A NEW METHODOLOGY FOR SP NOISE REMOVAL IN DIGITAL IMAGE PROCESSING

Upma Bansal¹
1Assistant Professor, Dept. of CSE, Chandigarh University, Punjab, India
Rekha Saini²
2Assistant Professor, Dept. of CSE, Chandigarh University, Punjab, India
Ashish Verma³
3Assistant Professor, Dept. of CSE/IT, SSIET, PTU, India

ABSTRACT

The paper purposes the removal of noise in digital gray scale images that often observed in scanned documents. Generally, Data i.e. picture, text can be contaminated by an additive noise during the process of scanning. This methodology prevents this type of noise known as Salt and Pepper noise (SP Noise) which causes white and black spots on the original image. We are designing a new algorithm for removal of these white and black spots after the knowledge of Median Filter, Adaptive Filter and the new proposed algorithm will definitely protect the image from noise and distortion. Firstly, Adaptive Histogram Equalization is done on the original image. Secondly apply Adaptive contrast Enhancement Technique on the resultant image. After Contrast Enhancement we apply filters Such as Homomorphic filtering. These filters are applied sequentially on distorted images for removing the image.

KEYWORDS

Salt and Pepper, filter, adaptive, image, noise.

1. INTRODUCTION

An image is an artifact that represents visual observation. It may be captured by optical means like cameras, lenses, telescopes, microscopes etc. Often the raw image is not openly suitable for this purpose, it always needs some processing. Such a processing on image is called image enhancement; processing by an observer to extort information is called image analysis. Enhancement and analysis are well-known by their output and by the challenges faced and methods exercised. Image enhancement has been done by various methods i.e. chemical, optical and electronic means [12].

A digital image is a mathematical representation of a two-dimensional image. Digital images are composed of pixels i.e. picture element. Each pixel represents the gray level for black and white photos at a single point in the image, so a pixel can be represented by a tiny dot of a fussy color. By calculating the color of an image at a large number of points, we can generate a digital approximation of the image from which a copy of the original can be recreated. Pixels are a slight like grain particles in a conventional photographic image, which can be arranged in a regular pattern of rows and columns and store information differently to some extent. A digital image is a rectangular arrangement of pixels sometimes called a bitmap.

Priyanka Kamboj and Versha Rani [1] have studied various noise model and filtering techniques. In image processing, noise reduction and image restoration is expected to improve the qualitative inspection of an image and the performance criteria of quantitative image analysis techniques.
Digital image is inclined to a variety of noise which affects the eminence of image. The purpose of image denoising is to restore the detail of original image to the great extent. The criterion of the noise removal problem depends on the type of noise by which is corrupting the image. Different methods for reduction of noise and image enhancement have been considered.

Raymond H. Chan, Chung-Wa Ho, and Mila [2] put forward a two-phase scheme for removing salt and pepper noise. In the foremost phase, an adaptive median filter is used which identify pixels that are likely to be infected by noise. In the successive phase, the image is restored using a specialized regularization method that applies only to those selected noise candidates. In terms of edge perpetuation and noise suppression, their restored images represent a significant enhancement compared to those restored by using just nonlinear filters or regularization methods only. Strategy can remove salt-and-pepper-noise with a noise level as high as 90%.

M. S. Nair, K. Revathy, and Rao Tatavarti [3] evinced an improved decision-based algorithm for the restoration of gray-scale and color images that are highly corrupted by Salt and Pepper noise which efficiently removes the salt and pepper noise by preserving all details. The algorithm utilizes formerly processed neighboring pixel values to get better image quality than the one utilizing only the just previously applied pixel value. The projected algorithm is faster and also produces better result than a Standard Median Filter (SMF). The advantage of the proposed algorithm lies in removing only the noisy pixel either by the median value or by the mean of the previously processed neighboring pixel values.

B. Singh, Ravinder Singh, Harmandeep Singh [4] proposed that removal of high density salt and pepper noise in noisy color images using projected median filter. The presentation of improved median filter is good at lower noise density level. The mean filter prevents little noise and gets the worst results. The enhanced median filter is good at lower noise density levels. It suppresses most of the noises effectively while preserving colored image details. The performance of the algorithm is analyzed in terms of Peak signal to noise ratio (PSNR), Mean square error (MSE), Image Enhancement Factor (IEF).

W. Luo [5] suggested that images are often corrupted by noise known as salt and pepper noise. This noise can corrupt the images and the corrupted pixel takes either maximum or minimum gray level. Along with these standard median filters has been established as reliable method to remove the salt and pepper noise without harming the edge features. Though, the major problem of standard Median Filter (MF) is that the filter is effective only at low noise densities.

2. PROPOSED ALGORITHM

The Sequence of algorithms used as follows:-

1. Firstly Adaptive Histogram Equalization Technique is performed on the input image to improve contrast in image.
2. After this, Adaptive Contrast Enhancement is applied to improve the quality of the image.
3. Contrast Stretching is done to improve the contrast in an image by stretching the range of intensity values it contains to span a desired range of values.
4. After Contrast Stretching, Homomorphic filtering is used for image enhancement. Usually it normalizes the brightness across an image and improve contrast. So, homomorphic filtering is used to remove noise.
5. Finally, we get the output noise free image.
The following strategy is used to get the desired results.

![Methodology for salt & pepper noise removal](image)

### 3. Parameters Used

The different parameters which are used to check the performance are as follows:

1. **Mean Square Error (MSE)** is the ratio of the square of difference between the input and output image to the size of the image.

   \[ MSE = \frac{1}{MN} \sum_{i=1}^{M} \sum_{j=1}^{N} (f_1(i, j) - f_2(i, j))^2 \]  
   \[ (1) \]

   Here \( f_1, f_2 \) are the input and output images respectively. \( M \) and \( N \) are the sizes of the images.

2. **Peak Signal to Noise ratio (PSNR)** is the logarithmic value of the ratio of size of the image and the mean square error of the image.

   \[ PSNR = 10 \log_{10} \left( \frac{255^2}{MSE} \right) \]  
   \[ (2) \]

   Peak Signal to Noise Ratio should be as large as possible which means that the content of signal in the output is large and the noise is less.

3. **Signal to noise ratio (SNR)** should be as large as possible which means that the content of signal in the output is large and the noise is less.

   \[ SNR = \frac{S_A - S_B}{\sigma_0} \]  
   \[ (3) \]

   \( S_A \) is the mean intensity value of the image and the background respectively. \( \sigma_0 \) is standard deviation of the image.
4. COMPARATIVE ANALYSIS BASED ON OBJECTIVE PARAMETERS

The Following table shows the comparative analysis of proposed techniques with previous techniques of salt and pepper noise removal using PSNR, MSE and SNR.

TABLE 1: Comparison Based on Mean Square Error Parameter for Figures.

<table>
<thead>
<tr>
<th>Technique</th>
<th>Proposed</th>
<th>Technique1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fig. 2</td>
<td>0.0021</td>
<td>603</td>
</tr>
<tr>
<td>Fig. 2</td>
<td>0.0024</td>
<td>608</td>
</tr>
<tr>
<td>Fig. 2</td>
<td>0.0017</td>
<td>605</td>
</tr>
</tbody>
</table>

TABLE 2: Comparison Based on Peak Signal to Noise Ratio Parameter for Figures.

<table>
<thead>
<tr>
<th>Technique</th>
<th>Proposed</th>
<th>Technique1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fig. 3</td>
<td>18.433</td>
<td>14.8526</td>
</tr>
<tr>
<td>Fig. 3</td>
<td>22.713</td>
<td>14.322</td>
</tr>
<tr>
<td>Fig. 3</td>
<td>20.344</td>
<td>15.855</td>
</tr>
</tbody>
</table>
TABLE 3: Comparison Based on Signal to Noise Ratio Parameter for Figures

<table>
<thead>
<tr>
<th>Technique</th>
<th>Proposed</th>
<th>Technique1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fig. 4</td>
<td>31.5275</td>
<td>17.4797</td>
</tr>
<tr>
<td>Fig. 4</td>
<td>32.6164</td>
<td>9.4315</td>
</tr>
<tr>
<td>Fig. 4</td>
<td>16.8741</td>
<td>10.4024</td>
</tr>
</tbody>
</table>

5. COMPARATIVE ANALYSIS BASED ON SUBJECTIVE PARAMETERS

The Following Table shows Comparisons Based on Subjective Parameters:-

Technique-1 is SP Noise Removal using Homomorphic Filtering.

Proposed Technique is the combination of Median Filtering and Homomorphic Filtering using Adaptive Histogram Equalizations.
6. CONCLUSIONS

In this paper, a recent adaptive noise reduction scheme for removing salt and pepper noise is proposed which categorizes impulse noise and will remove the noise from the corrupted image that is followed by image enhancement scheme to retain the details and image quality. As per the new results, the future algorithm yields good filtering result. This is recorded by numerical measurements like PSNR and visual observations through the experiments performed. So, we recommend an algorithm for eliminate salt and pepper noise removal. The suggested method is actually an adaptive median filter. The benefits of this proposed method are the fuzzy initialization of filtering window size and the precision of median value. Comprehensive method results expose that our filter consistently outperforms the existing filters by attaining much higher PSNR across a wide range of noise densities, from 10% to 90%.

The purpose of such method is mainly due to highly accurate noise detection experienced by the noise detection algorithm having high noise detection ratio and our method performs more desirable than the median filter and other conventional edge preserving method. The PSNR, SNR is high; MSE is low. This advised method is a fast method for removing salt and pepper noise.

REFERENCES