matrix bcimw
Step8. Concatenate rci, gci and bcimw component and stores into image variable fu_filt.
Step9. Calculate MSE between noi and fu_filt.
Step10. Calculate PSNR between noi and fu_filt.
Step11. Print PSNR and MSE values.
Step12. Print fu_filt as an enhanced image.

B. Flow chart of proposed solution

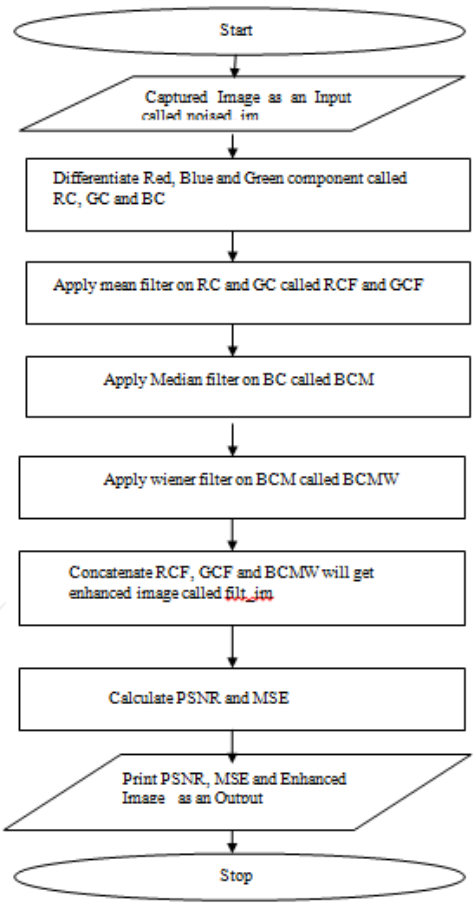


Fig 1: flow chart of proposed solution.

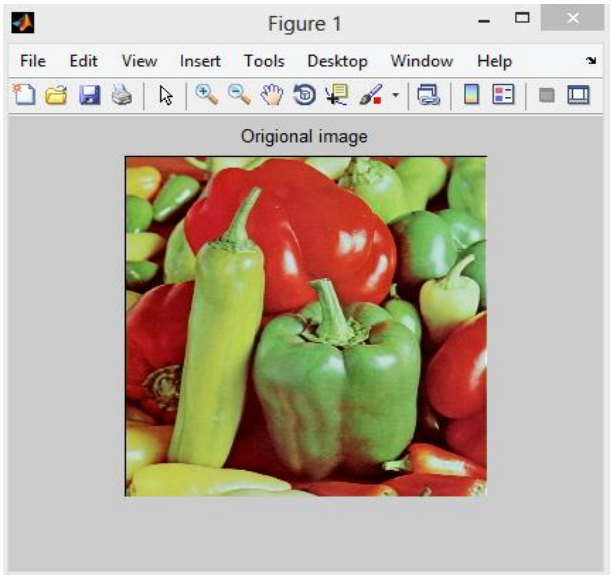
VI. SIMULATION USING MATLAB WITH GAUSSIAN NOISED IMAGES

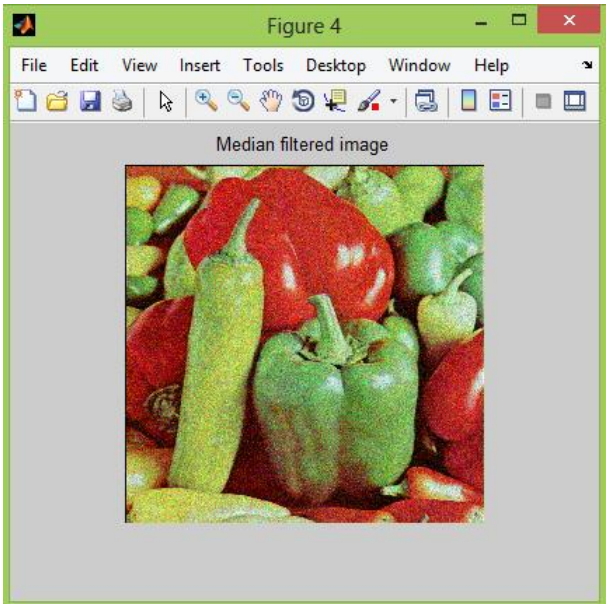
A. Simulation Tool

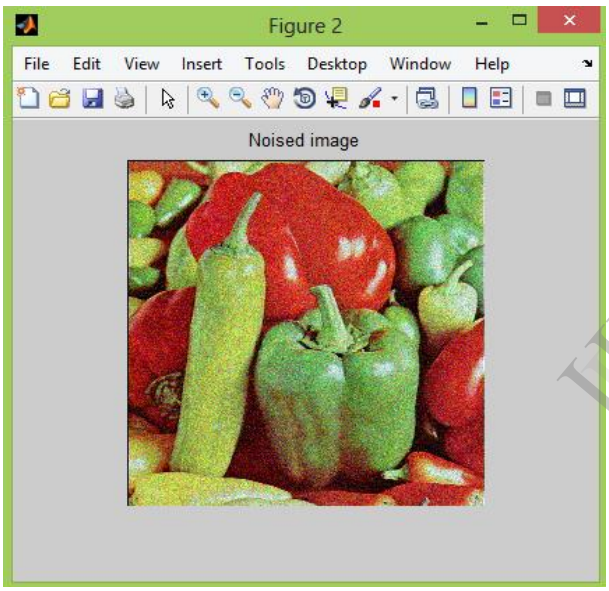
There are many approaches which can be applied on for its implementation but the software that is used in the implementation of this technique is MATLAB. MATLAB & Simulink Release 2010a which is a product by THE MATHWORKS. This software helps in doing tricky tasks of image processing which is widely used in the field of Digital Image Processing. It has variety of inbuilt functions and filters which helps to do complicated tasks of image processing in just few lines of coding.

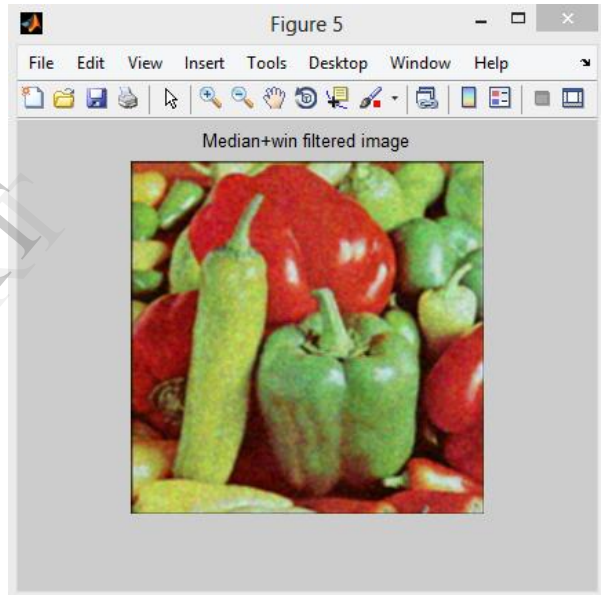
An inbuilt Simulink gives a platform for the beginners to perform image processing task by arranging the desired block which we need and making connection for the required task without knowing coding in this software version.

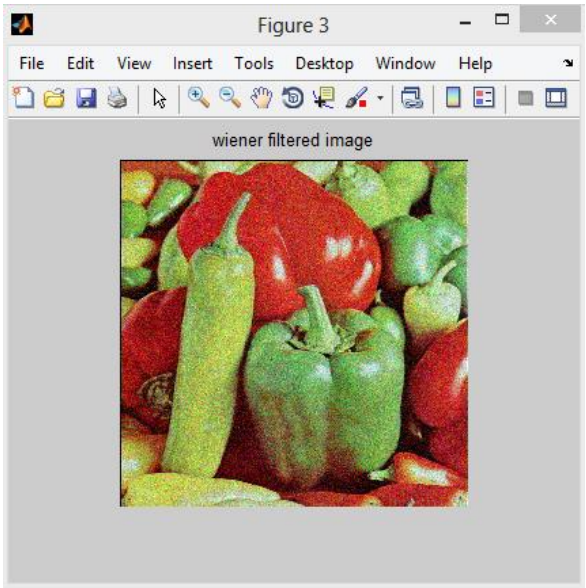
Image Name: peppers.ppm











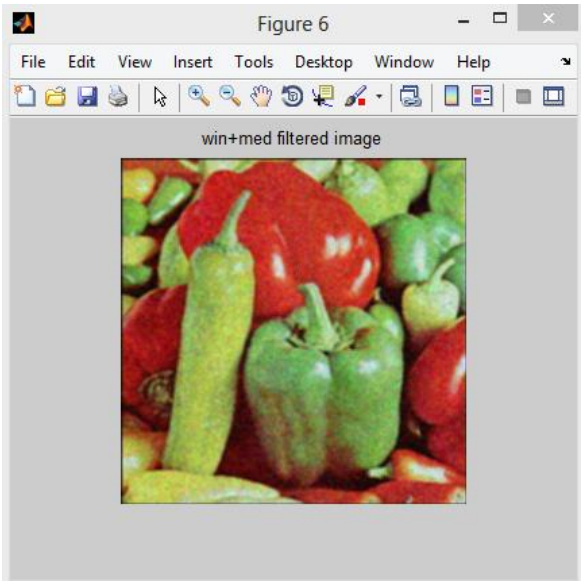
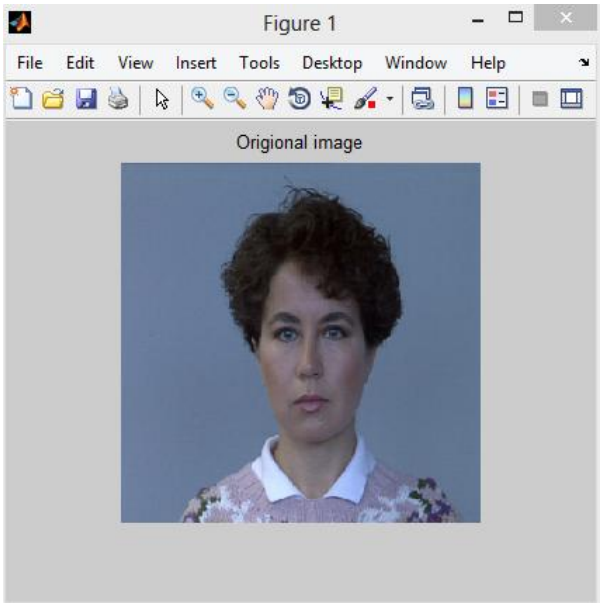
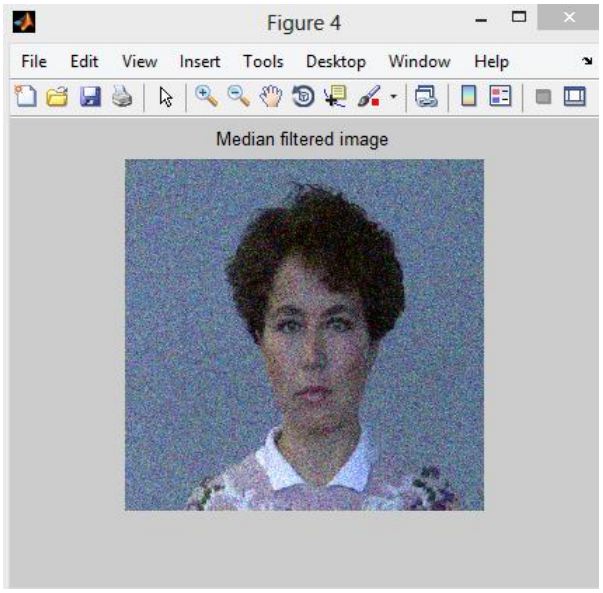
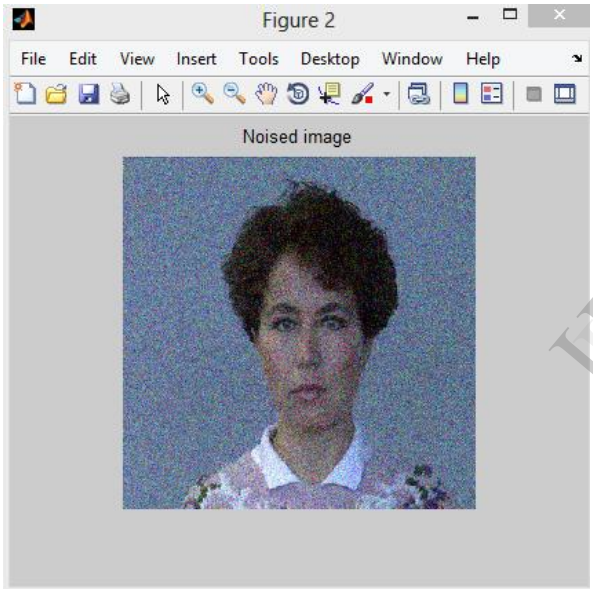
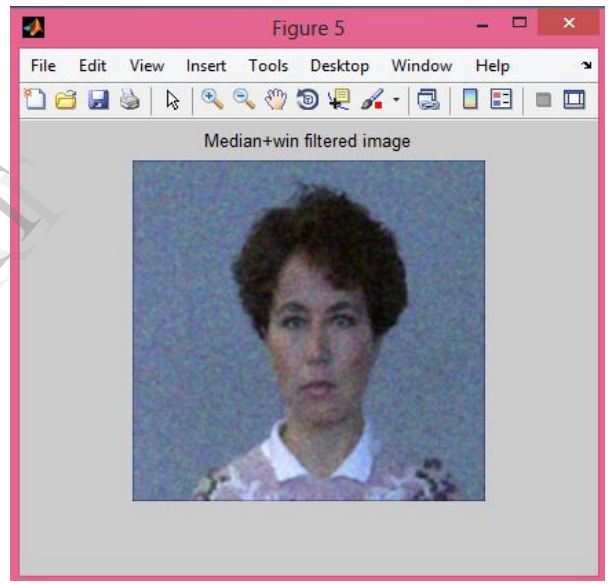


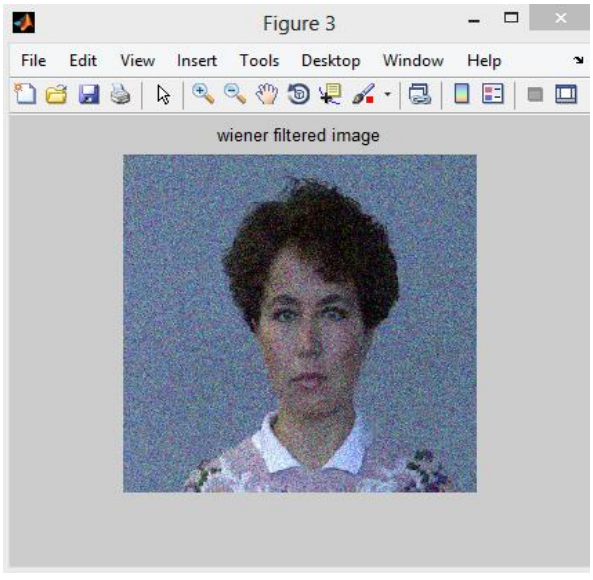
Image name: cara1.ppm

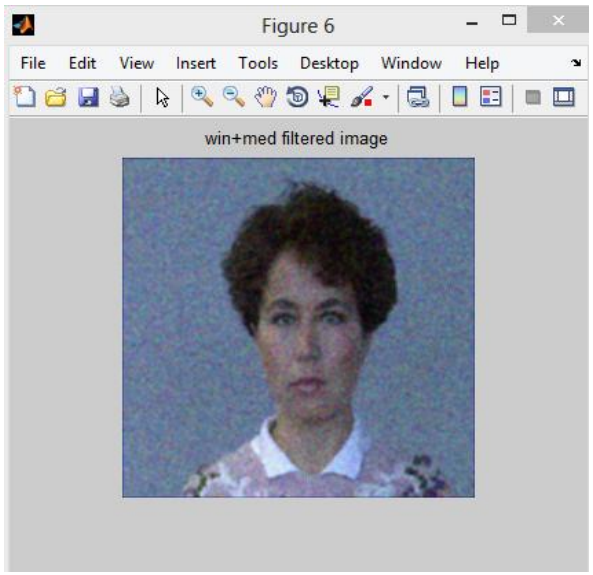










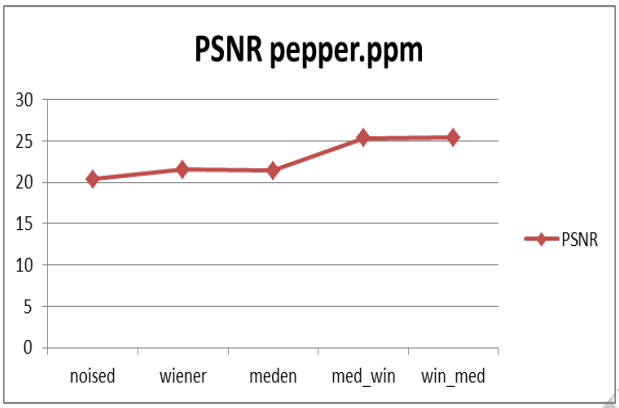


VII. RESULT ANALYSIS

Table 1 data set for image peppers.ppm

Filter type	PSNR	MSE
Noised	20.36	603.2306
Wiener	21.5341	460.3349
Meden	21.4199	472.5967
med_win	25.3501	191.192
win_med	25.4353	187.4781

Graph 1. Graph shows the PSNR values of image pepper.ppm with different filters



Graph 2. Ggraph shows the MSE values of image pepper.ppm with different filters

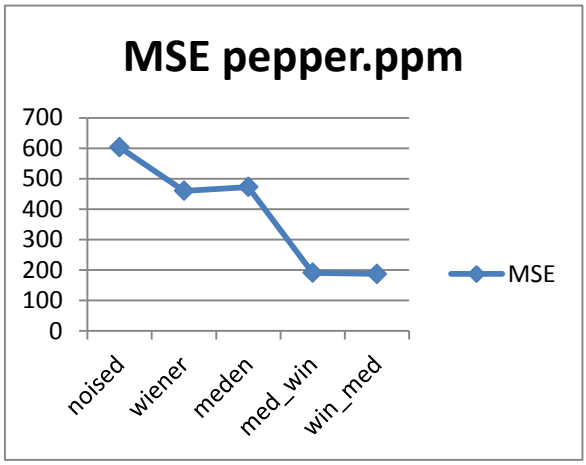
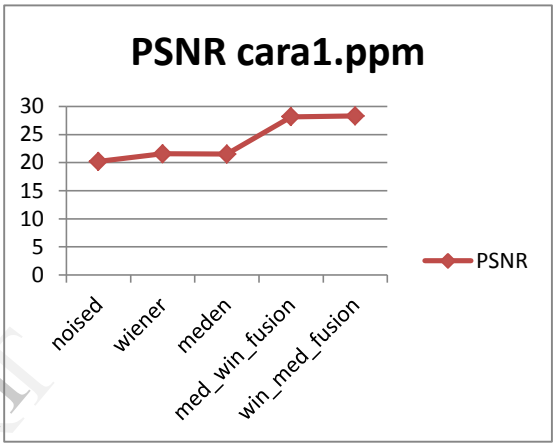


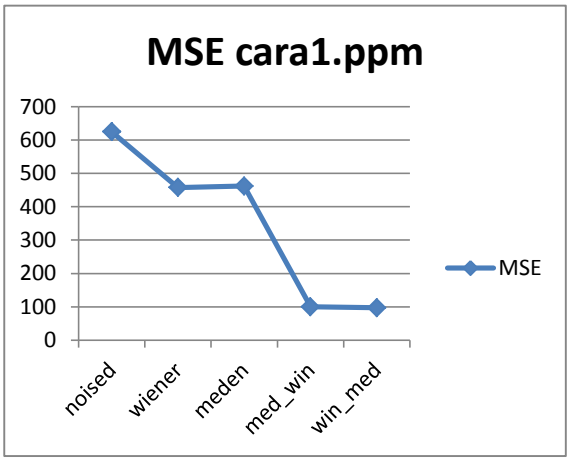
Table 2 PSNR and MSE of cara1.ppm

Filter	PSNR	MSE
noised	20.2054	625.0816
wiener	21.5587	457.7324
meden	21.5167	462.1806
med_win	28.1776	99.706
win_med	28.2959	97.0254

Graph 3. Graph shows the PSNR values of image cara1.ppm with different filters



Graph 4. Graph shows the MSE values of image cara1.ppm with different filters



VIII. CONCLUSION

In this paper three spatial domain filters (mean, median and wiener) are used to design a new technique called hybrid technique to de-noise and enhance digital image using fusion approach.". This research works gives an comparative study between all these filters. The comparative study makes the statement clearly that Hybrid technique has best result in both comparison as PSNR value comparison or image viewing. Hybrid technique is applicable on each type of digital image format whether it is gray-scale or color image. We have used four different images with RGB color mode and applied hybrid technique to remove noise from it which was done successfully and results were better after comparison from other filters.

This comparison concludes that mean filter produces very low PSNR value and very high mean square error and fusion (hybrid) technique Produces good result with effective PSNR value and less mean squire error.

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Prof. P. D. Murarka is currently working as Professor, Arya College of Engineering and Technology, Jaipur. He is member in International Societies/Associations. He has an excellent academic background with a very sound academic and research experience. He has an experience of more than 45 years with 5 years of industrial experience. He has penned down a number of text and reference books. He has authored many research papers in journal and conferences of national and international repute. His area of interest includes topics related to Artificial Intelligence, Robotics, and Security.

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