Robust Method for Reversible Image Watermarking using Histogram Shape based Method and Wavelet Construction

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Abstract: Nowadays with the rapid development of modern communication networks, information has been transmitted with speeds never seen before. At the same period, illegally manipulated copies of digital media can be easily transmitted and distributed. As a result copyright protection has become an abundant issue in the world wide. Digital watermarking is a promising technique to solve this problem. While digital watermarking can be implement to audio, image and video. This paper focus on reversible image watermarking. The filtering used here is the Gaussian filtering, after Gaussian filtering it uses the low pass Gaussian filtering component to construct histogram using a key and select pixel group. Then the watermark is embedded and high frequency component is combined to obtain the watermarked image. In the compression time the host image is need to compressed using wavelet compression method called SPIHT. The data is encoded by using the RS- encoder followed by arithmetic encoding. And different transmissions are occur. Then in receiver side it obtain a filtered low frequency component image and the histogram is reconstructed using the key. Watermarked message is extracted from the image. In the decompression, the received image is decompressed as followed by arithmetic decoding, RS decoding, and wavelet decompression. Hence we obtain the host image.

Keywords: SPIHT, HFCM, RS Algorithm, Gaussian filter.

I. INTRODUCTION

In this paper here mainly implementing the digital watermarking technique. Watermarking is the method of hiding digital information in a carrier signal, the hidden information should but does not need to contain a relocation to the carrier signal. Here it mainly implements the digital watermarking technique. The digital watermarking is a kind of marker covertly embedding in a noise-tolerating signal such as an audio, video or image data. It is usually used to find out the ownership of such signals. In a good watermarking the watermarking's should be perceptually unproductive. And the watermarks need to be extracted after undergoing from different attacks and security. While implementing the watermarking, it need to be undergoes through many attacks. Mainly there are different kinds of attacks like signal processing attacks and geometric attacks. In the signal processing attacks it mainly include the compression, filtering and noise addition. In the geometric attacks, it include the scaling, rotation, random bending and cropping. The clearness image watermarking in ridge let domain[1] uses mainly for the sparse representation of an image mainly deal with the singularities obtained. The watermarks can be extracted it from the [2] distorted images. In this method it does not use the original image, but it need some salient image points for the recovery of watermarks. In [3] its about the watermark removal software. By using the classical spread spectrum and the wavelet method here the software is implemented. In [4] it describes the implementation of Reed Solomon error correcting codes. In [5] it is the algorithm for watermarking that implementing for the RST distortions. In [6] it describes the copyright protection for images. Nowadays copyright protection is a abundant challenge to the world wide.   In [7]-[10] the watermarks can also be embedded it in the spatial domains for resisting it from the cropping attacks. Fourier transform of a Gaussian function is also a Gaussian, the Gaussian filter does not have a sharp cut off at some pass band frequency beyond which all higher frequencies are removed. Instead it has a graceful and natural that becomes ever lower as the frequency increases. This means that it will behave as a low filter, but also allow in higher frequency components with how quickly its tail decays. The Gaussian low pass filtering which simply allowed to define a particular of smoothing kernel with a single number the radius of a Gaussian or normal distribution. It provides a very fine control of the amount of blurring a very large radius to produce a strengthen effect.

In this paper, it mainly explicit the reversible of image watermarking by using the histogram shape method and

wavelet reconstruction. In the transmitter section, it manly explicit the watermark embedding. Here a Gaussian low pass filtering is applicable to the host image. The Gaussian filter is used to smoothen images and avoid noise. The Gaussian filters are used in image processing method because they have a property for the support in the time domain, is equal to the support in frequency domain also. Here it mainly uses the Gaussian low pass filtering. The basics of filtered operations is called low-pass method. A low-pass filtered method is also called as blurring or smoothing filter techniques, averages out immediate changes in intensity. The simplest low-pass filtering method just calculates the average of the pixel and all of the eight immediate neighbors. After that we are constructing a histogram from the filtered image in relation with the grey levels by using a key. Then we are propose to build a safe band between the selected and non selected pixel groups needed for robustness. After that a watermark bit is inserting in to the selected groups. Here HFCM is also implementing to compensate the defects of Gaussian filtering to get the robustness. After embedding the watermarks the filtered image undergoes through the compression and encoding process. For the compression uses the SPIHT(set partition in hierarchical trees) after that it undergoes through the RS(reed Solomon) encoder algorithm followed by arithmetic encoding. Then we have to obtain the final watermarked image. At the recovery and enhancement section the final watermarked image from the embedding section undergoes different attacks during transmission. After the attacks undergo through the watermarked image, we have to receive a image at the recovery section. In the receiver side image it again apply the Gaussian low pass filtering method and the histogram is constructed. After comparing both the histograms and using the key it can extract the message. In the decoding section it need to recover the host image too. For that the receiver sided image is decompressed by using arithmetic decoding, RS decoding (Reed- Solomon) and followed by SPIHT(set partition in hierarchical trees) wavelet decompression method. Hence it obtain the original host image. Now the host image will be contrast enhancement by applying histogram equalization method.

The continuation of this paper is organized as follows. Section II and III illustrate the proposed reversible image watermarking method. The simulation results are provided in section IV to show the performance of this reversible image watermarking method. Section V concludes the paper.

II. WATERMARKING-EMBEDDING PROCESS

In the watermark embedding process first stage is need to apply the Gaussian low pass filtering, histogram construction, pixel group selection, HFCM based watermarking, SPIHT compression, RS encoder followed by arithmetic encoding. The proposed method of embedding process is shown in fig 1:

First need to apply low pass Gaussian filter to the host image I (8 bit grey scale). After that perform the Gaussian filtering to get the low frequency image I_{low}

$$I_{low}(x, y) = F(x, y, \sigma) * I(x, y) \quad (1)$$

Then find the high frequent component by image subtraction

$$I_{high}(x, y) = I(x, y) - I_{low}(x, y) \quad (2)$$

After that the histogram is constructed by creating a pseudo noise(PN) sequence has security key.

$$H_s = \{h_s(K_i) i = 1, 2, \dots S\} \quad (3)$$

Where $h_s(K_i)$ is the number of pixels corresponding to grey level k_i. Randomly select grey levels(s.grey levels). Construct the histogram according to the key. Then it need to select the pixels groups for implementing the watermarks. The N_s be the number of pixels represented to the S selected grey levels.

$$N_s = \sum_{i=1}^{s} h_s(k_i) \quad (4)$$

From bins of grey levels, arrange neighboring bins to form groups. Then propose a pixel group selection criteria based on the ratio between $h_g(i)$ and N_s

$$g(i) = \frac{h_g(i)}{N_s} \quad (5)$$

after that select suitable groups by arranging a threshold frequency. Construct a safe band using the parameter α.

$$(1-\alpha) \cdot g_{min} < g(i) < g_{min} \quad (6)$$

In the next step it need to embed the watermarking through HFCM method. Transfer pixels between bins according to the watermark message

$$\begin{cases} \frac{h_B(2i-1)}{h_B(2i)} \geq 2 & \text{if } w_i = 1 \\ \frac{h_B(2i-1)}{h_B(2i)} \leq \frac{1}{2} & \text{if } w_i = 0 \end{cases} \quad (7)$$

Here in the above equation it take two bins. When the ratio of the two bins is greater than or equal to two then it can be watermarked on that section. When the ratio of the two bins is less than or equal to half then it cannot be watermarked. Then combined the watermarked low frequency image with the high frequency image to obtain the watermarked image.

$$\bar{I}_{low} = F * \bar{I}'$$
$$= F * \bar{I}^w$$
$$= F * (\bar{I}^w + I_{high}) \quad (8)$$

After that it need to implement the SPIHT wavelet compression algorithm to compress the watermarked image. In the sort transform coefficients by msb for the progressive selection of coefficients. By the transform characteristics to identify efficiently groups with the same msb. Then send the remaining bits by order of importance. The criteria is as first those identifying msb and then those

of same bit plane with larger msb's. after that the binary result of msb tests send to the RS decoder. Here two types of pixels are take place such that the LIP(list of insignificant pixels) and LSP(list of significant pixels). The list tested in order of LIP, LSP for efficient wavelet compression. The SPIHT encoding is implemented in a image can be subdivided into objects as well as sub band transforms can be applied on segmented image. That is image is subdivided into several frequency bands and each
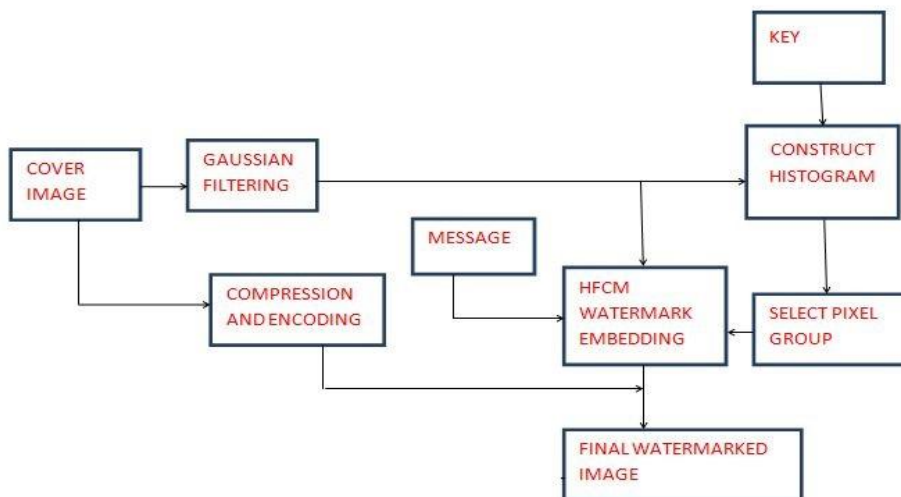
Fig 1: block diagram for embedding section

band is digitally encoded separately by SPIHT encoding. After completing the compression by using SPIHT wavelet compression algorithm, the bits need to transfer to the RS encoder. The encoder algorithm is used to make it in a code form. After that it followed by arithmetic encoding for the embedding of data in to the host image.

III. RECOVERY AND ENHANCEMENT

In the receiver section now we have the final watermarked image. The watermarked image has been transmitted during attacks such as cropping, rotation etc. after that the image is again undergo through the low pass Gaussian filtering. After that the histogram is again constructed. By using the key in the receiver section, it can decode the message from the image. After the decoding of the message. The image can undergo through arithmetic decoding for the data decryption. After that it followed by the RS decoder algorithm. After that the image is undergo through the SPIHT wavelet decompression algorithm. In SPIHT decoder the coded image can be decoded as well as inverse transform can be applied on it. So the original image is reconstructed.
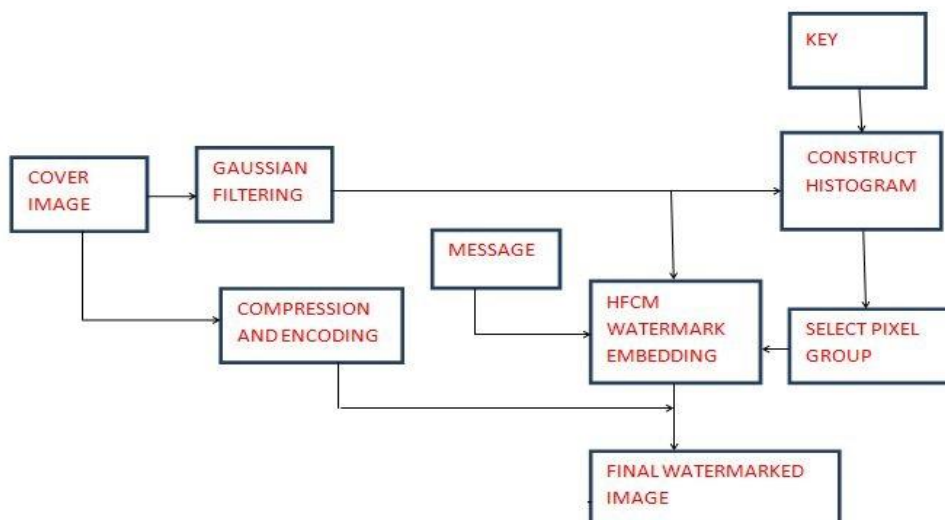

fig 2: block diagram for decoding section

So after all these steps applied in a reverse order as shown in fig 2: can obtain the restoration of host image. Then the histogram equalization method is applied to the restored host image, then it will obtain the enhanced contrast image.

IV. SIMULATION RESULTS

In this section, it evaluate the quality and robustness of proposed method by simulations. The fig 3: shows that the filtered image after applying the Gaussian low pass filter to the original image.
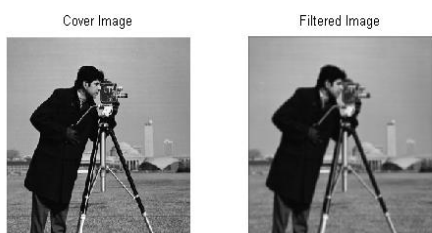

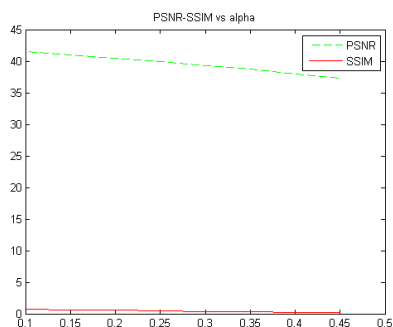Fig 3: filtered using low pass Gaussian filtering
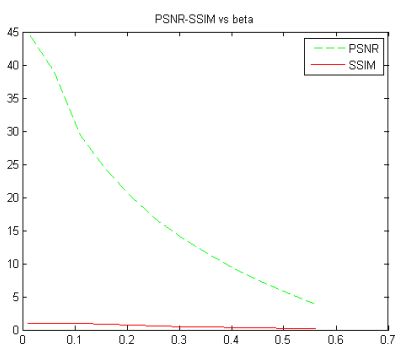

Fig 4: alpha variation

Fig 5: beta variation

The fig 4 and fig 5 shows the graph of $\alpha \ and \ \beta$ in accordance with PSNR and SSIM value. The fig shows the variations of alpha. It is drawn by taking the threshold value. The fig 6 shows the variations of beta according with the high frequency component modification.The fig 6 shows the histogram of watermarked image. The

histogram of one such pixel is shown here. When the Gaussian filtering is applied to the host image.
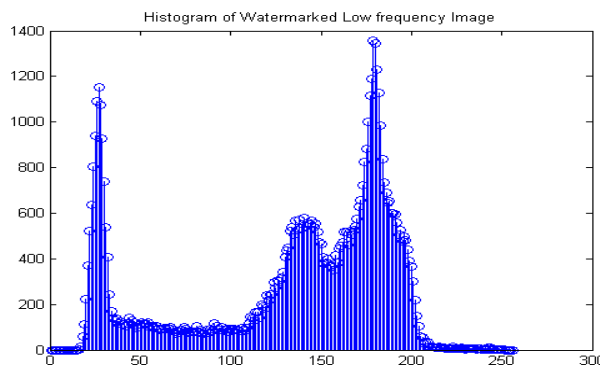

Fig 6: histogram of watermarked image

It converted to low frequency and high frequency image. From the low frequency image the histogram is constructed. The fig shows the watermark of low frequency image.

Fig 7: watermarked final image

The fig 7: shows the final watermarked image. after transferring the pixels between the bins according to the message that is watermarked. It will obtain a final watermarked image by combining with the watermarked low frequency image with the high frequency image

When the final watermarked image obtain at the receiver side, it will undergo through many attacks during the transmission. The below fig shows the different types of attacks that undergo during transmission.

So after gone through many attacks, the image will again undergo through low pass filtering and histogram is constructed and by using the key the message is decoded. For the reversible watermarking method it need to decode the host image to. So that image undergo through the arithmetic decoding, RS decoder and followed by the wavelet decompression method. Hence we obtain the host image as shown in fig 9:

After obtaining the host image, for the enhanced contrast of the host image, there apply the histogram equalization method. Hence the overall result of the proposed paper is as shown in the fig 10:

Fig 8: different attacks such as Gaussian noise, median filter, rotation, cropping
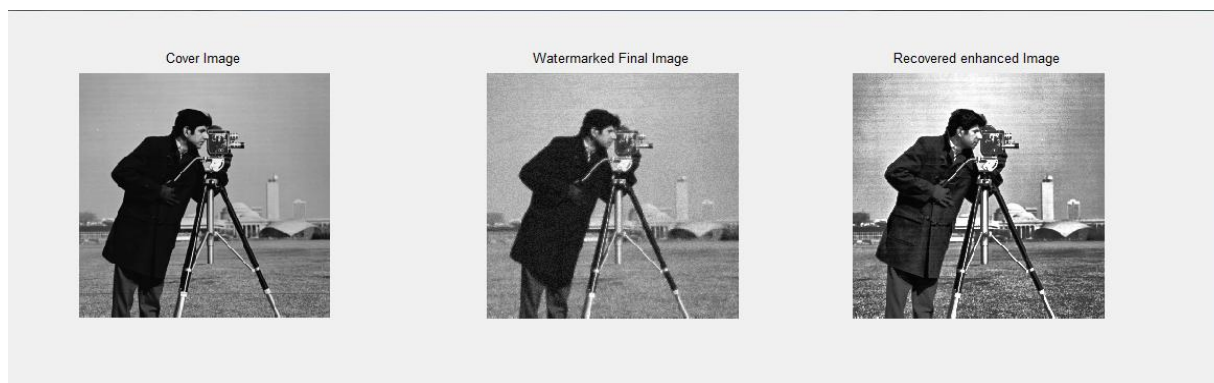

Fig 9: recovered host image

Fig 10: overall process

V. CONCLUSION

In this paper it can be conclude that the host image can also be extracted at receiver section. Here the host image can be reconstructed with improved signal quality. In this paper the output will be a enhanced contrast image. This paper can be implemented in special cases for military operations, hospital documents etc.. this paper is mainly dealing with the reversible image watermarking process, not only the embedded data but also the host image is also extracted from here.

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