Preprocessing of Biometric Images Using Various Filtering Techniques for Efficient Medical Diagnosis

A.Ananda Gopi[1], Dr. P.Raajan[2]

[1,2] Post Graduate Department of Computer Applications Ayya Nadar Janaki Ammal College(Autonomous), Sivakasi – 626 124

***Abstract-* In the present scenario the world of digital image processing dominates each and every corner in the field of Medical diagnosis. Most of the image which are captured is equipped with noise. In order to overcome the issue and in the elimination of noises preprocessing is a vital task as process itself as well as a component in other process. This paper presents various filtering techniques viz., Median, Average, Gaussian, Disk are used to eliminate the dissimilar noises in the biometric images. The experimentation is made with all the selected filters and the results are evaluated. The performances of the filter are evaluated in terms of Peak Signal-to-noise Ratio (PSNR), and Mean Square Error (MSE). Finally, the efficient filters which performs well in the elimination of noises are been considered for the further processing. Among them the median filter provides better enhancement result.**

***Index Terms-* Preprocessing, Median. Gaussian, Disk, PSNR, MSE.**

I. INTRODUCTION

Image Enhancement refers to enhancing the image against the noise presented in the image. Preprocessing is a technique used to improve the quality of images. The noisy or blurred images should be filtered and sharpened. In image processing, filters are mainly used to suppress either the high frequencies in the image, i.e. smoothing the images or the low frequencies, i.e. enhancing or detecting edges in the image. Due to various factors in image acquisition the images are general poor in contrast. Preprocessing of an image is to remove artifacts and degradations such as blurring and noise.

Generally, there are two types of models i.e. linear model and non-liner model. The benefits of linear noise removing models is the speed and the limitations of the linear models is, the models are not able to preserve edges of the images in a efficient manner i.e the edges, which are recognized as discontinuities in the image, are smeared out .On the other hand, Non-linear models can handle edges in a much better way than linear models. The performance of these techniques is compared with respect to PSNR value and MSE Value [1].

II. LITERATURE REVIEW

Deepa, P., *et al.* developed an efficient denoising and enhancement for medical image, the imfilter will provide the efficient denoising. The image is denoised using various filter and the quality and accuracy is measured by PSNR and MSE value and we evaluated the best denoised image according to these value[1].

Preprocessing of images commonly involves removing low-frequency background noise, normalizing the intensity of the individual particles images, removing or enhancing data images prior to computational processing [2].

Khera, S., *et al.* implemented a combinations of filters are required to be done to enhance the quality of the image. Wavelet transform is best suited for de noising because of its properties like sparsity, multi-resolution and multi-scale nature.Which wavelet should be applied on noisy image depends upon the nature of the application[3].

Baboo,S.S.,*et al.* developed a method for X-ray images are filtered by two different filtering algorithms. The filtering algorithms are used for anisotropic filtering and median filtering algorithm. The output results are compared in PSNR and MSE values. The targets for image enhancing are better contrast, sharpness of detail and visibility of features. Several algorithms are Histogram Equalization (CLAHE). Here they applied contrast limited adaptive histogram equalization algorithm[4].

Sundaram, M.K., *et al.*developed on Preprocessing a mammogram image using Adaptive Median Filter. Pre-processing technique for enhancing the content of medical image based on removal of special markings and noise. Removal of special markings and noise existing in medical images will increase the quality of image segmentation[5].

George, B.E., *et al.*[BK12] developed a combination of different approaches to preprocess and enhance the brain MRI images. the high frequency components and noise are removed from MRI using the following filters. Such as Median filter, Weighted Median filter and Center Weighted Median filter[6].

2.1 IMAGE NOISE

Image noise is a random variation of brightness or color information of images, and is usually an aspect of electronic noise. It can be produced by the sensor and circuitry of a scanner or digital camera. The noises are following :

A. Gaussian Noise : Gaussian noise is statistical noise that has its probability density function equal to that of the normal distribution, which is also known as the Gaussian distribution. In other words, the values that the noise can take on are Gaussian-distributed.

B. Salt and Pepper Noise : Salt and pepper noise is a form of noise typically seen on images. It represents itself as randomly occurring white and black pixels. Salt and pepper noise creeps into images in situations where quick transients, such as faulty switching take place.

C. Poison Noise : Poison noise is induced by the nonlinear response of the image detectors and recorders. This type of noise is image data dependent. This term arises because detection and recording processes involve random electron emission having a Poison distribution with a mean response value.

D. Impulse Noise : Impulse noise is a category of (acoustic) noise which includes unwanted, almost instantaneous (thus impulse-like) sharp sounds (like clicks and pops). Noises of the kind are usually caused by electromagnetic interference, scratches on the recording disks and ill synchronization in digital recording and communication.

E. Speckle Noise: Speckle is a complex phenomenon, which degrades image quality with a backscattered wave appearance which originates from many microscopic diffused reflections that pass through internal organs and makes it more difficult for the observer to discriminate fine detail of the images in diagnostic examinations[7].

2.2 FILTERS

The main function of filters is to suppress either the high frequencies in the image, that is smoothing the image, or the low frequencies, that is enhancing or detecting edges in the image. The filters are following :

A. Mean filter : Mean filtering is a simple, intuitive and easy to implement method of smoothing images, *i.e.* reducing the amount of intensity variation between one pixel and the next. It is often used to reduce noise in images. The idea of mean filtering is simply to replace each pixel value in an image with the mean (`average') value of its neighbors, including itself. This has the effect of eliminating pixel values which are unrepresentative of their surroundings.

$$y[i] = \frac{1}{M}\sum_{j=0}^{M-1} X[i+j] \qquad \text{….(1)}$$

In the above equation , input signal, is x[], y [] the output signal, and M is the number of points used in the moving average.

B.Wiener filter : The wiener filtering method requires the information about the spectra of the noise and the original signal and it works well only if the underlying signal is smooth. Wiener method implements spatial smoothing and its model complexity control correspond to choosing the window size. Wiener filtering is able to achieve significant noise removal when the variance of noise is low, they cause blurring and smoothening of the sharp edges of the image.

C. Median filter : Median filtering is a common step in image processing. Median filter is a well-used nonlinear filter that replaces the original gray level of a pixel by the median of the gray values of pixels in a specific neighborhood. The median filter is also called the order specific filter because it is based on statistics derived from ordering the elements of a set rather than taking the means. This filter is popular for reducing noise without blurring edges of the image. It is particularly useful to reduce salt and pepper noise and speckle noise[3].

$$\text{Median} = \hat{f}(x,y) = \underset{(s,t)\in S_{xy}}{\text{median}} \{g(s,t)\} \quad \ldots(2)$$

Where xxxxxx

D. Gaussian filter : Gaussian filters are designed to give no overshoot to a step function input while minimizing the rise and fall time. This behavior of Gaussian filter causes minimum group delay. Mathematically, a Gaussian filter modifies the input signal by convolving with a Gaussian function. The Gaussian filter is usually used as a smoother.

$$\text{Gaussian} = G_\sigma(x,y) = \frac{1}{2\pi\sigma^2} \exp -\frac{x^2-y^2}{2\sigma^2} \quad \ldots(3)$$

Where σ is the standard deviation of the distribution[3].

3. METHODOLOGY

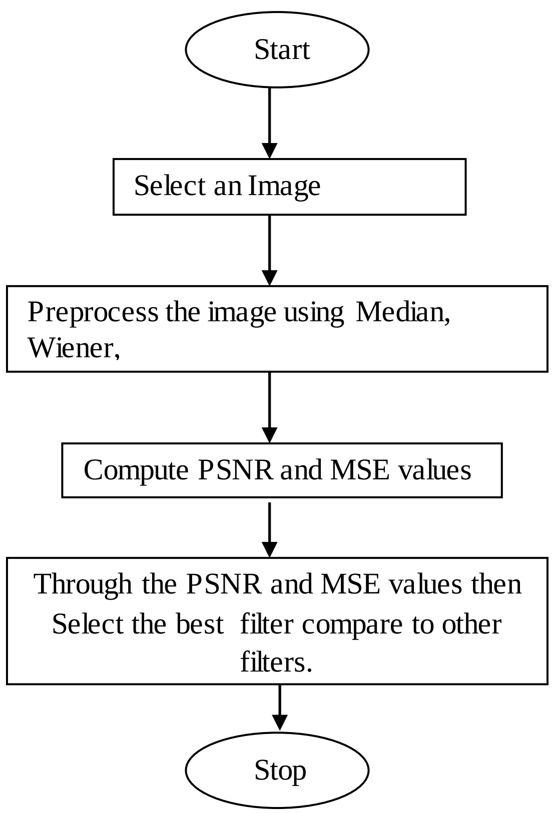

Figure 1. Block Diagram of Preprocessing

The proposed work starts with reads the input biometric image. Then applying the various filters such as Median, Wiener, Average, Disk and Gaussian filters on the input image. Next, computes the PSNR and MSE values. Through the PSNR and MSE values, select the best filter compare to the other filters.

2.1 Algorithm

// Preprocessing Biometric Images //

Step 1 : Start
Step 2 : Select an input image from Biometric dataset.
Step 3 : Preprocess the image with the following
- *Apply the Median Filter.*
- *Apply the Wiener Filter.*
- *Apply the Average Filter.*
- *Apply the Disk Filter.*
- *Apply the Gaussian Filter.*

Step 4 : Estimate MSE and PSNR values.
Step 5 : Compared the MSE and PSNR values for above applied filters.
Step 6 : Repeat the Step 2 to 5 for all images in the biometric Database.
Step 7 : End.

2.2 Performance Measures

The following mathematical metrics are used for the evaluation of the algorithm.

- Mean Squared Error
- Peak Signal to Noise Ratio

2.2.1 Mean Square Error

Mean square error also called average prediction error. It is calculated as the average of difference between the decompressed and original image. Higher value of MSE gives poor quality image.

$$\text{MSE} = \frac{1}{MN}\sum_{y=1}^{m}\sum_{x=1}^{n} (I(x,y)-(K(x,y)^2 \quad \ldots(4)$$

Where I is original image, K is approximation of decompressed image. And m, n are pixels of the image. A lower value of MSE means lesser error, and it has the reverse relation with PSNR.

It measures the average of the square of error. It is the second moment of error and its lower value indicate better picture quality.

2.2.2 Peak Signal Noise Ratio

PSNR is a measure of the peak error. Many signals have very wide dynamic range, because of that reason PSNR is usually expressed in terms of the logarithmic decibel scale in (dB). MSE and PSNR are very useful parameter to compare the image quality.

$$PSNR(dB) = 20\log_{10}\frac{1}{\sqrt{MSE}} \quad ...(5)$$

3. RESULTS AND DISCUSSION

Explain about datrabase

The proposed work implemented in MATLAB.

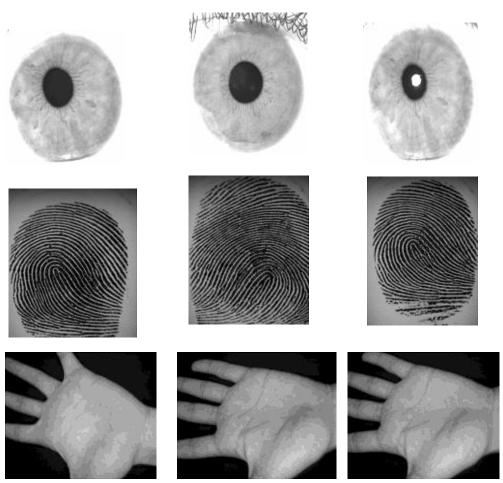

Figure 2. Sample Images

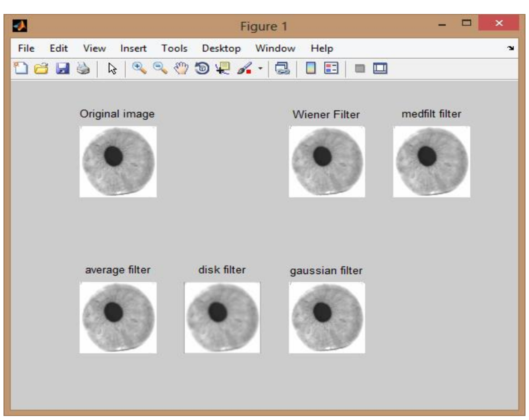

Figure 3 : Preprocessing of Iris Image

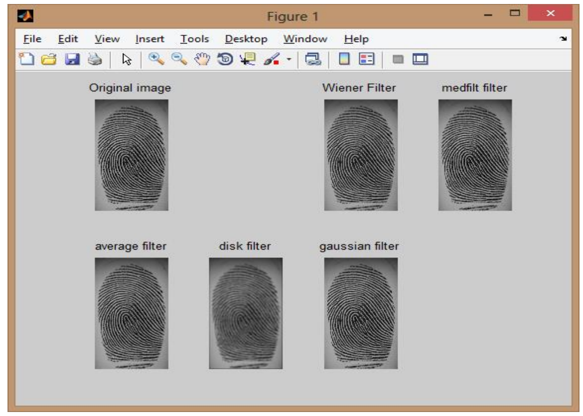

Figure 4 . Preprocessing of Finger Print Image

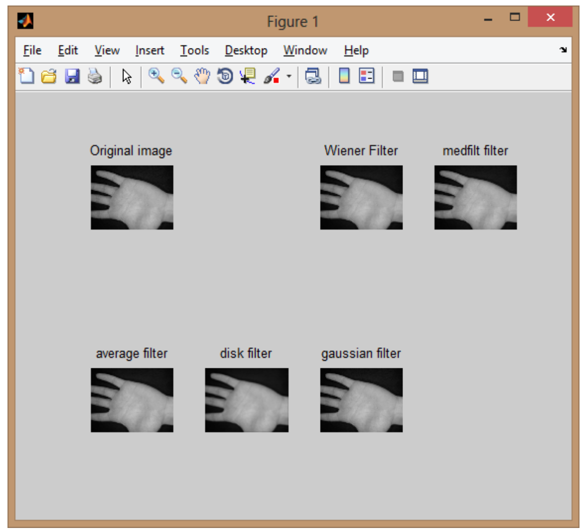

Figure 5. Preprocessing of Palm Print Image

3.1 PERFORMANCE EVALUATION

With the analysis of the values in the table the Median Filter is better with MSE and high PSNR values. In order to evaluate the performance of the Median Filter obtained results are compared with the standard filter are shown in the following table, and Figure 6 shows the comparisons for MSE and PSNR values. They are represented in chart. Through Figure 6, the median filter is better for other filters.

Filters	Iris Images		Finger Print		Palm Print	
Various Filters	PSNR	MSE	PSNR	MSE	PSNR	MSE
Median	42.56	3.51	38.57	10.13	51.15	0.5
Gaussian	42.40	3.77	38.10	10.46	50.7	0.55
Average	39.18	8.11	32.44	37.38	46.98	1.30
Disk	34.30	24.37	28.64	89.41	40.24	6.18
Wiener	41.54	3.68	34.41	24.77	50.93	0.50

Table 1. Performance Comparison with Various Filters

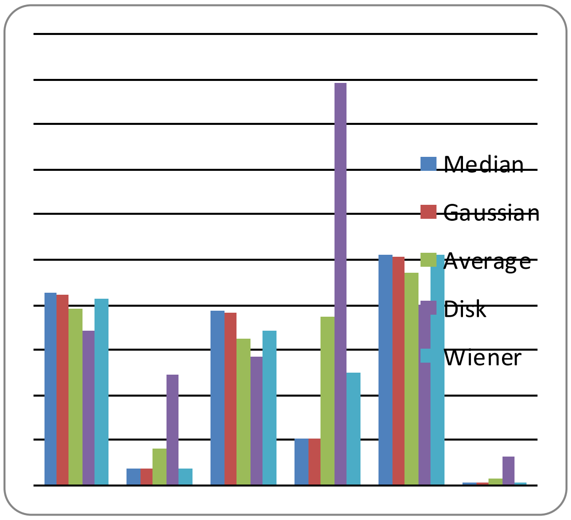

Figure 6. Comaparisons of PSNR and MSE

4CONCLUSION

With the various filtering techniques the biometrics images of different categories were experimented. The filter applied for this process Median, Disk, Gaussian, Wiener, Average. The performance of the various filters is evaluated with the similarity measure PSNR, MSE values. Among the them the median filter provides better performance with the PSNR of 42.56, 38.57, 51.15 for iris, finger print and Palm print respectively. Similarly the MSE of 3.51, 10.15,0.5 respectively compared to the other filter this filter provides better result and hence it is considered for the further processes.

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