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A Novel Method of Noise Removal from Digital Images

Rajib Barui[1], Supratim Chakraborty[2], Moumita Roy[2], Chaitali Chatterjee[2], Shreya Sinha[2], Shikha Sinha[2], Judhajit Sanyal[3]

Assistant Professor, Department of Applied Electronics and Instrumentation Engineering,

Techno International New Town, Kolkata, India[1]

Student, Department of Electronics and Communication Engineering, Techno International New Town, Kolkata, India[2]

Assistant Professor, Department of Electronics and Communication Engineering,

Techno International New Town, Kolkata, India [3]

Abstract: Among the many applications of image processing, which are being investigated extensively by researchers at present, noise removal from digital images is one of the most interesting. The criticality of noise removal from digital images has increased in recent years with the advent of modern high-speed communication networks. Multimedia processing has emerged as a major thrust area due to the availability of high bandwidth for users. The current paper proposes an effective novel method for de-noising digital images. Types of noise commonly affecting digital images, and standard techniques used to de-noise digital images are discussed in brief, before demonstrating the superiority of the proposed median filtering method. The method is found to be more effective than many of the standard methods available.

Keywords: Image Processing, Digital Images, De-Noising, Median Filtering

I. INTRODUCTION

The contamination of digital images with noise is a significant problem in the modern context, due to focus on enhancement of multimedia content accessible by users. Image noise can be defined as the random variation of brightness or colour information in images produced by the sensors and circuitry of a scanner or digital camera. Different types of noise can affect digital images. Of the many types, the focus of the present work is on salt-and-pepper noise and speckle noise. The proposed scheme seeks to minimize these two types of noise, since they are two of the hardest types of noise to remove from an image, when present in a conjugate manner.
The paper is arranged in the following manner. Section II presents a survey on the different types of noise removal algorithms inclusive of the proposed scheme. Section III shows the simulation results and presents discussions on the results obtained. Section IV concludes the paper.

II. LITERATURE SURVEY

The removal of noise from multimedia content has remained a relevant problem, which has gained in importance in recent years due to the proliferation in available multimedia content [1]. As a result, many researchers have worked on finding pixel modification-based solutions to enable the removal of noise from digital content [2]. Some researchers have worked on modification of noisy pixels for improving the quality of noisy digital images [3].

Among the various noise mitigation techniques explored, edge detection based methods have been preferred by many researchers for their relative simplicity and effectiveness. Multiple groups of researchers have extensively surveyed the major edge detection techniques commonly used by researchers [4] [5] [6]. The comparative performance analysis of edge detection algorithms has been conducted in recent times in [7]. Among edge-detection algorithms, the Canny filtering technique has been proved to be effective in terms of requiring lesser amount of data as well as preserving edge features with low susceptibility to noise corruption [8]. Canny filters have been observed to outperform Sobel and Roberts filters in terms of noise performance and edge detection capabilities [9]. Other algorithms have also been proposed in recent years for performing efficient edge detection for digital images [10]. Investigative studies on the mathematical nature of standard edge detection algorithms have also been conducted in recent times [11].

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An alternative to edge detection based denoising is the application of a histogram-based technique for noise removal. Median filtering techniques have also proved to be effective in recent times, however their noise handling capabilities are limited in comparison to histogram-based schemes [12]. Consequently, the paper outlines a histogram-based method for denoising of digital images. The proposed method is able to handle both low and high frequency noise to an appreciable degree.

III. PROPOSED SCHEME AND RESULTS

For noise mitigation of colour images, many types of schemes exist. For measuring the success of the different schemes, colour maps are often used, as illustrated in Figure 1 below.

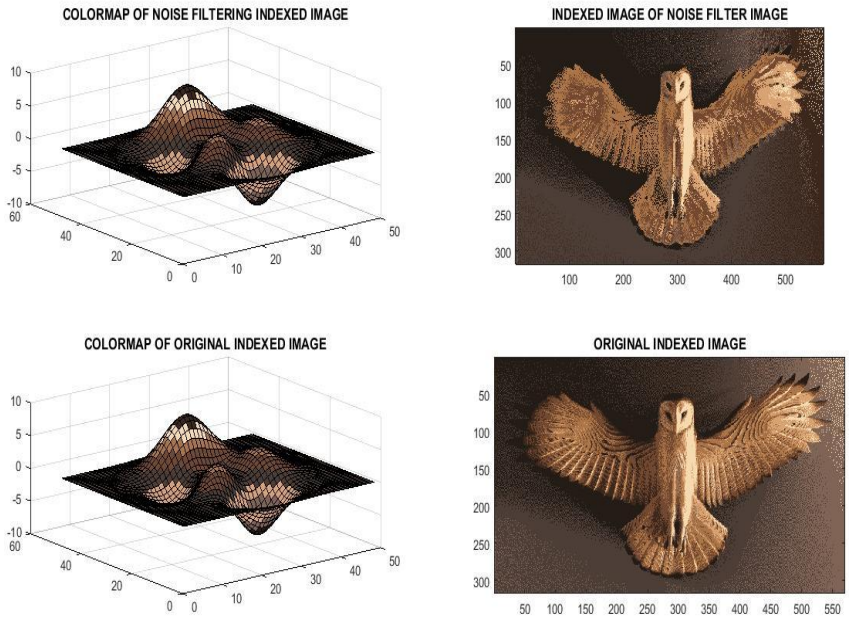

Fig. 1 Colourmap of original and noise filtered images

Initially, for the image selected, Canny edge detection and median filtering and applied in Figure 2 below.

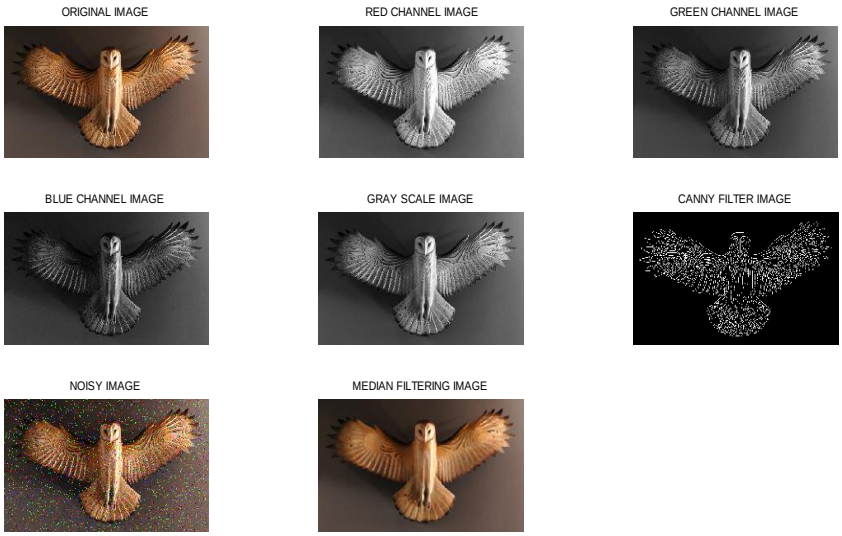

Fig. 2 Original and Canny/median filtered images

Histogram basically gives an accurate representation of the distribution of numerical data; hence accuracy of the technique is greater than the previous techniques, for colour images. The corresponding algorithm is outlined in Figure 3 below.

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Algorithm:

Step 1: Take a RGB/ true color image from any computer or select a file path to scan an image from the computer.

Step 2: Then from this RGB image, Red, Green and Blue color component is extracted.

Step 3: The RGB image is then converted to a grayscale image by using MATLAB function 'rgb2gray'.

Step 4: Then apply 'canny' filter for edge detection on the RGB image.

Step 5: After that apply a 'imnoise' function to add the noise to the original RGB image.

Step 6: To remove the noise, a filter is used to the noisy image.

Step 7: The RGB image is converted into Indexed image using dither which creates an indexed image approximation of the RGB image in the array RGB by dithering the colors in the colormap map.

Step 8: Then the Noise Filtered image is converted into Indexed image using 'dithering' as previous.

Step 9: Then we get the colormap for both Index images.

Step 10: Then comparing both the maps we calculate the visual differences of the images.

Step 11: Original picture and denoised picture shown together in a figure

Step 12: Histograms of both images are evaluated by MATLAB code.

Step 13: Absolute value of difference between matrix elements of corresponding histograms and saved.

Step 14: Using different value from 1 to 256 Histogram deviation is calculated which gives the difference between two images.

Step 15: Histogram deviation is used to recalculate the output image pixel values.

Fig. 3 Algorithm combining Canny and histogram based filtering

The output achieved for the histogram-based technique is illustrated in the following Figure 4.

Fig. 4 Original and Histogram filtered images

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The histogram-based filtering returns an image which is only 2.25% dissimilar to the original image. Therefore, it is seen that the histogram-based filtering technique is quite effective in denoising images corrupted with both high and low frequency noise.

IV. CONCLUSION

The present paper has outlined a histogram-based filtering technique for denoising of digital images. The technique is shown to be quite effective. In future, the technique can be modified by combination with any state-of-the-art machine learning technique, such as Convolutional Neural Network or Support Vector Machine algorithms.

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