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Modified LSB Based Steganography and Noise Removal for Noisy Image

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ABSTRACT: A when an image is processed for visual interpretation, the viewer is the ultimate judge of how well a particular method works. Visual evaluation of image quality is a highly subjective process. The main purpose of combine the feature of two fields Image enhancement and Steganography because we add salt and pepper noise in the original image and then secret image is embedded in the noisy image, produce a noisy stego image ,the message is extracted from the noisy stego image and finally removing the noise from stego image by various filters. In this paper, we implemented the various median filter such as Fuzzy based, Decision based and conventional median filters used for noise removal especially for salt and peppers noise. We also implemented the steganography based on LSB.

KEYWORDS: LSB, RGB, DBA, PSNR, MSE, NAE and FSIM.

I. INTRODUCTION

Digital communication [1] has become an essential part of infrastructure nowadays, a lot of applications are Internet-based and in some cases it is desired that the communication be made secret. Two techniques are used to achieve a goal: one technique is cryptography, where the sender uses an encryption key to scramble the message, this scrambled message is transmitted through the insecure public channel, and the reconstruction of the original, unencrypted message is possible only if the receiver has the appropriate decryption key and another is Steganography, where the secret message is embedded in another message.

Steganography is best utilized by people who specialize in the gathering and analysis of information and intelligence to provide advice to their government, defense and another organization- the intelligence officers. It is therefore crucial that intelligence officers have basic understanding and knowledge on the subject of steganography. But these days most of the people transmit the data or information in the form of text, images In order to safely transmission of highly confidential data, the multimedia object like audio, video, images are used to conceal the information in other medium.
Image Enhancement is among the simplest and most appealing areas of digital image processing. The idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image. The aim of Image Enhancement is to improve the interpretability or perception of information in images for human viewers, or to provide 'better' input for other automated image processing techniques.

II. STEGANOGRAPHY TECHNIQUE AND FILTERS

Usually 24-bit or 8-bit files are used to store digital images. The former one provides more space for information hiding; however, it can be quite large. The colored representations of the pixels are derived from three primary colors: red, green and blue. 24-bit images use 3 bytes for each pixel, where each primary color is represented by 1 byte. Using 24-bit images each pixel can represent 16,777,216 color values. We can use the lower two bits of these color channels to hide data, then the maximum color change in a pixel could be of 64-color values, but this causes so little change that is undetectable for the human vision system. This simple method is known as Least Significant Bit insertion. Using this method it is possible to embed a significant amount of information with no visible degradation of the cover image. In the fig 1, it shows the process.

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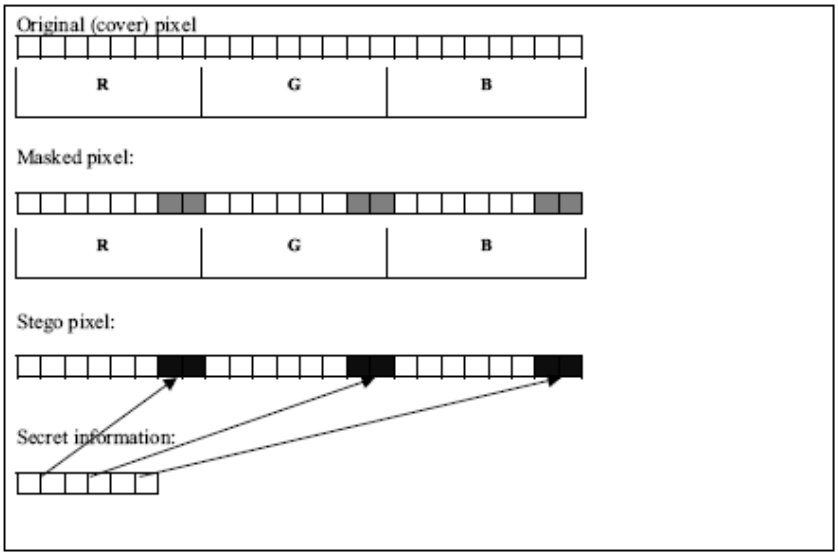

Fig 1 Process to implement LSB

1. Process of hiding the data: Using the Red, Green, Blue (RGB) model a stego tool makes a copy of an image palette, say, and an 8-bit image. The copy is rearranged so that colors near each other in the RGB model are near each other in the palette. The LSB of each pixels 8-bit binary number is replaced with one bit from the hidden message. A new RGB color in the copied palette is found. A new 8-bit binary number of the new RGB color in the original palette is found. The pixel is changed to the 8-bit binary number of the new RGB color.

2. Process of recovering the data: The stego tool finds the 8-bit binary number of each pixels RGB color. The LSB of each pixel's 8-bit binary number is one bit of the hidden data file. Each LSB is then written to an output file.

Median Filter: The median filter is one of oldest and effective filter for noise removal especially salt and peppers noise. Firstly it's sorted all pixel values from the near neighborhood into numerical form and replaces the pixel with the median pixel. Median filter are quite popular because, for certain types of random noise, they provide excellent noise-reduction capability with considerably less blurring than linear smoothing filters of similar size [1].

Fuzzy based median filter: 2Dimentional window S_{xy}, of size 3x3 is selected and is denoted as S(1), S(2), ..., S(9) . Let the pixel to be processed is Y(x, y). Next, the pixel values inside the window are sorted by arranging the rows, columns and the right diagonal in the ascending order. Hence, the first element of the window, S(1) so obtained is the minimum value Ymin, the last element of the window, S(9), is the maximum value Ymax and the middle element of the window, S(5), is the median value Ymed. Now, three cases are:-

1. Case 1: Y (i, j) is noiseless pixel if it lies in the max-min range i.e. Ymin <Y (i, j) <Ymax, Also, Ymin> 0, Ymax< 255, then the value of the pixel is not changed. Otherwise, Y (i, j) is a noisy pixel.

2. Case 2: If Y (i, j) is a noisy pixel, it is replaced by its median value. For this, the median value must lie in the max-min range i.e. Ymin<Ymed<Ymaxand 0<Ymed<255.

3. Case 3: If Ymin<Ymed<Ymax is not satisfied or 255<Ymed or Ymed=0, then Ymed is a noisy pixel. In this case, Y (i, j) is replaced by the value of the neighborhood pixel value. Above process is repeated until the processing is completed for the entire image [9].

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Decision based median filters: Srinivasan K.S. and Ebenezer D. presented fast and efficient decision - based algorithm (DBA) for removal of high density impulse noises [3]. The DBA processes the corrupted image by first detecting the impulse noise. The detection of noisy and noise-free pixels is decided by checking whether the value of a processed pixel element lies between the maximum and minimum values that occur inside the selected window. If the value of the pixel processed is within the range, then it is an uncorrupted pixel and left unchanged. If the value does not lie within this range, then it is a noisy pixel and is replaced by the median value of the window or by its neighborhood values. At higher noise densities, the median value may also be a noisy pixel in which case neighborhood pixels are used for replacement; this provides higher correlation between the corrupted pixel and neighborhood pixel [4].

III.OBJECTIVES

The objective of the paper is to give a new better, faster and efficient solution for removing the noise from the corrupted images and extracting the data embedded in the image. The main focus will be on:

A. Add a noise into source image: To add a Salt and Pepper noise into source image.

B. Embed an image in the noisy image: In steganography, we embed the message in the noisy source image.

C. Extract the message and remove the noise from image: In steganography, the message is extracted from the stego image.

D. Removal of the noise from the stego image: Removing the noise from the stego image. So, the removal of noise is using median filter, fuzzy based median filters and decision based median filters. At the end, we receive noise free image.

E. Noise free pixels must remain unchanged: During the noise removal process, we will make sure that only the noisy pixels are manipulated and non-noisy pixels should remain unchanged. For this we have to check every pixel of the test image.

F. Edges must be preserved: The pixels containing the value of edges have the higher intensity values. Generally, the pixels containing the noise have higher intensity values. So, we have to check whether it is an edge pixel or a noisy pixel. If it is an edge it must be preserved.

V. RESULT AND DISCUSSION

In this paper, we take a source image whose size is 1024 x 1024 and secret image size is 256 x 256 the colored image is taken for processing. The following are the screen-shots of the GUI of the work done in MATLAB R2010a.

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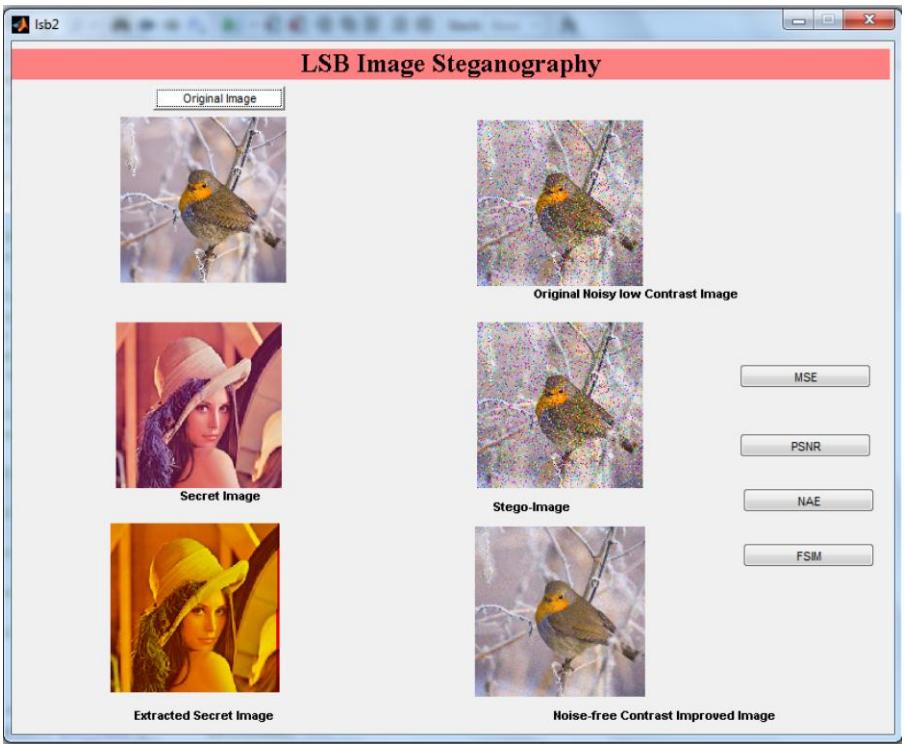

Fig 2: GUI for LSB Steganography and noise removal process

Performance evaluation for test images: The performance evaluation is done on the basis of quality metrics such as MSE (Mean Square Error), PSNR (Peak Signal Noise Ratio), NAE (Normalized Absolute Error) and FSIM (Feature-similarity index for full reference).

Table 1. Quality Metrics for test images with Fuzzy Based Median filter

Noise in %	Fuzzy based Median Filter for filtered image				LSB Steganography for stego image			
	MSE	PSNR	NAE	FSIM	MSE	PSNR	NAE	FSIM
10	1.9244	15.2879	0.0742	0.9193	0.1653	55.9493	0.0010	1.0000
20	3.8440	12.2829	0.1428	0.8594	0.1651	55.9533	0.0010	1.0000
30	5.7666	10.5216	0.2056	0.8086	0.1652	55.9446	0.0011	1.0000
40	7.6984	9.2668	0.2647	0.7601	0.1653	55.9516	0.0011	1.0000
50	9.6058	8.3055	0.3192	0.7218	0.1653	55.9469	0.0011	1.0000

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Table 2. Quality Metrics for test images with Median filter

Noise in %	Median Filter for filtered image				LSB Steganography for stego image			
	MSE	PSNR	NAE	FSIM	MSE	PSNR	NAE	FSIM
10	1.9356	15.2626	0.0828	0.9226	0.1652	55.9502	0.0010	1.0000
20	3.8355	12.2926	0.1482	0.8702	0.1652	55.9499	0.0010	1.0000
30	5.7252	10.5529	0.2080	0.8485	0.1652	55.9508	0.0011	1.0000
40	7.6860	9.2738	0.2633	0.8620	0.1652	55.9519	0.0011	1.0000
50	9.6690	8.2770	0.3122	0.8750	0.1654	55.9456	0.0011	1.0000

Table 3. Quality Metrics for test images with Decision Based Median filter

Noise in %	Decision based Median Filter for filtered image				LSB Steganography for stego image			
	MSE	PSNR	NAE	FSIM	MSE	PSNR	NAE	FSIM
10	1.9067	15.3281	0.0735	0.9209	0.1652	55.9513	0.0010	1.0000
20	3.8122	12.3191	0.1482	0.8596	0.1651	55.9524	0.0010	1.0000
30	5.7151	10.5606	0.2047	0.8114	0.1654	55.9456	0.0011	1.0000
40	7.5987	9.3234	0.2631	0.7676	0.1651	55.9522	0.0011	1.0000
50	9.4876	8.3592	0.3179	0.7225	0.1651	55.9524	0.0011	1.0000

VI. CONCLUSION

We implemented three median filter such as Fuzzy based, Decision Based and traditional median filters for enhancing the stego image and perform LSB based Steganography.Firstly, We add the impulsive noise in the Source Image, Secret image is embedded in the Source image, produce a stego image and extract the image from cover image using LSB steganography and finally receive a noise free image. The performance evaluation is done on parameter: MSE, PSNR, NAE and FSIM. The Decision based median filter gives better results as compared to the other fuzzy based median filter and conventional median filter for filtered image. It also slightly better results of Decision based median filter in the LSB steganography. The results allow us to conclude that, the implemented system presents greater robustness. The structure of various median filters is simple and easy to implement on the hardware.

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