International Journal of Recent Research and Review, Vol. VII, Issue 2, June 2014

ISSN 2277 – 8322

Removal of Salt and Pepper Noise from True Color Image Using Novel Technique

Rajat Dangi[1], Mr.Himanshu Joshi[2]

[1]Mtech Student, Deptt. of ECE, Jagannath University,Jaipur, India

[2]Assistant Professor, Deptt. of ECE, Jagannath University,Jaipur, India

E-mail : rajatdangi@gmail.com, himanshu.joshi@jagannathuniveristy.org

***Abstract* - Impulse noise removal is a mechanism for detection and removal of impulse noise from images. Median filters are preferred for removing impulse noise because of their simplicity and less computational complexity. In this paper, a novel technique is presented for removing salt and pepper noise from a true color image. This technique is based on simple trigonometrical formulas of general triangle so it is named as triangular analysis of true color image.**

***Keywords* – Noise removal, image, triangular analysis, impulse, image sensing**

I. INTRODUCTION

An image signal whose quality is being evaluated can be thought of a sum of an undistorted reference signal and an error signal [1]. Image noise removal plays a vital role in image processing as a pre-processing stage. The non-ideal imaging systems introduce potential degradations in digital images. Noise disturbances may also be caused by electronic imaging sensors, film granularity, and channel noise [2]. High levels of noise are always undesirable; hence noise removal has to be employed before the image could be used for further analysis [3-5]. Salt and pepper noise is an impulse type of noise, which is also referred to as intensity spikes [6]. This is caused generally due to dead pixels, analog-to-digital converter errors, errors in data transmission, malfunctioning of pixel elements in the camera sensors, faulty memory locations, or timing errors in the digitization process [7]. It has only two possible values, 'a' and 'b' [8]. The probability of each is typically less than 1 [9]. The corrupted pixels are set alternatively to the minimum or to the maximum intensity values, giving the image a "salt and pepper" like appearance. Unaffected pixels remain unchanged [10]. For an 8-bit image, the typical intensity value for pepper noise is 0 and for salt noise 255 [11].

In this paper, an experimental study on the state of the art impulse noise removal techniques mentioned above is presented. The rest of the paper is organized as follows. Section II describes the details about salt and pepper noise removal using a median filter. Section III tells about the novel technique and at last section IV indicates the simulation and results.

II. IMPULSE NOISE REMOVAL USING MEDIAN FILTER

The simple median filter replaces the center pixel of the window (Eg. 3X3.5X5 *etc.*) considered, by median of the window [12]. The center pixel is either '0' (Pepper) or '255' (Salt), it is replaced by median of the window which will be other than 0 or 255 [13]. The major drawback of standard median filter is that even if the pixel under consideration is uncorrupted (other than 0 or 255), it is replaced by the median of the window [14]. This will deteriorate the overall visual quality of the image. In addition, the simple median filter fails to preserve the edges. It works as follows. Window = {23, 32, 41, 255, 45, 52, 23, 32, 41}. The window sorted in ascending order = {23, 23, 32, 32, 41, 41, 45, 52, 255} [15]. Median is the mid value after sorting *i.e.*, 41. Hence the uncorrupted pixel is replaced by median of the window.

$$\text{Sample window} \quad \begin{bmatrix} 23 & 32 & 41 \\ 255 & (45) & 52 \\ 23 & 32 & 41 \end{bmatrix} \longrightarrow \begin{bmatrix} 23 & 32 & 41 \\ 255 & (41) & 52 \\ 23 & 32 & 41 \end{bmatrix} \quad \text{Output}$$

If the pixel under consideration is corrupted as shown below, the impulse noise will be removed following the same method [16].

$$\text{Sample window} \quad \begin{bmatrix} 23 & 32 & 41 \\ 255 & (255) & 52 \\ 23 & 32 & 41 \end{bmatrix} \longrightarrow \begin{bmatrix} 23 & 32 & 41 \\ 255 & (41) & 52 \\ 23 & 32 & 41 \end{bmatrix} \quad \text{Output}$$

III. TRIANGULAR ANALYSIS OF TRUE COLOR IMAGE

RGB format is a 3D matrix in which each pixel consists of three values of red, green and blue components. These values are used for triangular analysis of any true color image [17].

Concept: If the three RGB values of a pixel are considered as three sides of a triangle then for any random pixel of any true color image, the triangle formed satisfies the condition that sum of the angles of same triangle is 180°.

Consider the following figure,

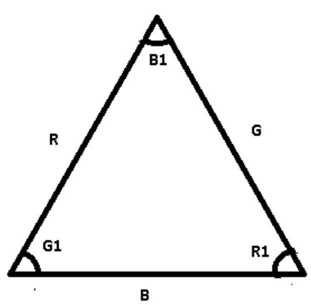

Fig. 1 A general triangle

In the figure, R, G and B are the values of red, green and blue component values of the pixel and R1, G1 and B1 are the respective angles formed by the same triangle.

Now we know that for any triangle ABC, of sides a, b and c and angles A, B and C, following formulas exists:

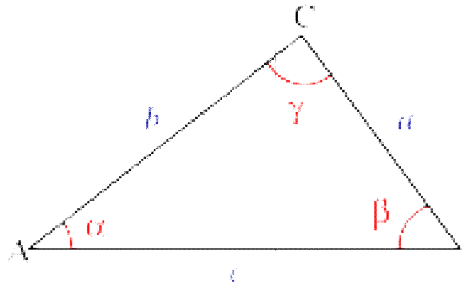

Fig. 2 Constructed Triangle containing the values R, G and B as its sides

$$c^2 = a^2 + b^2 - 2ab\cos\gamma$$
$$a^2 = b^2 + c^2 - 2bc\cos\alpha$$
$$b^2 = a^2 + c^2 - 2ac\cos\beta.$$

Replacing the values of a, b and c by R, G and B respectively we can obtain the values of α, β and γ

After calculating these angles, it was found that these angles satisfied the condition

$$\alpha + \beta + \gamma = 180^0 \qquad (1)$$

Now this condition can be used for removing the salt and pepper noise in the true color image.

The work done in this thesis work is explained as follows: Initially a true color image is considered and salt and pepper noise is added to one of the R, G or B matrix. The pixel which get affected by this noise fails to satisfy the condition (1) and so can be easily traced by 'if' condition and 'for' loop. And once the noisy pixel is detected, it is replaced by the original value just by using some interpolation technique or by using a median filter. Hence, once again the image is reconstructed.

IV. SIMULATION AND RESULTS

This technique was tested on the true color image 'wpeppers.jpg' freely available on MATLAB. Some salt and pepper noise is added to the image with m = 0.01. The simulation work was carried out in MATLAB 7.12 R2011a version. The program (m-file) does not contain the very hard commands of MATLAB but only utilizes the concepts of simple trigonometry and 'if' and 'for' statements. The results are as follows:

Fig.3 Original image

Fig.4 Corrupted image

Fig.5 Corrected image

The computation time was found to be 33.99 Seconds and PSNR value was obtained as 31.23 which is an optimized result.

V. CONCLUSION

This paper presented an experimental analysis of novel technique based impulse noise removal for true color images. Our experimental results show that computation time and PSNR value are much optimized as compared to other existing techniques. The other methods such as standard median filter, adaptive median filter, weighted median filter lack in preserving edges while retaining some noise components. However, these methods are suitable for impulse noise removal provided the noise density is low.

VI. REFERENCES

[1] Z. Wang, A. C. Bovik, H. R. Sheikh and E. P. Simoncelli, IEEE Transactions on Image Processing, vol. 13, no. 4, (2004).

[2] T. Chen and H. R. Wu, IEEE Signal Process. Lett., vol. 8, no. 1, (2001).

[3] E. JebamalarLeavline and S. Sutha, “Gaussian noise removal in gray scale images using fast Multiscale Directional Filter Banks”, Proceedings of International Conference on Recent Trends in Information Technology, Chennai, India, (2011) June 3-5.

[4] E. JebamalarLeavline, S. Sutha and D. Asir Antony Gnana Singh, International Journal of Computer Applications, vol. 33, no. 10, (2011).

[5] S. Sutha, E. JebamalarLeavline and D. Asir Antony Gnana Singh, European Journal of Scientific Research, vol. 86, no. 4, (2012).

[6] E. Jebamalar Leavline and D. Asir Antony Gnana Singh, International Journal of Imaging & Robotics, vol. 11, no. 3, (2013).

[7] H. Hwang and R. A. Haddad, IEEE Transactions on Image Processing, vol. 4, no. 4, (1995).

[8] Z. Wang, E. P. Simoncelli and A. C. Bovik, “Multi-Scale Structural Similarity for Image Quality Assessment”, Proceedings of the 37th IEEE Asilomar Conference on Signals, Systems and Computers, Pacific Grove, CA, (2003) November 9-12.

[9] T. Chen, K.-K.Ma and L.-H.Chen, IEEE Transactions on Image Processing, vol. 8, no. 12, (1999).

[10] S. Zhang and M. A. Karim, IEEE Signal Processing Letters, vol. 9, no. 11, (2002).

[11] T. Sun, M. Gabbouj and Y. Neuvo, "Multidimensional Systems and Signal Processing", vol. 6, no. 2, (1995).

[12] https://engineering.purdue.edu,/NonLinFilter.pdf

[13] Z. Wang and D. Zhang, IEEE Transactions on Circuits and Systems II, vol. 46, no. 1, (1999).

[14] P.-E. Ng and M. A. Kai-Kuang, IEEE Transactions on Image Processing, vol. 15, no. 6, (2006).

[15] D. R. K. Brownrigg, Communications of the ACM, vol. 27, no. 8, (1984).

[16] R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Pearson Prentice Hall Publication, (2008).

[17] J. Ko and Y. H. Lee, IEEE Trans. Circuits Syst., vol. 38, no. 9, (1991).