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Performance Analysis of Various Filtering Algorithm for Biometrics Image

Banupriya S[1*], Karnan M[2] and Sivakumar R[3]

[1*]*M.E Computer and Communication Engineering, Tamilnadu College of Engineering, Coimbatore, India*
[2]*Dept. of Computer Science and Engineering, Tamilnadu College of Engineering, Coimbatore, India*
[3]*Dept. of Information Technology, Tamilnadu College of Engineering, Coimbatore, India*

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Abstract-Image filtering algorithms are applied on images to remove the noise that are either present in the image during capturing in to the image during transmission. These Gaussian noise, speckle noise and salt and pepper noise are occurred when captured the image. Five different image filtering algorithms are compared with three different noises types. The Peak Signal to Noise Ratio (PSNR) and Mean Square Error (MSE) are compared by filters. The median filter gives desirable results in two parameters for the three different noises.

Key words: Adaptive filter, Mean filter, Median filter, Kalman filter, Gaussian filter, Additive noise, Salt and pepper noise, Modified Spatial Median filter for Gaussian noise, Peak Signal to Noise Ratio and Mean Square Error.

I. INTRODUCTION

Generally face images are collected by image sensors. They are contaminated by the different type of noise. Basically three type of noise are present in face images namely, Speckle noise, salt and pepper noise and Gaussian noise. There are many different cases of distortions. Face images suffer from nature mortification because of transmission of low contrast and blurred image due to quality of light and diminishing color. When a Biometrics image is captured, denoising is done to correct and adjust the image processing. Different filtering techniques are available in the literature for denoising of face images. The performance of an image filtering depends on its ability to detect the occurring of noisy pixels in the image. To improve the signal-to-noise ratio for acoustic images works with both hardware and software.

II. FILTERS

Filters are mainly used to suppress the high frequencies in the image that is smoothing the image, the low frequencies, enhancing and detecting edges in the image. An image can be filtered by the frequency or spatial domain [9]. Point operations are limited; they cannot accomplish tasks like sharpening or smoothing. Images are often manipulating by random variations in intensity, illumination, or havePoor contrast. Point operations are limited.

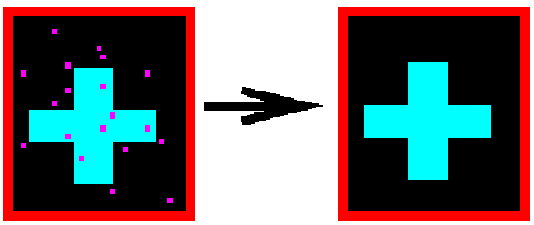


Figure 1: Filter Image

A filter is a process that removes unwanted component or feature from a signal. Removing some frequencies and reduce background noise. It cleans up appearances and allows for selective feature of specific information. A number of techniques are available and it can depend on the image and how it will be used [13].Analog and digital image processing may require filtering to produce a usable and attractive result. This can be a standard part of the editing process used to prepare images for distribution.

III. FILTERING METHODS

Adaptive filter: An adaptive filter is a transfer the function of optimization algorithm moved by an error signal. It required processing operation for some applications. It uses feedback in the form of an error signal by transfer function to match the changing parameters.An adaptive filter have adaptation algorithm, it vary the filter transfer function accordingly monitor the environment [2].The often no stationary by signal and/or noise characteristics and the vary with time by statistical parameters. Attempts to find the optimum filter design based in the actual signals received;Adaptive filters differ from FIR and IIR in the sense thatset of desired specifications determined by the coefficients. The coefficients are not fixed [6]. The specifications are not known with adaptive filters and change with time. Medical instrumentation, and speech processing, echo and noise calculation and channel equalization these applications are process control.Adaptive filter construct the following selections are update the coefficients of the selected filter. Whether to use an FIR or IIR filter.

- An adaptive filter is a nonlinear device; it does not obey the principle of superposition.
- Adaptive filters are classified as:
- Linear - it estimate quantity of interest is computed adaptively at the output of the filter as a linear

Corresponding Author:Banupriya S[1]

combination is set of observations applied to the filter input.
- Nonlinear-Neural Networks.

Advantages
- FIR Filter are Linear Phase
- Coefficients are easy and simple to calculate
- The design methods are generally linear
- Complex filters with many bands of different gains
- FIR filters are always stable
- They can be realized efficiently in hardware.

*Gaussian Filter:*Gaussian filter is a filter whose impulse response is an approximation to it. Gaussian filters have the properties of minimizing the rise and fall time while no overshoot to a step function input. Gaussian filter has the minimum possible group delay this behaviour is closely connected to the fact that the. It is the ideal domain filter; the sinc is the ideal frequency domain filter. These properties are important in digital telecommunication systems.

$$g(x) = \sqrt{\frac{a}{\pi}} . e^{-a x^2}$$

Properties of Gaussian Filtering
- Gaussian smoothing is effective for removing Gaussian noise.
- The weights reduces edge blurring
- They are linear low pass filters.
- Large filters are implemented using small 1D filter.
- Perform the same in all directions.
- Larger σ for more intensive smoothing.

Median Filter: It is nonlinear digital filtering technique, used to remove noise. The pixels are replaced with the median magnitude. The Median Filter has an advantage over the Mean filter; the median of the data is taken rather than of the mean ofimage [10]. To replace the pixel with the median magnitude. The median of a set ismore robust with the presence of noise. The median filter is given by

Median filter(*x1….xN*) =Median (||x1||2…….||xN||2) The Simple Median Filter, an original and the filtered pixel having the same pixel. A pixel that does not change through filtering is known as the root of the mask.

*Advantage:*The median filter is extremely large magnitudes; it can eliminate the input noise values with. In difference, linear filters are sensitive to this type of noise - that is, the output may be corrupted severelyssby even by a small fraction of anomalous noise values.

*Wiener filter:*The Wiener filter is a filter used to produce a desired random process by linear time-invariant filtering and detect noisy process, stationary signal and noise spectra, and additive noise are assuming known. The Wiener filter minimizes the mean square error between the evaluate random process and the desired process [9].
Wiener filters are characterized by the following
- Assumption: linear stochastic processes ,the signal and additive noise are stationary
- Requirement: This requirement can be dropped, resulting in a non-causal solution.
- Performance criterion: minimum mean-square error (MMSE).

Itstatistics of the data requires a priori information to be processed. Input data match theon which the design of the filter is based. The input data of the a priori information is not known completely, although, it cannot be feasible to design` the Wiener filter or else the design may no longer be optimum.This filter is often used in the process of deconvolution; for this application, see Wiener deconvolution.

Advantages
- Begins to exploit signal
- Controls output error
- Straightforward to design

*Average filter or mean filter:*It is windowed filter of linear class, that smoothes the image. Low-pass one works by this filter. The basic idea of filter is take an average for any element of the image across its neighbourhood. Passing the input signal through a moving average filter at two or more times by Multiple-pass moving average filters. To analyze data points by creating a series averages of different subsets of the full data set [12].

*Advantage:*Removing a small amount of high frequency noise from N dimensional signal by the moving average filter. It is good for noise removal.

IV. NOISE

*Gaussian Noise:*It represents noise, it having probability density function equal to that of the normal distribution, which is known as the Gaussian distribution or Gaussian-distributed take the values that are noise [8].
The probability density function *P* of a Gaussian random variable Z is given by:

$$PG(z) = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{(z-\mu)^2}{2\sigma^2}}$$

Salt and pepper noise: Salt and pepper noise typically seen on image formed by noise . Randomly occurring white and black pixels, it represents itself. Noise involves this type of filter a median filter, morphological filter or a filter. Effective noise reduction method is used. Faulty switching noise edge into images by salt and pepper in situations where quick transients. It is also known as impulse noise. It can be caused by sharp and sudden disturbances in the image signal. Its appearances is randomly scattered white or black pixel over the image

I= imnoise (I,'salt& pepper', 0.02);

*Speckle Noise:*It is granular noise in conventional rader result from fluctuations in the return signal from objects. It not has bigger than a single image. It is caused by coherent processing backscattered signals from distributed targets.Speckle noise random values multiplied by pixel values modeled by speckle noise. It is also called multiplicative noiseI (1+N). Imnoise can produce speckle

T_spk=imnoise (t,'spckle');

It can be modelled by random values by pixel value of an image.

V. EXPERIMENTAL SETUP AND EVALUATION

To test the accuracy of the medianFiltering algorithms, steps are followed.

i) First an uncorrupted face image is taken as input.
ii) Second different noises are added to the face image artificially.
iii) Third, the filtering algorithms are applied for reconstruction of face images.

Calculate the Mean Squared Error and Peak Signal to Noise Ratio for the original and the reconstructed images.Performances of various filters are tested for three types of noise models by calculating the Mean Square Error [11]and Peak Signal to Noise Ratio [5]. The values are calculated by the following expressions:

$$PSNR=10\log_{10}(R^2/MSE)$$

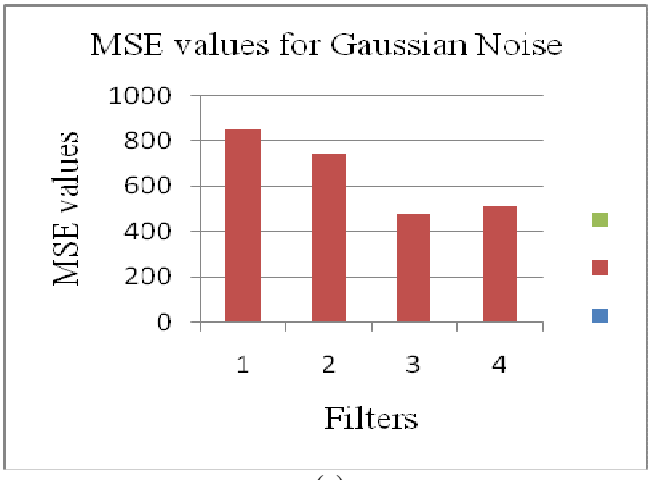
Where MSE represents the mean square error of the estimation. The image size is 256X256.Graph Represents the Filters Name are

1-Average Filter

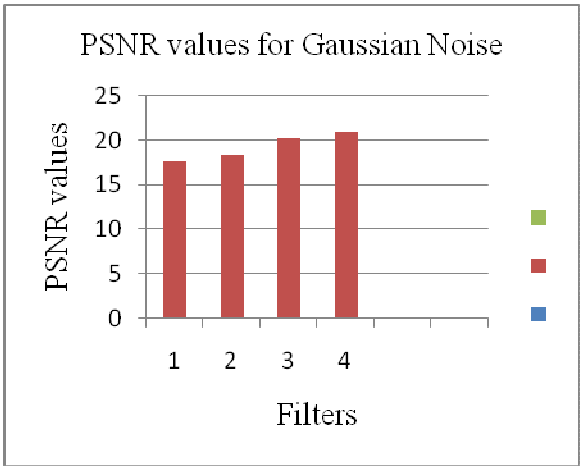
2-Median Filter

3-Wiener Filter

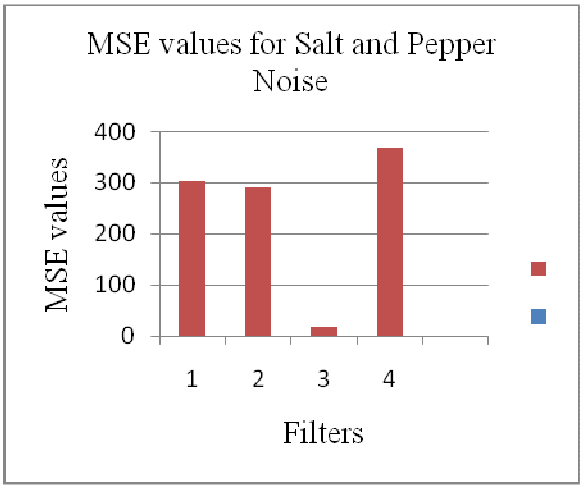
4-Gaussian Filter



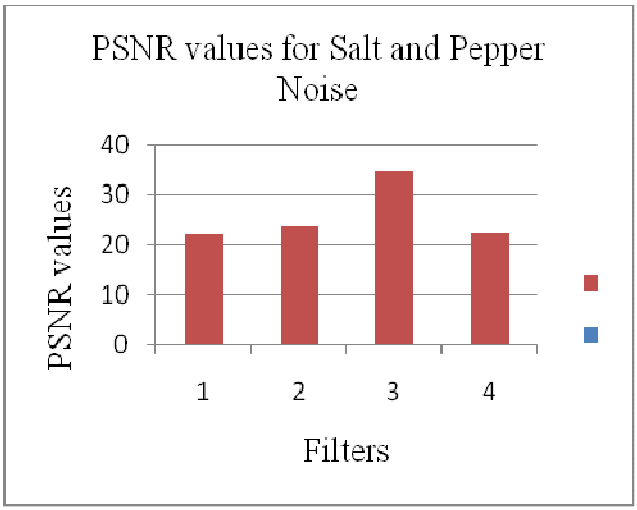
(a)



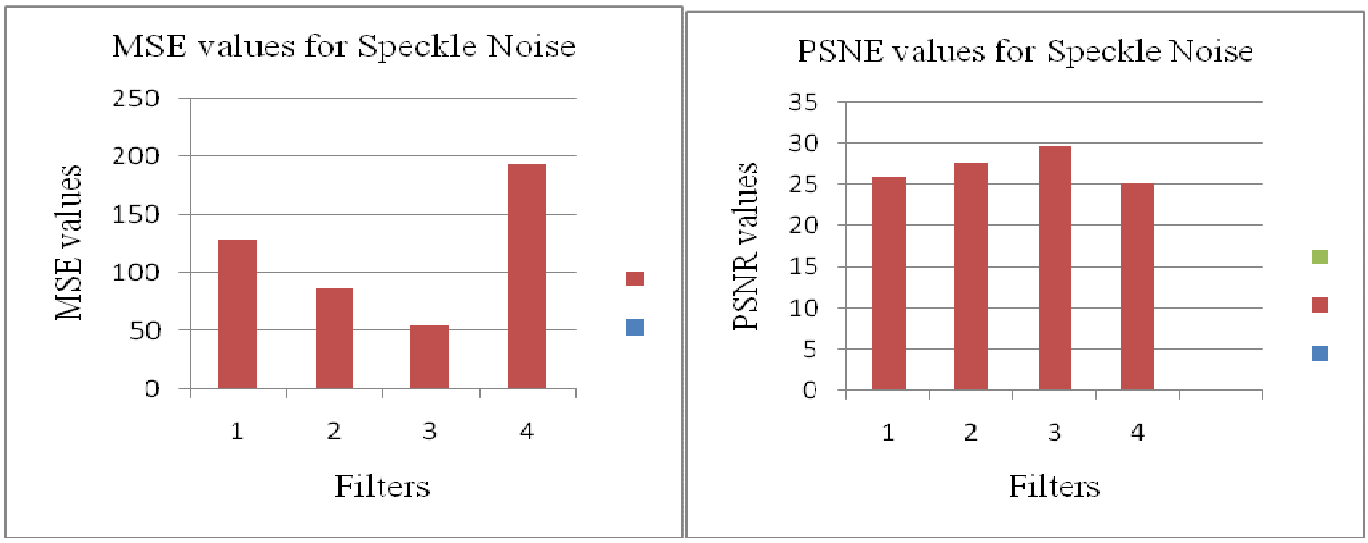
(b)



(c)



(d)



(e) (f)

Figure 2 : (a)MSE value for Gaussian Noise,(b)PSNR for Gaussian Noise,(c)MSE value for Salt and Pepper Noise,(d)PSNR for Salt and Pepper Noise,(e)MSE for Speckle Noise ,(f)PSNR for Speckle Noise.

Table .1 - comparison of filters using noise value and MSE

Method	PSNR value	MSE value	Noise type
Average filter	17.7376	852.3283	Gaussian noise
	22.2189	303.7229	Salt and Pepper noise
	25.9556	128.4719	Speckle noise
Median filter	20.2684	743.7187	Gaussian noise
	23.5151	289.4480	Salt and Pepper noise
	27.6913	86.1458	Speckle noise
Wiener filter	20.2684	475.9081	Gaussian noise
	34.7624	16.9094	Salt and Pepper noise
	29.7068	54.1613	Speckle noise
Gaussian filter	21.0363	513.3932	Gaussian noise
	22.4870	366.7556	Salt and Pepper noise
	25.2586	193.7413	Speckle noise

The table.1 shows the comparison of fourfilters. The median type filters give better performance than other type of filters. It is clearly observed that salt &pepper noise is completely removed when compare too their two noise types.

VI. CONCLUSION

In this paper image filteing algorithms are applied on biomertics image to remove the noise that are present in the image during capturing.Biometrics images when captured usually have Gaussian noise,speckle noise and salt and pepper noise.In this work four different image filtering algorithms are compared with three diffrerent noise.The performance of the filters are compared with Peak signal to noise ratio and Mean Square Error.The Wiener filter gives desirable results in terms of PSNR and MSE for three noise.Fourty Biometrics imagesare taken for implementation.

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AUTHOR PROFILE

Banupriya S pursuing M.E in Computer and Communication from Tamilnadu College of engineering, Coimbatore, Indiaand Bachelor of Engineering in computer science and Engineering from Avinashilingam University, Coimbatore, India in 2012. His research interests generally are inHuman computer interaction, biomimetic Intelligence system design, and machine learning and computer vision.