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De-Noising of Mango fruits using Mean Convolution Mass Filter (MCMF)

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Abstract*: *In this modern age transmission of visual information in the form of digital images are becoming a major method of communication. The noise is the result of errors in image acquisition process and they do not replicate the accurate intensities of the actual scene. This image can be utilized as an input for decision making. To produce high quality image it should be de-noised using suitable algorithm. There are various types of noises that degrades the image such as salt and pepper noise, Gaussian noise and Poisson noise, it is necessary to have knowledge about the noise present in the image. The paper proposed a new algorithm "Mean Convolution Mass Filter (MCMF)". This approach has been proved to have better PSNR value in de-noising the digital image when compared to the other existing algorithms.

Keywords: Data Mining, Image processing, MCMF, Noise Removal

I. INTRODUCTION

Fruits production is an important source of economic growth of a country. Advance prediction of disease occurrence in fruit will help to improve the yield percentage of fruits. Digital image has its application spread in the fields of monitoring the traffic, to enhance the geographic information system, to identify the handwritten information etc. Digital images can also be used in classification of diseases and its features in fruits. But the accuracy of these applications depends on the quality of the image. As image may contains various types of noise during its acquisition. Noise will reduce the contrast of the image and effects of unwanted occurrence such as damage to the edge details, unnecessary lines and it may create unclear intuition.

To improve the quality of the image the noise should be reduced. Quality of the image may be affected by different types of noise such as impulse noise, fractal noise, speckle noise and Gaussian noise. It is the challenging task for the researchers to remove the noise from the image without affecting the other image information. There are several methods available to reduce or remove the noise, but the idea of a de-noising algorithm is to preserve the edge and quality of the image. Hence this paper focuses on to remove the noises and preserving the edge information with a relatively higher PSNR values without blurring of image

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II. TYPES OF FILTERS

A. Mean Filter

Each pixel value in an image is replaced with the *mean* (average) value of its surroundings, including itself is the idea of mean filtering. Eliminating pixel values which are non-representative of their environment is the effect of mean filtering. Mean filtering is also known as a convolution filter. It is based around a kernel, who represents the size and shape of the neighborhood to be considered as a sample while calculating the Average.

B. Median Filter

Each pixel in the image has to depend on its nearby neighbors who decides whether or not this pixel is a representative of its surroundings by considering the median filter. It replaces it with the *median* of the neighbors considered, Instead of replacing the pixel value with the average of the neighbor pixel values this prefer a median value.

C. Gaussian Filter

Convolution operator is generally used to `blur' images and to remove detail and noises is the Gaussian smoothing operator in Gaussian filter. Here it is similar in working to the mean filter, but it has a different kernel which represents the shape of a bell-shaped Gaussian hump. The Gaussian distribution has the following notation

$$G(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{x^2}{2\sigma^2}}$$

D. Adaptive Filter

This filter performs only on the corrupted image due to noise. It depends on m x n window region. It uses two statistical measures that is mean and variance. It is better than other filter because it is good in the edges and the other high-frequency parts found on the image.

III. EXISTING METHODS

Cao, W., Wang, K., Han, G., Yao, J., & Cichocki, A (2018) [1] Proposed robust PCA approach for hyper spectral image restoration. To improve the robustness of this approach they introduced anisotropic spatial-spectral.

Then they combined Expectation-Maximization algorithm with alternative direction to produce optimized result.

Lalit Kumar, Jyoti, Mithlesh (2018) [4] developed an advanced median trimmed filter. It removed 90% of noise and also produce highest PSNR value than the other filter. By applying proper filter the salt and pepper noise removed. Various case has been studied using same and different images of the same and different format at various noise level from 30% to 70%. At the end, important parameters are calculated which determine how efficiently salt and pepper noise removed from original data. These parameters include PSNR, MSE, and IEF. PSNR and MSE are inversely proportional to each other and if the value of PSNR would be high then the image would be considered as best.

Chithra, P. L., and Henila (2017) [3] utilized middle channel to dispense with the commotion in apples. It separates the high force esteem pixels from lower power esteem pixels. It is choosing the estimation of focus pixel from the arrangement of qualities with in m x n adjacent reference pixel. This channels sorts all qualities inside a window, find the middle worth and reestablish the first pixel esteem with the middle worth. Sharma, S., Sharma, S., & Mehra, R(2013)[2] introduced "Modified Lucy Richardson algorithm" in the presence of Gaussian blur and motion blur. It removed Gaussian noise only and it produce better PSNR value than other methods and quality of the image is better when compared with other methods.

IV. PROPOSED METHODOLOGY

The proposed methodology consists of the following stages which involves Image Capture, Size Conversion, Colour Translation, Noise Removal and Image Enhancement. The Figure 1 shows the details of proposed method

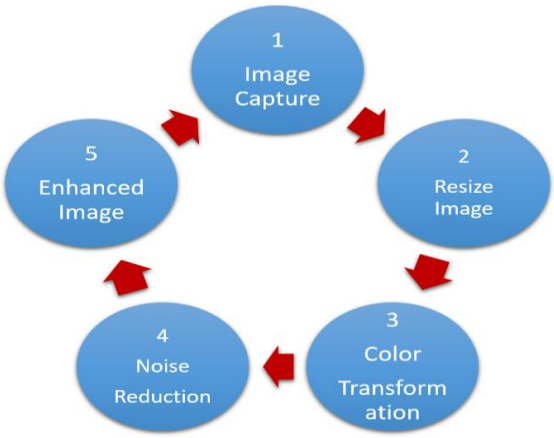

Figure 1 Proposed Method

The Mango fruit pictures are caught by High Resolution camera in RGB shading mode with 10 mega pixels with measurements 3120 x 4160, is considered as the input information. The information picture is resized into a dimension of 256 x 256. And now the resized picture is subjected to a color transformation into HSV shading space.

The proposed framework separate the Luma part (Y) that is dark picture. Salt and pepper commotion has included with the dim picture. This noisy image is given as input to the Mean Convolution Mass Filter (MCMF). The figure 2 demonstrates the computation of the proposed method.

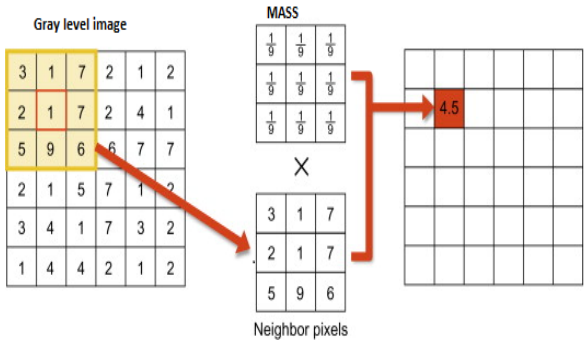

Figure 2 Computation of Proposed filter

This filter is computing adjacent pixels with set of mass which is predefined with a weight mask that is applicable for every pixels in the image. A pixel at location (a, b) in the image I using a mask K of size $M \times N$ is computed as:

$$I_{new}(a, b) = \sum s = X X \sum t = -Y Y \; K(s, t) \; I(a + s, b + t) \quad [1]$$

where I_{new} is the new image found after filtering. Assuming the domain as a two-dimensional image without any loss of generality, the mask K is symmetrical along a and b axis, and M and N are odd numbers, then $X = (M - 1) / 2$, and $Y = (N - 1) / 2$. Figure 2 shows the computation of proposed filter using a 3 × 3 mask as a sample. This filter is very fast and effective due to independent computation using predefined mass and the adjacent pixels alone are used for the calculation, leading to a higher spatial memory access requirements.

V. RESULTS AND DISCUSSIONS

To prove the performance of proposed filter is tested with five images. The proposed Mean Convolution Mass Filter (MCMF) removes noise and improve the quality of the image. It removes almost every noise found in the image. It preserves the edge information of the image and computation time is also minimized. Two metrics are used to measure the quality of image they are as PSNR (Peak Signal to Noise) and MSE (Mean Square Error). The comparison of this metrics of our proposed MCMF to the existing filters are visualized in the below table .The Figure 3 shows the original input image.

Figure 3 Original Input Image

The Figure 4 shows the color conversion by HSV model of input image. In this model Y-Luma part is gray scale image. This is separated from S part and V part. Then this gray image is used for further analysis.

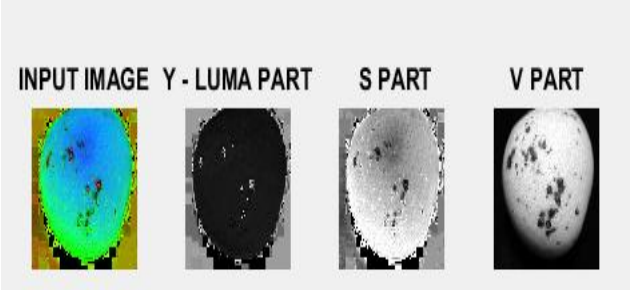

Figure 4. Color conversion using HSV

The figure 5 shows the result of de-noising of input image using MCMF. The proposed filter gives better result than other filters.

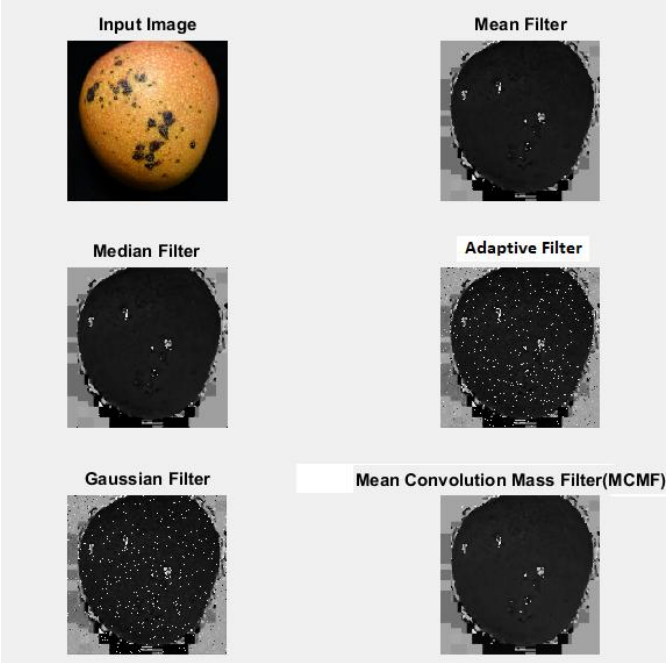

Figure 5. Image De-noising using various filters

The PSNR Value is calculated by using the equation (2).

$$PSNR = 20\log_{10}\frac{255}{RMSE} \qquad [2]$$

RMSE (Root Mean Square Error) is found with the square root of MSE.

$$MSE = \frac{1}{M*N}\sum_{J,K}(f(j,k) - g(j,k))^2$$

$$RMSE = \sqrt{MSE} \qquad [3]$$

Table-1: Comparison of PSNR Values

Image	Mean Filter	Median Filter	Gaussian Filter	Adaptive Filter	MCMF Filter
Mango1.jpg	85.637	74.123	55.715	60.523	**89.276**
Mango2.jpg	84.072	73.724	57.781	61.433	**87.124**
Mango3.jpg	85.228	73.524	58.423	61.453	**90.278**
Mango4.jpg	85.431	73.282	57.378	61.342	**93.682**
Mango5.jpg	84.128	74.421	54.043	61.532	**85.104**

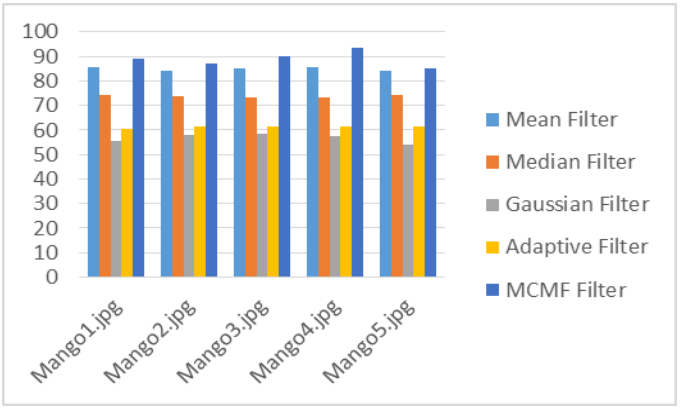

Figure 6. Comparison of PSNR Values

Table 1 and Figure 6 shows the result comparison of PSNR values of filters: Mean, Median, Gaussian, and Adaptive filter with proposed method (MCMF). For the mango1.jpg the PSNR value of proposed filter is 89.276 and among the other fruits considered MCMF gave highest PSNR value of 93.682 for mango4.jpg.

Table 2 and Figure 7 shows the comparison of MSE values of Mean, Median, Gaussian, and Adaptive filter with proposed method. Proposed filter acquired a minimum error value than other existing method.

Table-2: Comparison of MSE Values

Image	Mean Filter	Median Filter	Gaussian Filter	Adaptive Filter	MCMF Filter
Mango1.jpg	0.022	0.022	0.210	0.312	**0.0001**
Mango2.jpg	0.021	0.022	0.119	0.231	**0.0001**
Mango3.jpg	0.023	0.022	0.294	0.123	**0.0001**
Mango4.jpg	0.023	0.032	0.219	0.213	**0.0000**
Mango5.jpg	0.023	0.023	0.259	0.321	**0.0002**

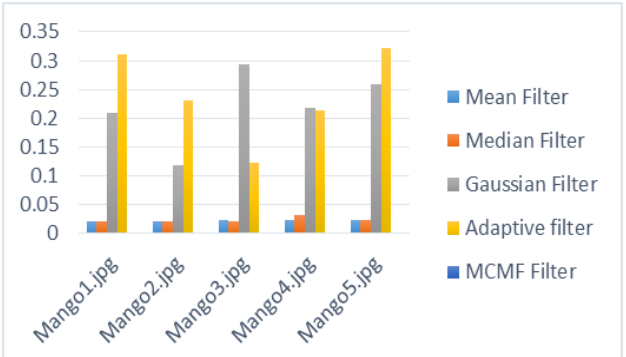

Figure 7. Comparison of MSE Values

VI. CONCLUSION

This research proposed a new filter "Mean Convolution Mass Filter" (MCMF) and it is compared with the other existing filter. In this research various types of filters used in various researches are discussed and reviewed. The proposed filter preserves the edges information and doesn't blur the image. The Experimental result shows high PSNR such as 93%. It signifies proposed filter improved the quality of mango images than the other filters such as Mean, Gaussian, Median and Adaptive Filters. It gives low value of MSE (0.0001) than the rest of the filters considered. It indicates the better enrichment of images than other existing methods.

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AUTHORS PROFILE

Dr. M.. Renuka Devi , has nearly 18 years of post-graduate teaching experience in Computer Science. She has indulged in training the post graduate students to complete real time projects and also guides research scholars in Computer Science. She has published 45 papers in various international journals and she has acted as chairperson in various international conferences. Currently she is working as Professor and Head, Department of BCA, Sri Krishna Arts & Science Coimbatore (Dt), Tamil Nadu, India.

Ms. Archana Tamizharasan has 13 years of teaching experience. She is currently pursuing her Ph.D. under the guide ship of Dr. M. Renuka Devi. Her research interest are Data mining, Image processing and Computer vision. She is currently working as Assistant professor in School of Computer science and Engineering, Vellore Institute of Technology (Deemed University), Vellore.