Preprocessing Methods to Remove Impulse Noise in Avian Pox affected Hen Image using Image Processing

C. Hemalatha
Research Scholar
Dept. of Electronics and Instrumentation
Bharathiar University
Coimbatore – 46, Tamil Nadu, India

S. Muruganand
Assistant Professor
Dept. of Electronics and Instrumentation
Bharathiar University
Coimbatore – 46, Tamil Nadu, India

R. Maheswaran
Research Scholar
Research and Development Centre
Bharathiar University
Coimbatore – 46, Tamil Nadu, India

ABSTRACT
The main objective of this paper is to discuss the preprocessing method involved in the identification of avian pox disease in poultry farm. Due to the acquisition of the hen images and lighting variations noise can affect the images. Preprocessing is the first and very important step in image processing, after preprocessing we can do analysis in that image for future work. In this paper, impulse noise are removed using active filters. Mean filter, median filter and wiener filters are used for removing the noise. The performance evolution tests are made using Mean Square Error and Peak Signal to Noise Ratio. Based on the evolution test among the three filters median filter removes the impulse noise than the other filters.

Keywords
Avion pox, impulse noise, median filter, Wiener filter

I. INTRODUCTION
India is the one of the largest growing country in poultry industry and also the third largest egg producer in world level [1]. Many diseases which affects the poultry farm. Due to the disease, productivity of an egg is decreased. One of the major disease which affects the hen is avian pox disease. It is a slow developing disease of birds that is caused by a large virus belonging to the avipox virus group, a sub group of pox virus. Mosquitos are the transmitters of this disease. Avian pox is transmitted when a mosquito feeds on an infected bird that has viremia or pox virus circulating in its blood. The symptoms of avian pox disease is highly visible wart – like appearance and lesions on the head, comb and featherless area of the body. So identification of avian pox disease is very important. This process incudes preprocessing, feature extraction and classification. In this paper we concentrate on preprocessing methods.

Digital images are often corrupted by different kinds of noise while transmitting and acquisition of images due to errors produced by noisy sensors, faulty CCD elements and dust on the lens or communication channels. This noise could degrade the image quality and cause loss of image details. Noise removal process is one of the pre-processing steps in image processing. So it is a very paramount important to remove noise from digital image. The objective of this paper is to remove impulse noise without affecting the fine details and preserve thin lines, fine texture and image details. This paper takes into account to remove impulse noise using different active filters that are mean, median and wiener filter.

2. RELATED WORK
In this paper preprocessing methods are used for removing noise in the image and it provides an effective way to identify an avian pox disease in hen. Impulse noise may occur due to sudden fluctuations in image signals. It is like white and black dots over the image. So that it is called Salt and Pepper noise, i.e., dark pixels in the bright region and bright pixels in the dark region.

Lots of research work have been proposed for impulse noise removal in the literature. Standard Median filter removes the impulse noise from an image by utilizing the fact that impulse noise is having gray level value which is different when compared to uncorrupted neighbourhood pixels [2]. Weighted Median (WM) filter [3] and Centre Weighted Median filter (CWM) [4] have been proposed to remove impulse noise. These filters assign weights to the pixels inside the window and preserves the signal details in the image.

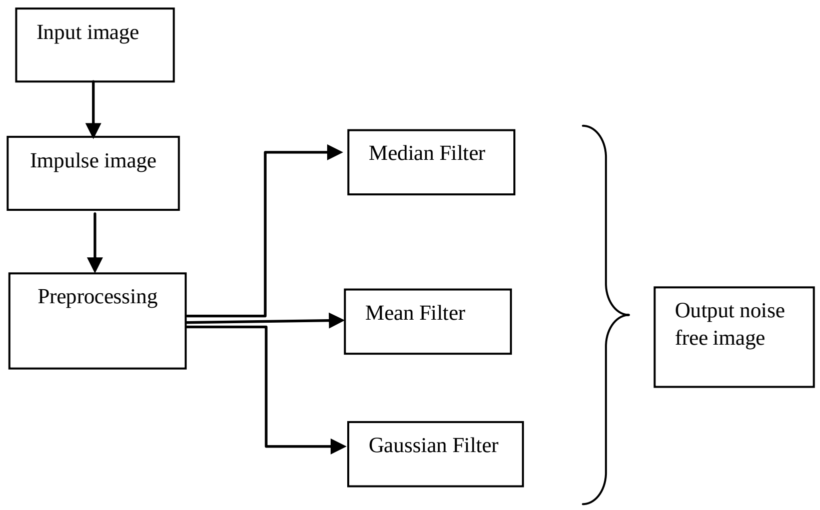
Switching Median filter (SM) [5], if the centre pixel is corrupted, the window is filtered by standard median filter, otherwise window is not filtered. Here impulse noise detector is employed. The Tri-State median filter [6] performs better than switching median filter.

Recently, the application of artificial intelligence based non linear technique such as fuzzy systems and neural network are alternative for median based noise detection and reduction. Fuzzy inference rule by else action filter (FIRE) [7] which uses fuzzy rules to estimate degree of noisy pixels and calculates a correction term based on this estimation. The weighted fuzzy mean filter (WFM) [8] and the iterative fuzzy control based filter (IFCB) [9] are able to outperform rank order filter.

Indeed, fuzzy systems are very well suited to model the uncertainty that occurs when both noise cancellation and detail preservation are required. When the images are highly corrupted, the rule-base structure becomes quite difficult. So combinations of neural network and fuzzy systems have been shown to be very promising field for nonlinear filtering of noisy image data [10-11].

3. METHODOLOGY
The acquired image is a combination of R, G, B image. For preprocessing we need to convert RGB image into gray image. After the conversion, impulse noise are removed using active filters. The following block diagram are used in this paper.

Block Diagram



3.1 Median Filter

The median filter is a simple rank selection filter that outputs the median of the pixels contained in its filtering window [2]. The input-output relationship of the median filter may be defined as follows:

Let x[r,c] denote the luminance value of the pixel at location (r,c) of the noisy input image. Here, r and c are the row and the column indices, respectively, with $1 \leq r \leq R$ and $1 \leq c \leq C$ for an input image having a size of R by C pixels. Let WN[r,c] represent the group of pixels contained in a filtering window centered at location (r,c) of the noisy input image and having the size of (2N+1) by (2N+1) pixels.

WN[r,c] = (x[r + p, c+q]);(p,q)= -N,…,N ------- (1)

Where N is a positive integer number related with the size of the filtering window and p,q are integer indices each individually ranging from –N to N.

The output of the median filter is equal to the median of the pixels contained in the filtering window WN[r,c]

m[r,c] = Median (WN[r,c]) -------- (2)

3.2 Wiener Filter

To remove Gaussian noise Wiener filter is prescribed. The Wiener filter is the Mean Square Error (MSE)-optimal stationary linear filter for images degraded by additive noise and blurring. Calculation of the Wiener filter requires the assumption that the signal and noise processes are second order stationary (in the random process sense). Here power spectrum can be deemed as a constant. Then Wiener filter H (ω1, ω2) is given

$$\frac{P_f(\omega1,\omega2)}{P_f(\omega1,\omega2)+P_v(\omega1,\omega2)} = \frac{\sigma^2 f}{\sigma^2 f+\sigma^2 v} \quad \text{--------- (3)}$$

Where $\sigma^2 f$ is the local variance of the original image and σ2v is the variance of Gaussian noise. Adaptive wiener filter works well for removing Gaussian noise.

3.3 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. It is based around a kernel matrix which represents the shape and size of the neighborhood to be sampled when calculating the mean

4. EXPERIMENTAL RESULTS

The impulse noise are removed using median filter, wiener filter and mean filter. The performance of these three filters are evaluated using some per Peak signal to Noise Ratio (PSNR) and Mean Square Error (MSE). The results are compared and show which filter gives best result to reduce the noise.

4.1 Mean Square Error (MSE)

It is defined as

$$MSE = \frac{1}{RC} \sum_{r=1}^{R} \sum_{c=1}^{C} (s[r,c] - y[r,c])^2 \quad \text{------- (4)}$$

Here, s[r,c] and y[r,c] represent the original image and filtered image of size RC, respectively.

4.2. Peak Signal to Noise Ratio (PSNR)

PSNR values are calculated using following formula

$$\text{PSNR} = 10\, log_{10} \frac{255^2}{MSE} \text{ dB} \quad \text{----- (5)}$$

Table 1 PSNR values of median, wiener, mean filter for different noise level.

Noise density	Median filter	Mean filter	Wiener filter
10	42.014	33.982	35.984
20	38.865	31.250	33.586
30	35.864	30.254	31.054
40	33.641	29.784	30.154
50	30.987	28.324	29.652
60	29.544	27.036	27.892
70	28.673	26.001	26.541
80	27.879	23.471	24.512
90	26.051	22.008	23.587

From the table 1 comparison observed that the median filter provides better result to remove the impulse noise in the hen image than the other filter.

Figure 2 shows hen image affected by the noise density level of 25% and noise are removed using median, mean and wiener filter.

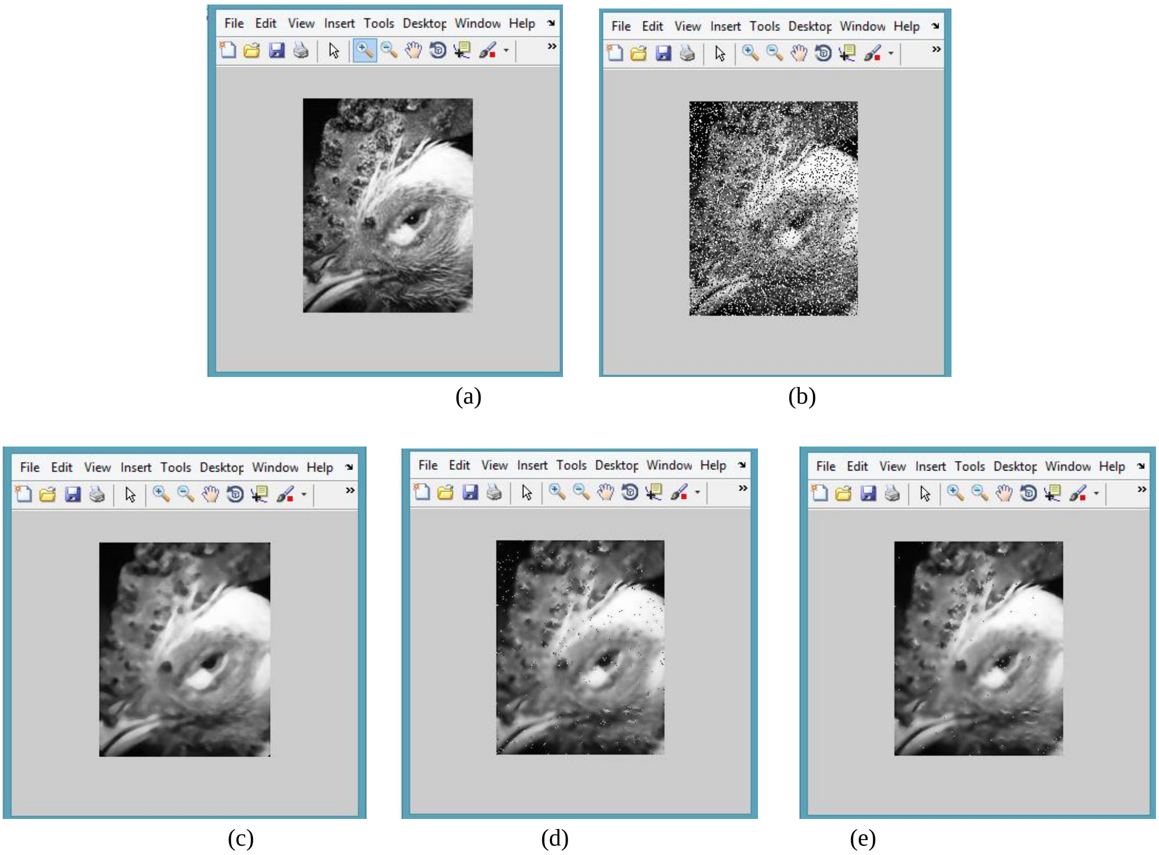


Fig. 2. Shows (a) original hen affected by avian pox disease (b) noise affected by 25% (c) noise removed by median filter (d) noise removed by mean filter (e) noise removed by wiener filter

Figure 3 shows the graph between noise density and PSNR values of median filter

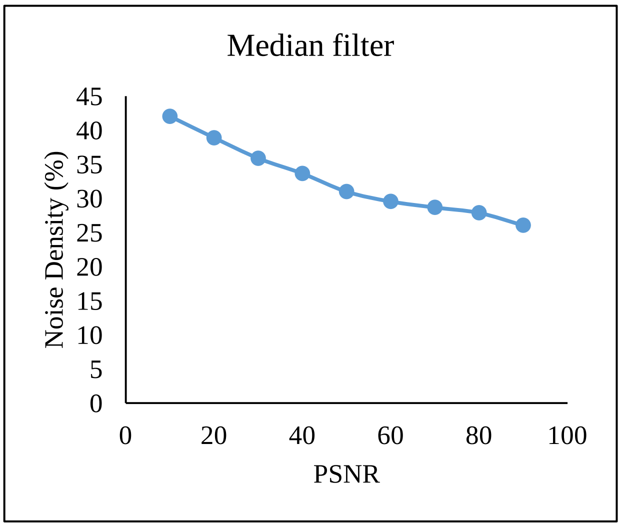


Fig. 3 graph between noise density and PSNR

Figure 4 shows the graph between noise density and PSNR values of mean filter.

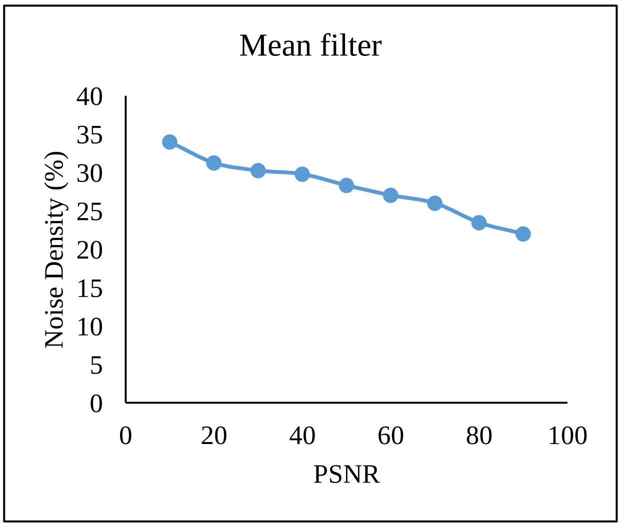


Fig. 4 graph between noise density and PSNR

Figure 5 shows the graph between noise density and PSNR values of wiener filter.

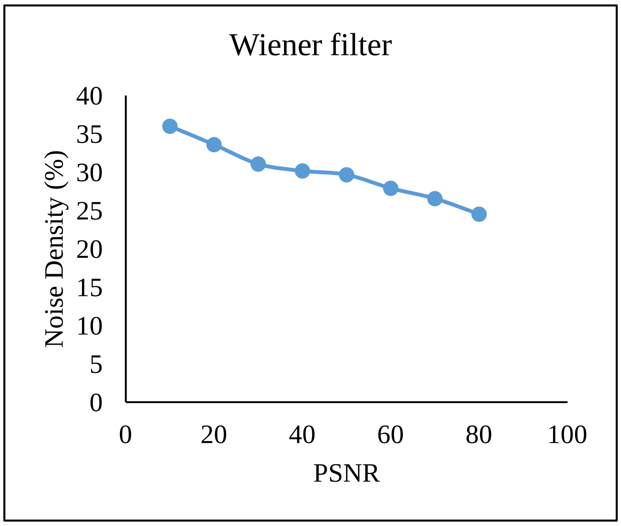


Fig. 5 graph between noise density and PSNR

From the above graph it is noted that the median filters provides better result compared to other filter such as mean filter and wiener filter.

5. CONCLUSION

Preprocessing is a very important phenomenon in image processing. In this paper impulse noise are removed using three different filters such as median filter, mean filter and Gaussian filter. The performance are evaluated using PSNR and MSE. Based on the performance evaluation test, table 1 shows the median filter gives the best result than wiener filter and mean filter.

6. REFERENCES

[1] U.S. Department of Agriculture, "International Egg and Poultry Review", VOL. 14, No. 34, 2011, August.

[2] R.C. Gonzalez, R.E. Woods, Digital Image Processing, Prentice-Hall, EnglewoodCliffs, NJ, 2002.

[3] D. Brownrigg, "The Weighted median filter, "Commun. Assoc. Computer, pp. 807-818, Mar. 1984.

[4] S. J. Ko and Y. H. Lee. "Centre weighted median filters and their applications to image enhancement," IEEE Trans Circuits Syst. Vol.38, no.9, pp. 984–993,1991.

[5] S.Kalavathy and R.M.Suresh., "A Switching Weighted Adaptive Median Filter for Impulse Noise Removal," International Journal of Computer Applications,. vol.28, no.9 pp:8-13, August 2011

[6] T. Chen, K. K. Ma, and Chen L.H., " Tri- State median filter for image denoising , "IEEE Trans. Image Process., vol.8, no. 12, pp. 1834-1838, Dec.1999.

[7] F. Russo and G. Ramponi, "A fuzzy filter for images corrupted by impulse noise," IEEE Signal Process Lett, vol.3, no.6, pp. 168-170, 1996.

[8] C. S. Lee, Y. H. Kuo, and P. T. Yu, "Weighted fuzzy mean filters for image processing," Fuzzy Sets Syst., no. 89, pp. 157–180, 1997.

[9] F. Farbiz and M. B. Menhaj, "Fuzzy Techniques in Image Processing," Studies in Fuzziness and Soft Computing, ch. A fuzzy logic control based approach for image filtering, New York: Springer-Verlag, 2000, vol. 52, pp. 194–221.

[10] F. Russo, "Recent advances in fuzzy techniques for image enhancement," IEEE Trans. Instrum. Meas, vol.47, pp.1428-1434, Dec. 1998.

[11] F. Russo, "Evolutionary neural fuzzy systems for data filtering," IEEE Instrumentation and Measurement Tech. Conf. (IMTC/98) pp. 826-830, St. Paul, MN , USA, May 18-21, 1998.

7. AUTHOR'S PROFILE

C. Hemalatha received M.Sc., and M. Phil., degree in Electronics and Instrumentation from Bharathiar University, Coimbatore, Tamil Nadu, and India in 2010 and 2012 respectively. She is pursuing Ph. D (Electronics and Instrumentation) in Bharathiar University. Her research interests include Digital Image Processing, object recognition, Neural Network and Signal Processing.

S. Muruganand received his M.Sc., degree in Physics from Madras University, Chennai, Tamil Nadu, India, and the Ph. D degree from Bharathiar University in 2002. He is working as an Assistant Professor in the Department of Electronics and Instrumentation, Bharathiar University, Coimbatore, India. His area of interest is Embedded Systems, Sensors, Physics and Digital Signal Processing.

R. Maheswaran received M.Sc., degree in Electronics and Instrumentation from Bharathiar University, Coimbatore, Tamil Nadu, and India in 2010. He is pursuing Ph. D (Electronics) in Bharathiar University. His research interests include Embedded System, LabVIEW, PLC, SCADA, Wireless Sensor Network, Digital Image Processing and object recognition.