WJCMS

Wasit Journal of Computer and Mathematics Science

Journal Homepage: https://wjcm.uowasit.edu.iq/index.php/WJCM

e-ISSN: 2788-5879 p-ISSN: 2788-5879

Optimized the Performance of Super Resolution Images by Salt and pepper Noise Removal based on a Modified Trimmed Median Filter

Muthmainnah[1,*] and Luís Miguel Cardoso[2]

[1]Al Asyariah Mandar University Polewali Mandar Jl. Budi Utomo No. 2 Manding Kecamatan Polewali Kabupaten Polewali Mandar,Indonesia
[2]Polytechnic Institute of Portalegre and Centre for Comparative Studies University of Lisbon, Portugal Indonesia

*Corresponding Author: Muthmainnah

DOI: https:// doi.org/10.31185/wjcms.191
Received: June 2023; Accepted: September 2023; Available online: September 2023

ABSTRACT: Image processing is an interesting area where noisy images can be restored from salt and pepper noise. Various filtering algorithms can be used in the restoration process. Pixels in the original image should not be affected by the restoration process. Despite changes in dimensions and image format, the problem of the existing work persists. A hybrid technique used Ant colony Optimization to remove high-density salt and pepper noise from images. This hybrid technique would remove salt and pepper noise in corrupted images. Ant Colony Optimization (ACO) identifies and selects noisy pixels from corrupted images. It eliminates salt and pepper noise (SP Noise), which causes black and white spots in the original image. All the processes are explained to prove the theory, and the simulation results are presented.

1. INTRODUCTION

It is mathematically possible to represent a digital image in two dimensions. Pixels, or picture components, are the building blocks of digital images. A speck of particular shading can be associated with a pixel in highly contrasted photographs because every pixel represents the dark level. A duplicate of a photograph can be created by computing the shade of the image at a significant number of focuses. An ordinary photographic image is composed of grains of grain, which are organized in the form of lines and sections, storing data in an opposite way in some respects. In computerized images, pixels are arranged in rectangles, called bitmaps.

A qualitative image investigation system can be enhanced by analyzing the different methods for preparing images, reducing commotion, and rebuilding images used for clamour displays and separation procedures [1, 2]. An image processing problem is optimizing, compressing, resizing, and restoring images [3]. These factors cause disturbances to the image environment. The image quality can be improved by using various filters, allowing for finality, clarity, and fast image movement through the filters. As part of my image enhancement work, I used a hybrid filter to remove the upcoming noise using trimmed average, minimum-maximum, median, inverse, adaptive, wiener, and median filters. An image remains dense, bright, and intense.

In recent years, the image sensor industry has experienced a dynamic price change and developed new technologies that have made cameras almost universally available. Due to this change, image processing will be improved to produce higher-quality images. Image and video processing textbooks lack any mention of super-resolution [1], [4–8].

All image processing uses require image improvement to be conducted before they can be used. Different techniques, for example, Median channel, α-trimmed mean channel, and so forth, have been proposed. It was demonstrated that the α-trimmed mean channel changes middle and mean channels. Then again, channels have indicated magnificent execution in stifling commotion. Regardless of their effortlessness, they accomplish great results. A new channel based on trimmed means is discussed in our paper. Based on the exploratory results, this new strategy appears to provide better results than past strategies [3].

[9] According to experimental results, salt-and-pepper clamour can be successfully channeled using the proposed technique. Calculating the clamour reduction of advanced images can be difficult, and no singular tool is available. In other words, the factual amount measures used to determine how much commotion is reduced in images are the signal-to-noise ratio (PSNR) and the Root Mean Square Error (RMSE) [10]. This channel contrasts with a Wiener separating system when executing images spoiled by various clamour levels. [11] learning algorithm based on supervised learning is the neural network. [2] During image de-noising, different separating strategies are applied; however, there is no consistency in commotion evacuations and edge protections. Defining an exchange between the opposing perspectives is necessary to de-noise this disagreement. Another strategy is proposed in this paper to remove commotion and protect edges. This paper proposes another approach that uses choice tree structure to replace the loud pixel in a given window. Based on its negative determination-based calculation, the proposed system supplants the rebellious pixel with the best reasonable option. According to the close investigation, the proposed method is superior to the available methods.

2. LITERATURE REVIEW

A blocky effect occurs when a sensor with fewer detector elements produces an image. Photographing a scene results in aliasing because resolution cameras use a low spatial sampling frequency. Increased density enables smaller photodetector elements, resulting in higher sampling rates. When pixels become smaller and less light is incident on them, the quality of the image degrades. A higher pixel density results in a higher resolution. But it also causes noise in the shots. Currently, this is the highest level of technology for image sensors. Increasing the wafer size also increases the capacitance, which increases resolution. The charge transfer rate decreases as capacitance increases, so this method is ineffective. A point light source will have a blurred image due to this limitation. A low-resolution sensor with a low sampling rate also results in distortions due to aliasing. Satellite imagery, for example, has physical constraints that make a high-resolution sensor unreachable. Enhanced resolution must be achieved through post-acquisition signal processing, and low-resolution images must be processed post-acquisition. Besides being flexible, they are also cost-effective. It does not involve any additional hardware costs. However, the user may be burdened with the increased computational costs.

Clearing image noise is most commonly accomplished using a median filter. This paper removes image noise caused by sales and pepper with an improved median filter algorithm. The number of pixels marked as signals is avoided by creating a noise-marked matrix based on salt and pepper noise characteristics. Having marked the pixel's sign as not treated, the neighbourhood noise is analyzed to determine the window size of the pixel-weighted mean filter, and the local histogram is based on the weighted mean filter. In Matlab experiments, improved median filters reduce noise while maintaining image edges better than median filters and can thus reduce the time required to clear image noise. A new method of enhancing images with means that have been α-trimmed is presented [12]. Almost all applications of Image Processing require image enhancement as a pre-processing step. Some methods have been proposed, such as the mean-trimmed and median filters. This study showed that the α-trimmed mean filter modifies median and mean filters.

In contrast, noise is effectively suppressed by filters. It is surprising how well they perform despite their simplicity. As a result of this study, we propose a new filter based on mean-trimmed data.

3. PROPOSED METHOD

With this filter, noisy pixels from a 3x3 window size are rejected. P_{ij} (if $P_{ij} = 0$ is greater than 255, then P') is corrupted. A pixel placed in a window containing all $O's$ & $255's$ is changed by its nasty element if it contains all $O's$ & $255's$. If the selected window does not contain all pixel elements, the median value is swapped with the median value. The entire image is processed in this manner.

An Advanced Modified Decision Unsymmetrical Trimmed Median Filter is implemented first to detect noise in corrupted images. Noisy or noise-free pixels are verified as part of the processing. Noise-free pixels have processing pixel values ranging from 'l' to '254'. If a noisy pixel has a value of 0 or 255, it is processed by the proposed method. This method involves the following algorithmic steps.

ALGORITHM

- Image 1. Insert this in the image's first row and column 1. Image 2. Insert this into the image's last row and column 2.
- A window with a size of 3 x 3 would contain the Processing pixel. P_{ij}.

- An uncorrupted pixel whose processing cost deceits among 0< p') <255 the two boundaries is left unprocessed.
- A corrupted pixel is P,) = $O's$ and $255's$, then P') is a corrupted pixel. Pixels can be processed in the following ways:
- If the selected window contains all the elements, the mean of these elements is replaced $O's$ and $255's$, then P'.
- **Case ii):** Using the remaining elements, find the median value, eliminate $O's$ or $255's$ after the certain window, sort in ascending order, and eliminate any elements with $O's$ and $255's$. The median value should be substituted. P_{ij}.
- Process all pixels in the image by recapping ladders 2 finished 4.
- Replication ladders 2 to 5.
- In step 1, remove the additional rows and columns $O's$ that were inserted.

4. PERFORMANCE PARAMETER

Based on the table, we can see that the image has been executed. For clamour removal, the topical channel is most effective.

$$PSNR\ in\ dB = 10log_{10}\left(\frac{255^2}{MSE}\right) \tag{1}$$

$$MSE = \frac{\sum_i \sum_j \left(\gamma(i,j) - \gamma(i.j)^2\right)}{M \times N} \tag{2}$$

5. SIMULATION RESULTS

Several visual assessment tasks have demonstrated the power of colour descriptors. A texture measurement may also be required when surfaces are irregularly coloured or unusually shaped. Combining colour and texture in many applications can achieve a good performance. Size, shape, colour, and texture have all been considered. Following the simulation, we use nonlocal mean filters to remove salt and pepper noise using super-resolution, registration, restoration, and transformation techniques. To convert the second image to a reference coordinate system, we will use the first image as a reference picture. The image quality is enhanced by applying a modified decision-based trimmed median filter. Originally, RGB-formatted images were used for input or original images. The process of acquiring images is the beginning of image processing. Digital images can only be acquired with these two elements.


(a) (b)

FIGURE 1. **Original Images (a) Lena and (b) Collage**

Convert RGB image or colour map to greyscale. Grayscale is achieved by eliminating hue, saturation, and luminance information from the RGB image while maintaining luminance information. Uint8, Uint16, double, or single can be used as input for an RGB image. Images input and output I are of the same class. Double-class colour maps are input and output if the input is a colour map. Using discrete wavelet transforms and fusion algorithms, we obtain the final super-resolution image. A blurred and dark image is input here, which is removed to get the original and high-resolution image in pixels.

Taking the control points from both images and applying Projective Transformation to them, we get the following image: a basic super-resolution model is interpolated to generate this image.

FIGURE 2. **Image restorations by the blurred image**

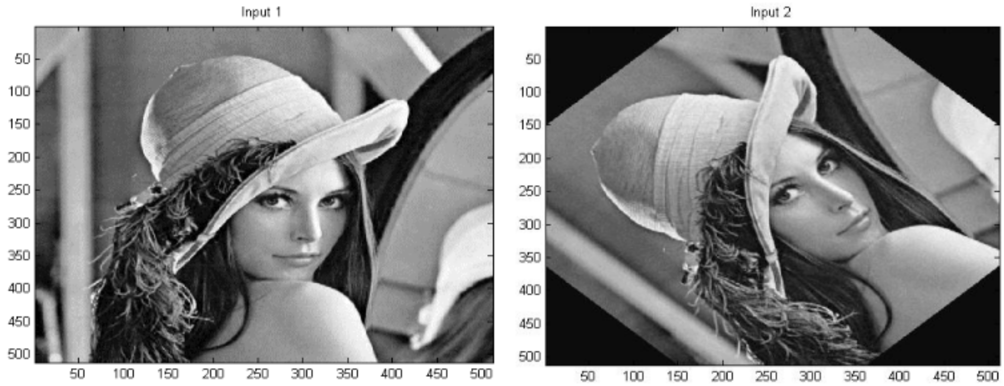

FIGURE 3. **Lena's input image and interpolation image**

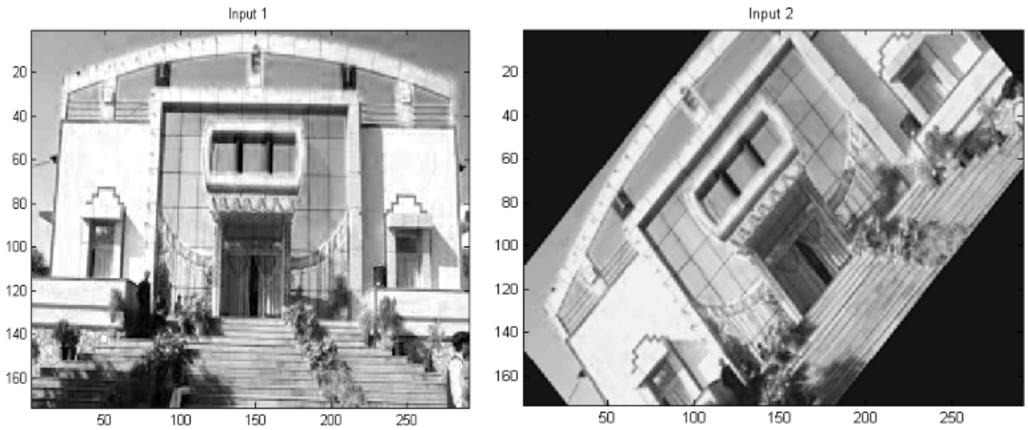

FIGURE 4. **College input image and interpolation image**

As a result, the ordered array would be organized from low to high; the summed data should be sorted from high to low. Moving average filters, however, suppress white Gaussian noise more efficiently than median filters, which reduce the standard deviation by dropping data values. Moving average filters preserve edges better and reject impulses less effectively. Multidimensional array A is created with the trimmed average filters, and multidimensional filter H. Numeric arrays of any class and dimension can be logical or non-sparse. As a result, there is no difference in the size or class of B and A.

Double-precision floating point is used to compute each output element, B. The output elements over the range of A, whether integer or logical array, are truncated, and fractionals are rounded. In this example, we have used modified trimmed filters in grayscale images to remove noise with lossless mode; as a final step, we padded the image with salt & pepper noise. The noise components salt and pepper were applied after several iterations. This stage involves applying trimmed median filters based on modified decision-based techniques. The output is obtained by removing the noise from the image using this filter. Once the padding has been removed, call another Matlab function to degree the excellence output and the act limits again.

FIGURE 5. **Lena Image noise removal**

This process aims to determine which images are more effective at removing noise after calculating their performance and comparing them. Noise detection algorithms with high noise detection ratios enable such a method because they offer highly accurate noise detection. Compared to other conventional edge-preserving methods, our method performs better than the median filter. It has a high PSNR and SNR, while its mean squared error is low and a low MSE. Salt and pepper noise can be quickly removed with this method. Taking the difference between what the estimator estimates and what the estimator estimates and averaging the squares, the MSE is calculated. As the squared error or quadratic loss is expected, MSE is a threat function.

It measures how mutilating noise affects the representation of a sign and how extreme its estimation is. PSNR is generally expressed on a logarithmic decibel scale due to the wide element range of numerous signs. A computerized image's visual nature can be improved or enhanced subjectively. The quality of an image may differ from person to person, depending on the strategy used. The quality of images should be measured quantitatively/observationally based on the impact of image upgrade calculations.

Different image upgrade calculations can be compared deliberately using the same arrangement of test images to determine if a specific calculation produces better results. The signal-to-noise ratio is the metric being examined. It will be more accurate to conclude that a control or set of controls can strengthen the first picture by making a corrupted known picture more similar. In the table, the topical channel for clamour removal is shown to be the best channel for the complete execution of the image.

Table 1. **Performance Table**

S.No	PSNR	IEF	Image Format
1	16.4012	2.9750	Lena.jpg
2	20.3560	4.9754	College.jpg
3	20.0499	4.6663	College.png
4	20.3061	4.8159	College.bmp
5	20.4560	4.7459	College.gif

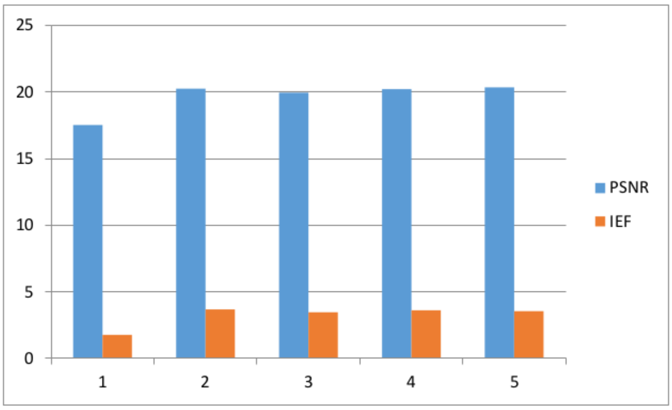

FIGURE 6. **1=lena.jpg; 2=college.jpg; 3=college.png; 4=college.bmp; 5=college;**

Now, we will show a comparison table of PSNR, IEF and MSE as we increased noise in an image and their images to how much extent we can remove them.

Table 2. Performance Table for Lena Image

S. No	Noise in %	PSNR IN DB	MSE	IEF
1	10	17.7245	0.0169	1.8574
2	20	14.7819	0.0333	1.8620
3	30	12.9347	0.0509	1.8244
4	40	11.3800	0.0728	1.7274
5	50	10.0516	0.0988	1.5821
6	60	8.7243	0.1341	1.3980
7	70	7.4614	0.1794	1.2228
8	80	6.3235	0.2332	1.0741
9	90	5.4074	0.2879	0.9790

In the table, the topical channel for clamour removal is the best channel for complete execution of the image. To extract useful information from these images, we first add 10% noise to the first image, then increase the noise to 90%, and then extract these images. As part of our desertion, we eliminate salt and pepper noises.

FIGURE 7. **Original Image**

FIGURE 8. **Lean Image with 30% Noise (left) and recovered with 30% noise (right)**

FIGURE 9. **Lean Image with 30% Noise (left) and recovered with 30% noise (right).**

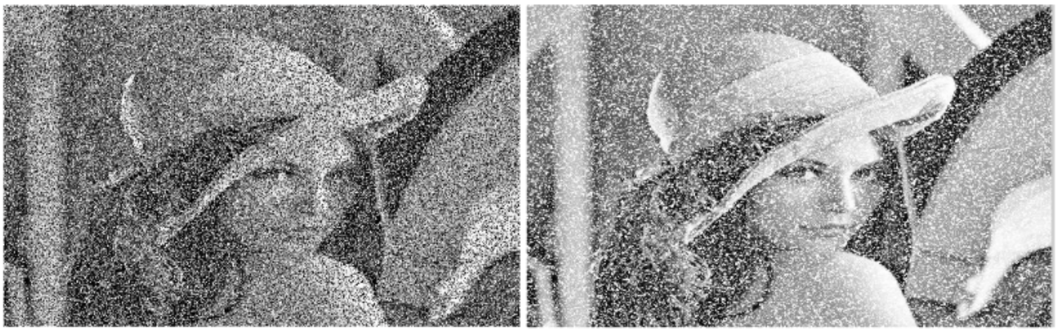

FIGURE 10. **Lean Image with 50% Noise (left) and recovered with 50% noise (right).**

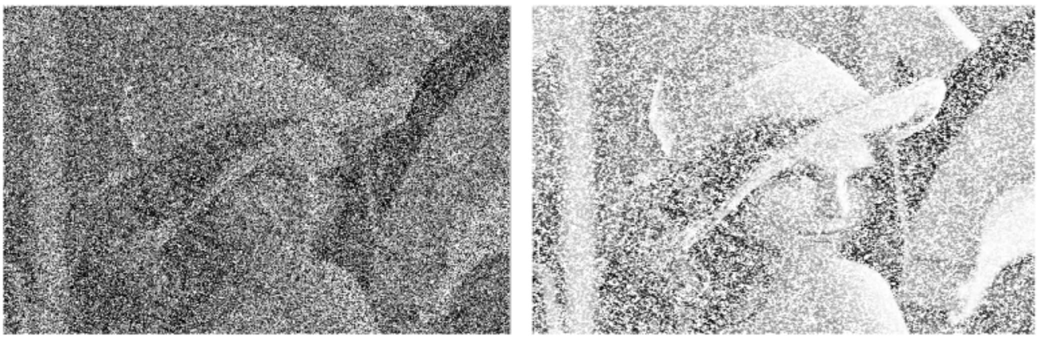

FIGURE 11. **Lean Image with 70% Noise (left) and recovered with 70% noise (right)**

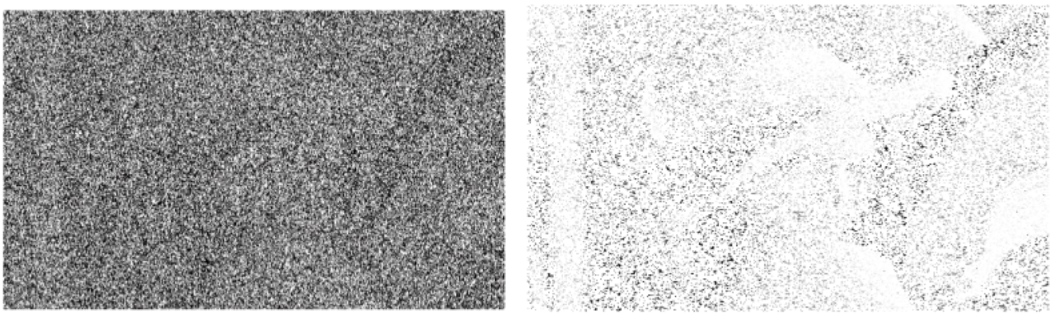

FIGURE 12. Lean Image with 90% Noise (left) and recovered with 90% noise (right).

6. CONCLUSION

Many vital applications use digital images, both grayscale and colour and to remove noise during message transmission is essential. Over the past decade, imagery has become an increasingly important communication tool, similar to social media. Images and visual information are becoming increasingly popular on social media sites. Image information is disturbed when noise appears. Hybrid median filters are also optimal only for salt and pepper noise. Gaussian and random noises must also be removed with other filters. The paper proposes modifying the restoration stage to improve the super-resolution model. After removing the noise, an enhancement scheme will be applied to the corrupted image. This will maintain details and image quality. According to the new results, the future algorithm produces good filtering results. Observations made during experiments and quantitative measurements such as PSNR are used to quantify the proposed method. Our recommendation is to eliminate salt and pepper noise by using an algorithm.

FUNDING

None

ACKNOWLEDGEMENT

None

CONFLICTS OF INTEREST

The author declares no conflict of interest.

REFERENCES

[1] R. Y. Tsai and T. S. Huang, "Multiframe image restoration and registration," *Multiframe image restoration and registration*, vol. 1, pp. 317–339, 1984.
[2] V. Rani and P. Kamboj *Image Enhancement using Hybrid Filtering*.
[3] G. Ansari, P. Rani, and V. Kumar, "A Novel Technique of Mixed Gas Identification Based on the Group Method of Data Handling (GMDH) on Time-Dependent MOX Gas Sensor Data," *Proceedings of International Conference on Recent Trends in Computing: ICRTC 2022*, pp. 641–654, 2023.
[4] T. Komatsu, K. Aizawa, T. Igarashi, and T. Saito, "Signal-processing based method for acquiring very high resolution images with multiple cameras and its theoretical analysis," *IEE Proceedings I (Communications, Speech and Vision)*, vol. 140, pp. 19–25, 1993.
[5] T. Komatsu, T. Igarashi, K. Aizawa, and T. Saito, "Very high resolution imaging scheme with multiple different-aperture cameras," *Signal Process Image Commun*, vol. 5, pp. 511–526, 1993.
[6] S. C. Park, M. K. Park, and M. G. Kang, "Super-resolution image reconstruction: a technical overview," *IEEE Signal Process Mag*, vol. 20, no. 3, pp. 21–36, 2003.
[7] H. Ur and D. Gross, "Improved resolution from subpixel shifted pictures," *Graphical models and image processing*, vol. 54, pp. 181–186, 1992.
[8] C. Wang, T. Chen, and Z. Qu, "A novel improved median filter for salt-and-pepper noise from highly corrupted images," *2010 3rd International Symposium on Systems and Control in Aeronautics and Astronautics*, pp. 718–722, 2010.
[9] M. S. Nair, K. Revathy, and R. Tatavarti, "Removal of salt-and pepper noise in images: a new decision-based algorithm," *Proceedings of the International Multi Conference of Engineers and Computer Scientists*, 2008.
[10] P. Rani and R. Sharma, "An Experimental Study of IEEE 802.11 n Devices for Vehicular Networks with Various Propagation Loss Models," *International Conference on Signal Processing and Integrated Networks*, pp. 125–135, 2022.
[11] . S. Dr, S. Lal, M. Kumar, and Chandra *Removal of High Density Salt & Pepper Noise Through Super Mean Filter for Natural Images*, 2012.
[12] A. K. Tripathi and S. Mukhopadhyay, "Single image fog removal using bilateral filter," *2012 IEEE International Conference on Signal Processing*, pp. 1–6, 2012.