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Secure Communication of Images with Bandwidth Conservation Scheme

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ABSTRACT:We proposed a novel approach for highly secure, stable and simplified communication system. — In this paper we use 2 level DWT and DCT watermarking to bring a complex and secure system. Other main aim of the paper is to implement watermarking of several images under single cover.

The paper also review the advantages of using proposed system in particular watermarking of several (4) images under single cover reduces the bandwidth required to transmit the data. This paper describes the proposed algorithm, implementation and results. Four images and single cover is used to test the system and the results are much efficient than existing systems.

KEYWORDS:DCT, DWT, Watermarking, Compression.

I.INTRODUCTION

We are living in the era of information where billions of bits of data is created in every fraction of a second and with the advent of internet, creation and delivery of digital data (images, video and audio files, digital repositories and libraries, web publishing) has grown many fold. Since copying a digital data is very easy and fast too so, issues like, protection of rights of the content and proving ownership arises. There are many encrypting systems to overcome copyright and also for security purpose.

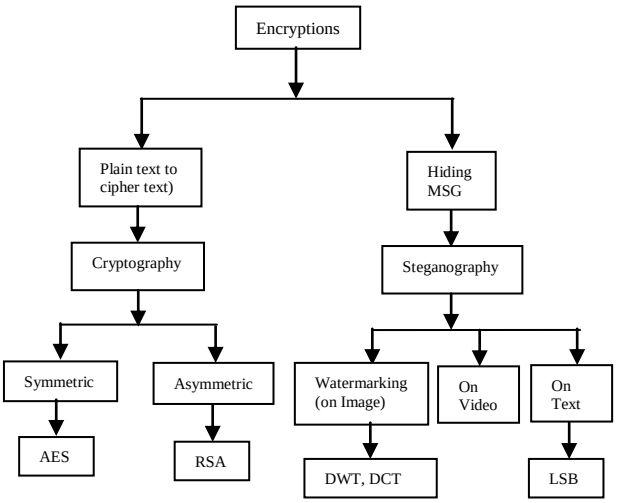

Fig. 1 Encryption Classification

The classification of encrypting system can be described by above Figure 1.

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For efficient protection against copyrights and also for secure and efficient communication we proposed this approach, it is a combination of Watermarking and Bandwidth Conservation Scheme. This proposed system will satisfies most important aims of cyber world i.e., Security, Stability and Simplicity.

Security and Stability can be increased by complicating the encryption system. That is why I used 2 level DWT and DCT watermarking in encoding process. Stability can also be improved by changing the format of encrypted image into other format such as .mat, which cannot be accessed by others.

Simplicity means reducing the size of data that to be transmitted i.e. bandwidth conservation. In general to implement watermark on an image we need a cover (i.e. for single image we need single cover). If we want to implement watermark on two or more images we require two or more covers, this lead to increase the data size enormously. But in this system I used single cover for multiple images for watermarking, this in return reduces the size of datathat to be transmitted.

II.EXISTING WATERMARKING SYSTEM (2 LEVEL DWT & DCT)

Presently for each secure image that to be transferred we use a cover for single image, to transfer more images we required more cover images.

For each image we use watermarking, that watermarking involves three steps

1. Decomposition of colour image into its RGB channels.
2. Each colour channel is decomposed into three spatial components using DWT.
3. Applying DCT to convert these components into respective frequencies.

The input cover image is decomposed into its R, G and B colour channels. For each colour channel, spatial components (LH, HL, HH) are generated by using DWT transform. Further, frequency components can be generated by applying DCT to every spatial component. Among these frequencies, mid frequencies are used to embed the watermark. To enhance security, a code can be created in which the coefficients of one colour channel signify the indices of the other colour channel.

2.1 Watermark Embedding Algorithm

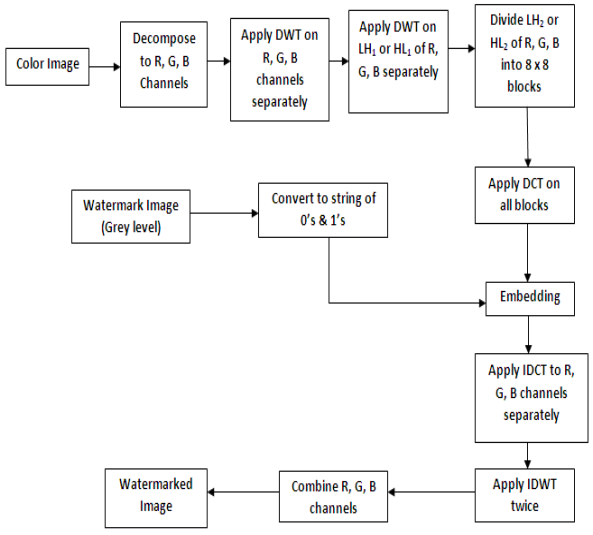

Fig. 2 Watermark embedding process

Figure 2 shows the block diagram of watermark embedding algorithm.

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2.2 Watermark Extraction Algorithm

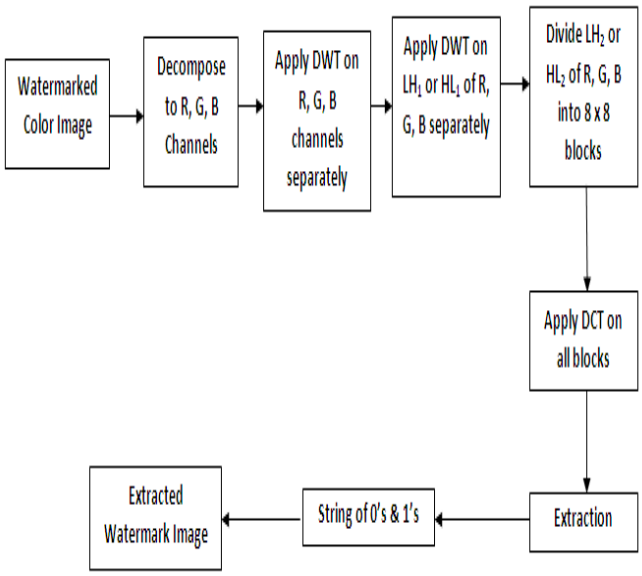

Fig. 3 Watermark embedding process

Figure 3 shows the block diagram of watermark extraction algorithm.

III.PROPOSED SYSTEM & EXPERIMENTAL RESULTS

Our proposed method will provide secure and efficient communication. This method uses single cover image to secure many confidential images.

In this project we considered four secure images that is Watermarked under single cover.

Our proposed method involves four steps

1. Create a blank image.
2. Combine four images into one image.
3. Use 2 level DWT & DCT method of watermarking on blue component of cover.
4. Send the Watermarked image to the receiver.

3.1 Considered Confidential Images

Fig. 4 Image A

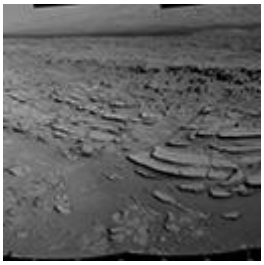

Fig. 5 Image B

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Fig. 6 Image C

Fig. 7 Image D

3.2 Create a Blank Image

Create a blank image of size equal to 4 times single image considered.

Size of each image (considered) is 128*128.
Therefore size blank image is 4*128*128 = 256*256.

```
fori=1:256
for j=1:256
Z(i,j)=0;
end
end
```

3.3 Combined Four Images

1. Take four confidential images A, B, C and D.
2. Resize each image into 128*128 resolution.
3. Replace the pixels of blank Z image with pixels of four images, such that first pixel with A, next pixel with B repeat this process until all pixels in A and B are completed.
4. Now replace the remaining pixels of Z with pixels of C and D as in the point 4 until all pixels in C and D are completed.

```
size=128*128;
fori=1:size
Z(2*i-1)=A(i);
Z(2*i)=B(i);
end
fori=1:size
Z(2*(i+size)-1)=C(i);
Z(2*(size+i))=D(i);
end
```

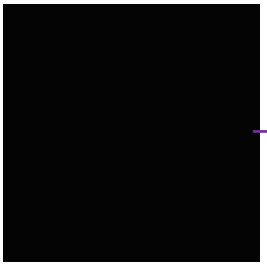

Fig. 8 Created Image Z

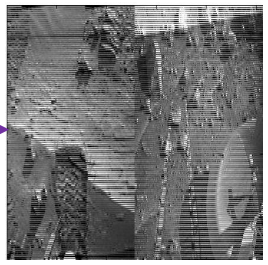

Fig. 9 Compound Image Z

The result of above algorithm is shown in figure 9.

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3.4 Apply 2 level DWT & DCT method of watermarking on blue component of cover

Modify the existing watermark system as prescribed below.

A. Watermark embedding over cover

Step involved in watermark embedding are

1) Select any color image as cover image, denote it by 'I'. Obtain R, G and B channels of cover image 'I'.
2) Apply DWT to B channel separately to get the multi-resolution sub-bands LL_1, HL_1, LH_1, and HH_1.
3) Apply DWT again to HL_1 (or LH_1) sub-bands of R, G and B channels and select HL_2 (or LH_2)sub-bands of B channel.(Decomposition is continued only up to 2 levels as the energy becomes 0 at the third level.)
4) Divide the HL_2 (or LH_2) sub-bands of R, G and B channels into blocks of size 4X4.
5) Apply DCT to each of the blocks obtained in previous step.
6) Convert the watermark 'w' into string of 0's and 1's.
7) To embed bits, first calculate average of middle band coefficients of first block of B component.
8) Repeat this process for all bits of the watermark.
9) Apply IDCT to the blocks of B channels.
10) Apply IDWT for 2 levels to B channels.
11) Combine R, G and B channels to get watermarked image 'WI'

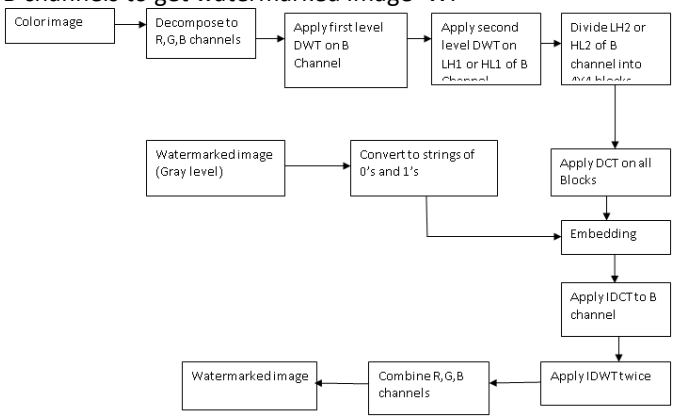

Fig. 10 Watermark Embedding in proposed system

Modified watermark embedding process is as shown in figure 10 (Watermark Embedding in proposed system)

B. Watermark Extraction

Steps involved in watermark extraction from cover are

1) Obtain R, G and B channels of watermarked image 'WI'.
2) Apply DWT to B channel to obtain the multi-resolution sub-bands LL_1, HL_1, LH_1, and HH_1.
3) Apply DWT again to HL_1 sub-bands of B channel and select HL_2 sub- B channel.
4) Divide the HL_2 sub-bands of B channel into blocks of size 4×4.
5) Apply DCT to B block obtained in previous step.
6) Water marking bits are extracted from first block of B channel and repeat this process until extraction of all bits from all 4X4 blocks
7) Then apply IDCT to all 4X4 blocks to get the watermarked image.

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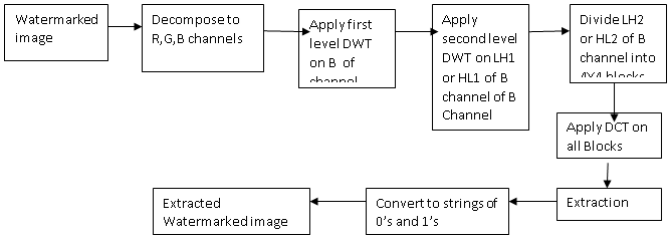

Fig. 11 Watermark Extraction in proposed system

Modified watermark extraction process is as shown in figure 11 (Watermark Embedding in proposed system)

- ***Experimental inputs and Results***

Cover image and Watermark image (Z) are shown in figures 12 and figure 13 respectively.

By using this system, watermarked image is same as of cover image, no human eye can distinguish them. This makes the image appears as normal image with no significant information.

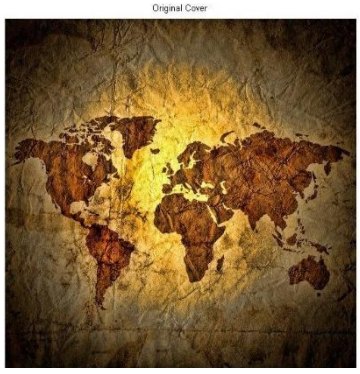

Fig. 12 Cover Image

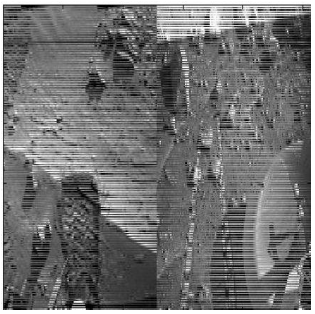

Fig. 13 Z Image (Watermark)

Resultant of Watermarking is shown in figure 14

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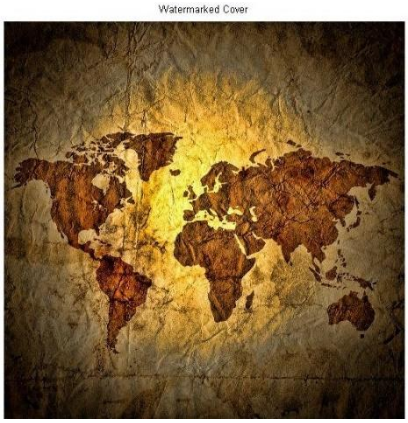

Fig. 14 Resultant of watermarking

3.5 Decoding Process

Decoding Process is exactly the reverse process of Encoding.
Steps

1. Extracting Watermark image Z.
2. Extract four confidential images from Z.

Extracting each images from Z can be implemented using below code.

```
fori=1:128
for j=1:128
A(i,j)=w(2*i-1,j+128);
end
end
```

A. Experimental Results

The decoding architecture (process) of proposed system is as shown in figures below.

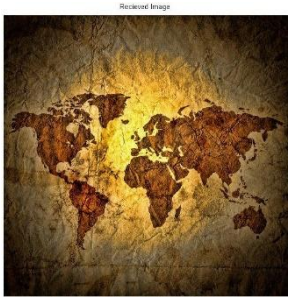

Fig. 15 Watermarked image Received

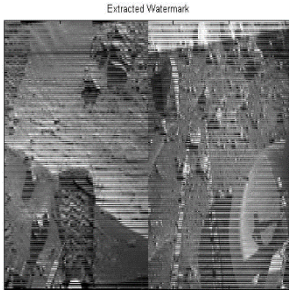

Fig. 16 Extracted Watermark image Z

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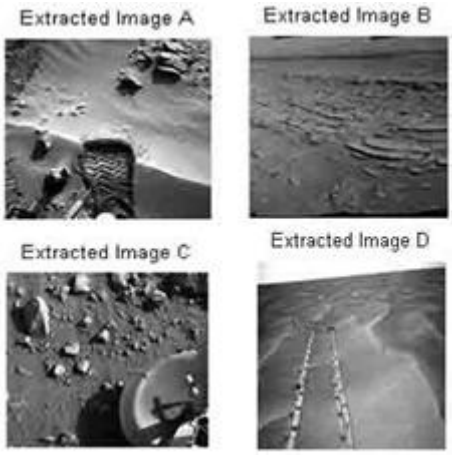

Fig. 17 Extracted confidential images A, B, C & D from Z

IV. FUNCTIONS USED FOR PROPOSED SYSTEM & EXECUTION RESULTS

TABLE 1: DESCRIBES THE MATLAB FUNCTION USED IN THE PROPOSED SYSTEM AND ITS EXECUTION RESULTS.

Test Function	Expected Result	Observed Result	Pass/ Fail
Main	Loads four confidential images and a cover image	A,B,C,D & Cover images are loaded	Pass
Create_ Image()	Create an image of size 4 times the each image.	Blank image of size 256*256 is created	Pass
Combine4()	Combine 4 images in one	Image Z is created	Pass
Watermark_ encrypt()	Watermark Z on cover	2 level DWT & DCT is applied	Pass
Watermark_ decrypt()	Extract Z image from Watermarked cover	Z image is extracted	Pass
Split4()	Extract 4 images from Z	A,B,C & D images are extracted	Pass

IV. COMPARISON OF RESULTS

In my proposed system we need single cover to transmit many images (4).

In this paper I used 4 images of each 120 KB and a cover image of 1MB. The resultant output size is 1MB.

In general four images require 4 covers i.e. 4 images of each 120KB require 4MB of covers (4 covers of each 1MB).

Thus data is compressed logically which results in efficient communication.

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TABLE 2: COMPARISON BETWEEN CRYSTOMARKING (PROPOSED SYSTEM) AND GENERAL WATERMARKING SYSTEM

	No of images to hide	Size of total image to hide	No of covers	Size of covers	Total size of data	Band width conserved
Crystomarking	4 (120KB each)	480 KB	1 (1 MB each)	1 MB	1504 KB	3072 KB
General Watermarking	4	480 KB	4	4 MB	4576 KB	0 KB

TABLE 5.1: COMPARISON BETWEEN ORIGINAL COVER AND WATERMARKED IMAGES

Mean Square Error	Peak Signal to Noise Ration	Ratio of Squared Norm	Normalized correlation	Standard Correlation
3.7443e-04 ~ 0	82.3971	1	1.0000	1.0000

VI. CONCLUSION AND FUTURE WORK

This paper introduces the effective and efficient method of communication in unreliable environment that can modify the previous techniques. This method is simpler to use and very reliable. Special configuration (hardware) is not a necessity. Using this method efficient bandwidth consumption for transmitting the data worked out practically and the results are displayed.

The above proposed method can be made more secure, stable, and efficient by implementation of the best lossless compression algorithm and also by providing a biometric or face recognition as an authentication to access this algorithm.

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BIOGRAPHY

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