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Robust Invisible Watermarking Using OSTU Method and DWT

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Abstract: ***In this work we have devised the invisible watermarking using Haar wavelet function and otsu segmentation. Here we have contributed by providing a threshold parameter to binarise message image using ostu's method and analysing a new formulation for Normalised Coefficient parameter. As all watermarking consists of two units i.e. embedding and extracting. In this we also calculate the five parameters i.e. contrast, dissimilarity, homogeneity, angular momentum and entropyee of cover image and message image***.

Keywords: Watermarking, DWT, OSTU Method and Image Segmentation

1. Introduction

The prompt evolution of internet augmented the access of multimedia data enormously. Day by day innumerable digital multimedia is established and all multimedia prerequisites protection so that their all data would be threatened from intruders. There is innumerable digital multimedia: - audio, video and text. Approximately, twenty years back this technique has established entitled as watermarking or digital watermarking. As we all discern that information is in digital format, it can be effortlessly wrought, retransmitted or replicated, and so consuming this technique worker can easily hide their useful data or digital multimedia without any kind of defeat. There are innumerable attributes of digital watermarking like robustness, data embedding capacity, blind and informed detection, embedding effectiveness and perceptual similarity. Basically, Digital watermarking is the endeavour of hiding a message connected to a digital signal (i.e. an image, audio, and video) inside the signal itself. It is a concept meticulously connected to steganography, in that they together hide the message confidential the digital signal. Watermarking attempts to hide message connected to the authentic content of digital signal, while in steganography the digital signal has no relative to message, and it is purely rummage-sale as a cover to hide its reality.

2. Literature Survey

Jih Pin Yeh, Che-Wei Lu, Hwei-Jen Lin, and Hung-HsuanWu[1],they concentrated on DWT. Basically in this for embedding the watermark image they used fixed position. After that by using DWT transform they embed the watermark into the HL and LH bands of the original image and for extracting the watermark from an original image they applied IDWT. Our method rallies the robustness and the excellence of stego image by embedding watermarks into some static blocks moderately than erratically designated blocks in the HL and LH sub-bands and by overall DWT instead of integer-DWT. The experimental results demonstration that our method entails less time cost and delivers better *PSNR* values for stego images and better *NC* ethics for extracted associated with Chang's method watermarks with/without assaults.

Yusuk Lim, Changsheng XU and David Dagan Feng[2], proposed image authentication which is based on web. In any fragile watermark system, the watermark can be identified easily that is embedded inside the image. Watermark detection is generally not possible as it unseen and information embedded inside the watermark is invisible to detectors so that the secret information can be protected. It is kind of code that cannot be detected easily. The web images that all sent or formed on internet can be easily hacked by intruders hence watermarking is the necessity to keep the information secure from the outsiders. There are two parts or we can say structure for doing web based authentication i.e. watermark embedding system and authentication system. The more secure and perfect system can be attained by using enriched watermarking algorithms.

3. Proposed Method

In this work we have devised the invisible watermarking using Haar wavelet function and otsu segmentation. Here we have contributed to the base paper by providing a threshold parameter to binarise message image using ostu's method and analysing a new formulation for Normalised Coefficient parameter. In this we also calculate the five parameters i.e. contrast, dissimilarity, homogeneity, angular momentum and entropyee of cover image and message image.

Algorithm for embedding

Step 1:- Firstly, we take a cover image and one message image.

Step 2:- Pre-processing both the images i.e. cover image and message image (pre-processing means resize the cover image into 512*512 and resize the message image into 64*128).

Step 3:- Then, we apply 2- level DWT on cover image and otsu segmentation on message image.

Step 4:- We select HL and LH bands of cover image and binarize the message image.

Step 5:- Divide HL and LH band in 2*2 blocks ad message image, binarize by image ≥ threshold, calculated by Otsu algo.
Step 6:- Take odd columns of LH band and even columns of HL band which is in 2*2 blocks and take bit by bit of message image.
Step 7:-For a selected block and a watermark bit we have to calculate the mean value
Mean (m,n)= $\frac{1}{4}\sum_{i=0}^{1}\sum_{j=0}^{1} Xm+i,n+j$
//Embed watermark bit *w*
R :=*M(m, n)* mod 6;
for*i* := 0 **to** 1
for*j* := 0 **to** 1
if0 ≤ *R* < 3 **then**
if*w* = 1 **then** *xm+i,n+j*:= *xm+i,n+j*+ (3-*R*);
if*w* = 0 **then** *xm+i,n+j*:= *xm+i,n+j*- *R*;
if3 ≤ *R* < 6 **then**
if*w* = 1 **then** *xm+i,n+j*:= *xm+i,n+j*+ (3-*R*);
if*w* = 0 **then** *xm+i,n+j*:= *xm+i,n+j*+ (6-*R*);
Step 8:- Then, reshape the HL band and LH band.
Step 9:- Finally perform IDWT on the embedded image to obtain a covered image.

4. Algorithm For Extraction

Step 1:- We take a cover image.
Step 2:- Apply 2 level DWT.
Step 3:- Divide the HL and LH bands into 2*2 blocks
Step 4:- For each block we have to calculate the mean
Mean (m,n)= $\frac{1}{4}\sum_{i=0}^{1}\sum_{j=0}^{1} Xm+i,n+j$
//Extract watermark bit *w*
R :=*M*(*m, n*) mod 6 ;
if0 ≤ *R* < 1.5 **then** *w*:= 0;
if1.5 ≤ *R* < 4.5 **then** *w*:= 1;
if4.5 ≤ *R* < 6 **then** *w*:= 0;
Step 5:- Reshape it into 64*128.
Step 6:- Finally, we get our message image.

Flow Chart for Embeddin

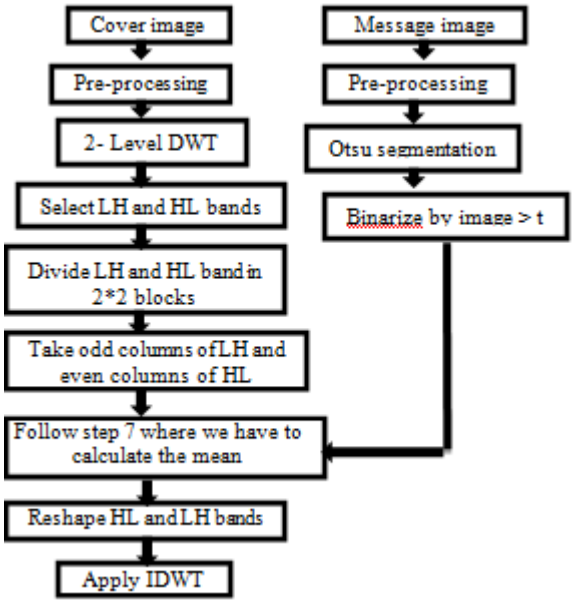


Figure 1: Flow chart of embedding

Flow Chart for Extraction

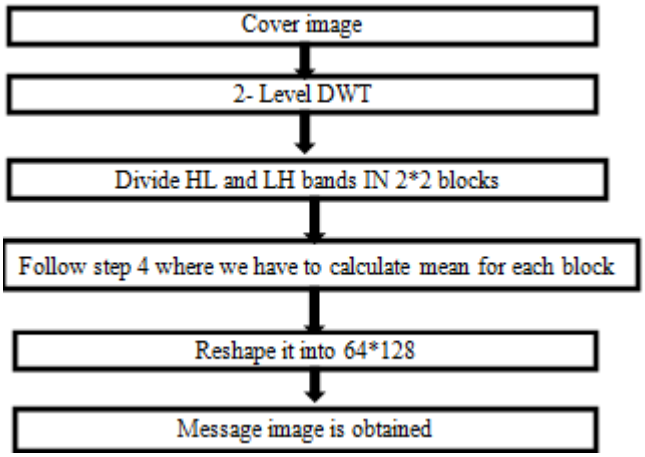


Figure 2: Flow chart for extraction

5. Experimental Result

Test data include images of size 512*512 were used as cover images and binary images or message image of size 64*128as watermarkimages. Here we take three cover images and three message images.

Figure 3: images of cover image and message image

After that we apply ostu algorithm and get a binarized image with its threshold value and histogram**.**

Binarized image 1
Threshold value= 139

Histogram of binarized image 1

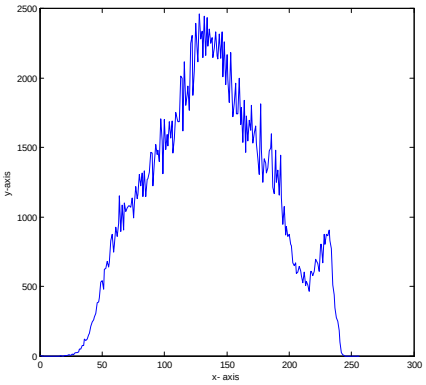


Figure 4: Binarised Image 1 And Graph Of Histogram

Binarized image 2
Threshold value= 104
Histogram of binarized image 2

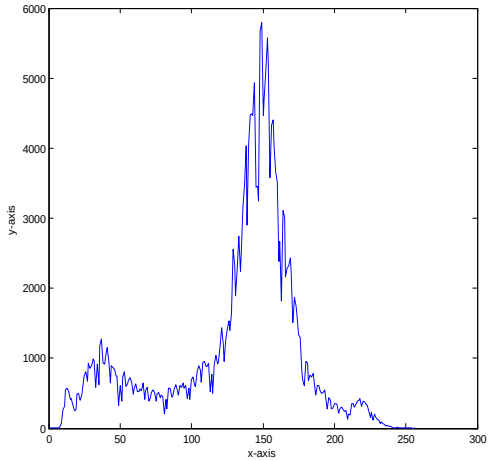
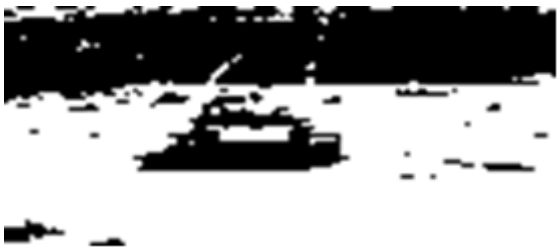


Figure 5: Binarised Image 2 And Graph Of Histogram



Binarized image 3
Threshold value= 120
Histogram of binarized image 3

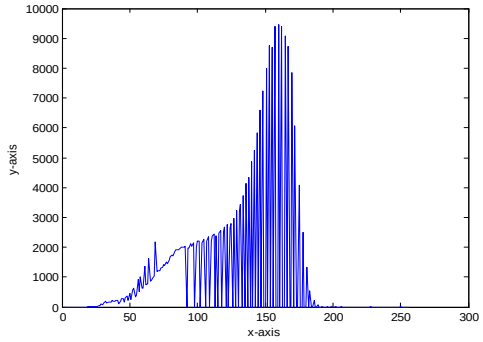


Figure 6: Binarised Image 3 And Graph Of Histogram

The images formed by embedding message image into cover image or watermarked image are as follows:-

Watermarked image 1

Watermarked image 2

Watermarked image 3

Figure 7: Images of Watermarked Image

Table 1: Values of Five Parameters for Cover Image

Parameters/ Cover images			
Contrast	84.0067	887.6045	99.0740
Dissimilarity	2.22057	19.5900	3.3311
Homogeneity	0.5950	0.0844	0.4282
Angular momentum	0.0031	1.6081e-004	0.0019
Entropyee	-0.2096	-0.0146	0.1258

Table 2: Values of Five Parameters for Message Image

Parameters/ Message images			
Contrast	84.6839	877.4190	99.6573
Dissimilarity	2.4128	19.4904	3.4769
Homogeneity	0.5359	0.0827	0.3932
Angular momentum	0.0022	1.1959e-004	0.0013
Entroypee	-0.0584	-0.0796	-0.0378

Finally, the extracted image which is hidden in the cover image :-

Extracted image 1

Extracted image 2

Extracted image 3

Figure 8: Images of extracted image

To equate the enactment, the rate of *PSNR* (peak signal to noise ratio) of the cover image is evaluated. The formulae for *PSNR* are given below, where *H0* and *W0* denote the height and the width of the watermark, and $w(i, j)$ and $w'(i, j)$ designate the bit values at location (i, j) of the original watermark. The *MSE* (mean square error) rummage-sale in the formula for *PSNR* is defined in; where *H* and *W* denote the height and width of the image. In over-all, a *PSNR* value greater than 30 dB is perceptually acceptable.

$$\mathbf{MSE} = \frac{1}{W*H}\sum_{i=1}^{H}\sum_{j=1}^{W}\left(\left(I(i,j) - I'(i,j)\right)\right)^2$$

$$\mathbf{PSNR} = 10\times\log_{10}\left(255^2/MSE\right)$$

For finding the NC (normalized correlation), we have derived the formula and for this we have two images, one is hidden and another one is extracted. We will extract the hidden image from watermarked image. The image will have certain width and height and being a binary image it will have bits (either 1 or 0). So the formula will be, for hidden image a ratio of total number of 1's(bits) to total number of pixels which will be expressed as (α)alpha and same will be followed for extracted image and that will be expressed as (β)beta. Now the derived formula will be ratio of beta (β) to (α) alpha i.e. extracted image to hidden image which is equals to 1 and if not then the image might have undergone some variation.

So, for hidden image

$$\frac{TOTAL\ NUMBER\ OF\ 1's\ (BITS)}{W_0\times H_0} = \alpha$$

And, for extracted image

$$\frac{TOTAL\ NUMBER\ OF\ 1's\ (BITS)}{W_0\times H_0} = \beta$$

NC will be β/α= 1

NOTE: $W_0\times H_0$ denotes total number of pixels

Table 3: Table for PSNR Value of Cover Image

Cover image	MSE	PSNR	PSNR value of JihChe-We, Hwei-Jen , and Hung-Hsuan method
Cover image 1	0.01	66.9846141 dB	48.49
Cover image 2	0.00	Inf dB	48.79
Cover image 3	0.00	Inf dB	48.61

Table 4: Table for NC (Normalized Correlation)

For hidden images value of α	For extracted image value of β	β/α	NCvalue of JihChe-We, method
0.7316	0.7316	1	1
0.7316	0.7908	1.0809	0.99
0.7316	0.7316	1	1

6. Conclusion and Future Work

In this work the robust invisible watermarking is achieved by hiding the binarized message using proposed algorithm. The bits of segmented message image are hided in the HL and LH wavelet domains. Successfully we retrieved an extracted image from watermarked image. We also achieved high roubtness and we successfully calculate the contrast, dissimilarity, homogeneity, angular momentum and entropyee of cover image and message image.

Thus, the experimental results show that we retrieved watermark shares a high PSNR and we successfully analysis a new formulation of normalised correlation. In two images we got the value of NC is 1 while in four images there is some variations but there value is near about 1. And the value of NC and psnr is better. In future,

we can use other binarise technique and another parameter for mod operations.

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