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Design and Simulation of Appropriate Digital Watermarking Technique for Secure and Reliable Data Communication

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***Abstract*—** The latest advancements in the field of multimedia promised significant improvements in data transit, transmission, and manipulation. Along with the expansion of facilities, there are greater dangers to data authentication, licenced use, and data security from unlawful usage. Copyright infringement, tampering, and unlawful distribution of digital media have all been presented as reasons for using digital watermarking (e.g. video, audio, and images). The watermark indicates whether or not the data has a copyright. The field of information concealment has exploded in popularity. However, numerous doubts remain about the technology's potential and role in establishing and maintaining intellectual property rights in the digital age. This paper gives an overview of information concealment, highlighting its key disciplines (covert channels, stenography, digital watermarking, and anonymity) as well as some of the applications that are currently generating interest. The focus is on the state of digital watermarking and its prospects, with a taxonomy based on insertion domain, applicability, and types of existing methods receiving significant attention. This thesis presents a new technique for meeting the world's digital watermarking demands by focusing on embedding watermarks in the R-G-B planes of colour images. The colour image is watermarked three times for intellectual property rights protection by embedding the same watermark in each plane of the multimedia image. Watermarks are put into individual colour planes when multimedia images are segmented into R-G-B colour planes. In one or more of the colour planes, one or more watermarks can be placed. The authentication procedure involves retrieving watermarks from all three-color planes and constructing a final watermark from the intersection of all the obtained watermarks. With existing approaches as well as a new proposed methodology, the suggested work has been implemented in both the spatial and transform domains. The threshold-based correlation watermarking approach is employed in the spatial domain, while DCT based watermarking and correlation based DCT watermarking are employed in the transform domain. Finally, the performance of digital watermarking systems is assessed as a tradeoff between message carrying capacity, attack robustness (e.g., Gaussian noise, JPEG compression), and embedding caused distortion. In comparison to existing methodologies, our proposed methodology has produced better outcomes.

Keywords- Digital Watermarking, Digital Information MATLAB (matrix laboratory), bit error rate (BER). Peak signal to noise ratio (PSNR)

I. INTRODUCTION

Cryptography is described as the mathematics science of data back and is the study of secret (crypto) writing (graphic). It enables two persons, typically referred to as Alice and Bob, to securely communicate with one another by sending and not editing data. Encryption is a means of hiding information in plaintext by obscuring it, and the encrypted text is known as cypher text. Decryption is the process of converting cypher text back to its original form. Figure 1.1 [1] depicts this.

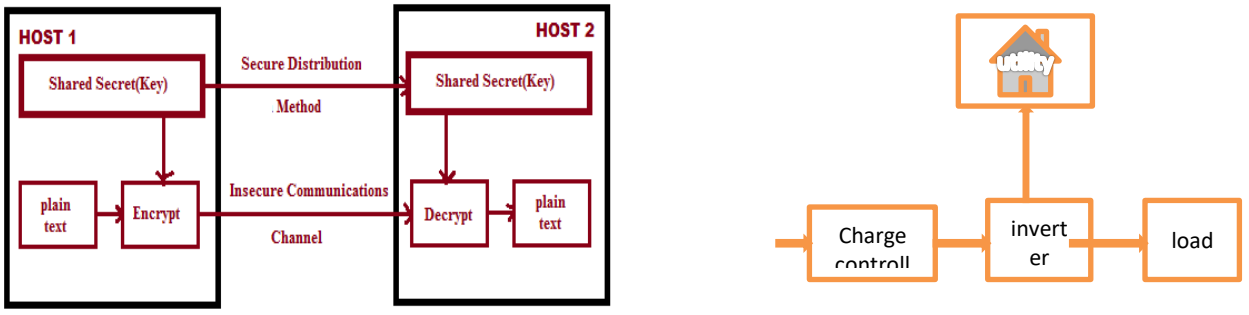

Figure 1.1: Cryptography used for communication

Dealers share data by e-mails or by spies for communications, which is defined as secret and covered writing (derived from the Greek [1]). Consider Alice, who wants to send Bob a secret message m, and she chooses an innocuous message or cover object C at random. By using key K (also known as stego-key), the message to be shared is embedded into C, and the cover object C is

turned into stego object S. This stego object can be sent to Bob without eliciting suspicion. This should be done in such a way that a third party who only knows the seemingly innocent message S is unable to discover the secret's presence. Any data, such as image files, written text, or digital sound, could be used as the cover object. In an ideal system, neither a human nor a computer looking for statistical patterns would be able to tell the difference between a conventional cover object and the stego object [6]. To safeguard digital information on a broad scale against illegal manipulation, a suitable system is required that allows for the immediate avoidance of dangers of intellectual property theft and unlawful tampering. The reason for the initial digital communications is that information kept digitally is easier to copy than physically.

So the digital watermarking is used for better and it may be comprised of codes and for signal interpretation. Because of special detector used in this technology, different images are drawn by codes [7]. It has following properties:

1. Non-obstructive; it should be unperceivable for host signal.
2. Discreet; not authorized for some mean data and watermark sinking for some places.
3. Extracted; The data must be full of reliability for watermarking signal.
4. Robustness; the watermark must be so that modification is going on easy process of data distortion and for other applications.

The following Figure 1.2 and 1.3 shows a basic process of watermarking in which it is cleared that a watermark exhibits a sequence of binary data and applied in a special way for the purpose. This information is used for embedded system in regular process by the watermark and this procedure consists of hoist signal regarding watermark and then to be interoper-ate according to the embedded system and watermark.

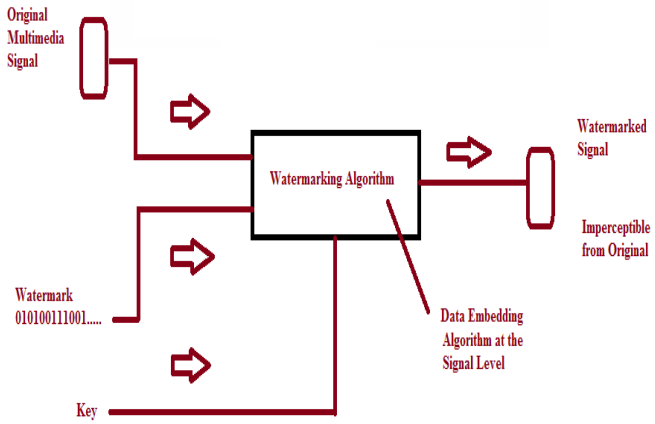

Figure 1.2: Process of embedded of watermark

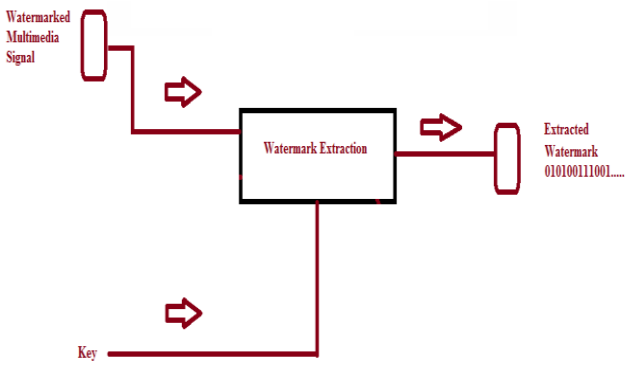

Figure 1.3: Process of extraction of watermark

Many researchers have done a good work on the digital watermarking and its algorithm design, for improvement its reliability with many obstacles and complexity according to the utmost requirements of industries and moreover the digital watermarking system. So the digital watermarking system is broadly used for multimedia communications and its different applications with its security and reliability.

II. WATERMARKING BASED ON THRESHOLD CORRELATION SYSTEM AND DCT

The threshold correlation technique of watermarking scheme consists of embedded system and many properties related to this. In these two techniques of watermarking, working in spatial mode is easy and less robust. In this mode of operation, decoding and encoding of data and messages are selected with PN block sequence and then prepare a watermark stage with embedded system.

The watermark sequence is to be checked by bit of message as 0 or 1. The procedure is to be repeated and expanded for all stages and then contributes with image of watermarking done.
Then the algorithm related to pseudo-random noise is applied and correlation between noise and watermark is done with computer technique. No check the correlation for threshold value and detection of watermark is available in the exceeding stage. This method is repeated again and again for obtains accuracy of watermark. This is used for multiple bit checking and technology also. Now the correlation factors at mean values of particular block of watermarking scheme with the PN sequence is applied for detection of watermarking.

To Embed:

a. Generate a PN sequence equal to the size of the block.
b. Process the image into blocks.
i. Define a watermarking mask of size equal to the cover image.
ii. For each message bit:
1. If the bit is '0'
a. Add the PN sequence to the watermark mask in the position of the corresponding block.
2. Else
a. Fill the watermark mask with zero-matrix of size equal to the block.
iii. Process next bit.
c. Add the watermark mask directly to the cover image after applying a gain factor of 'k'.
i. (i.e. watermarked image = cover image + k * watermark mask)

To Recover:

a. Generate a PN sequence equal to the size of the block.
b. Process the image into blocks.
c. Define a correlation vector in which to store the correlation values of each block with the PN sequence.
i. Now for each block
1. If block is identical to the PN sequence a. Make corresponding element of correlation vector as 1;
2. Else
a. Calculate the correlation of the block with the PN sequence and store the same in correlation vector.
d. Process next block;
e. For each element in correlation (iterate I)
i. If correlation (I) > mean (correlation)
1. Corresponding message bit is 0;
ii. Else
1. Set the bit to 1;

The frequency of image which is used in watermarking is generally complex and to make it easy, the technology used for this frequency into different frequency range. This technology is known as DCT based watermarking scheme. This technology is related to the Fourier Transform in which the data is working in spatial mode of operation. The basic operation of DCT is given by:

a. The input image is N by M.
b. F (x, y) is the intensity of the pixel in row x and column y.
c. C (u, v) is the DCT coefficient in row u1 and column u2 of the DCT matrix.
d. For most images, much of the signal energy lies at lower frequencies; these appear in the upper left corner of the DCT.
e. Compression is achieved since the lower right values represent higher frequencies and are often small enough to be neglected with little visible distortion.
f. The input is an N x M matrix (image) and the output is the DCT matrix of same dimension. The 2D DCT is computed by using the direct matlab function "dct2".A pseudo code is as follows:

dct_image = dct2 (input_image);

Comparison of mid-band DCT coefficients:

The DCT image technique based on mid band coefficients is one of the type of watermarking in which the conversion is made about 0 or 1 for particular watermarking scheme. Then different type of images is to be divided into some blocks and then each block is choosing for watermarking scheme with definite pixels of embedding. This data in the form of digitally as 0 or 1 remains constant for whole process of embedding. The robustness of technology is achieved by changing the pixels of data of watermarking scheme. This is constraint that no visualise of images is present in this technology. [11][12]
The algorithm of the above method is given below:

To embed the watermark:

a. Process the image in blocks.
b. For each block
i. Transform block using DCT.
ii. if message_bit is 0.

1. if dct_block (5,2) < (4,3) .
a. Swap them.
iii. Else
1. If (5,2) > (4,3)
a. Swap them.
iv. If (5,2) - (4,3) < k
1. (5,2) = (5,2) + k/2;
2. (4,3) = (4,3) – k/2;
v. Else
1. (5,2) = (5,2) - k/2;
2. (4,3) = (4,3) + k/2;
c. Move to next block.

To recover the watermark:

a. Process the image in blocks.
b. For each block
i. Transform block using DCT.
ii. If (5,2) > (4,3)
1. Message = 1;
iii. Else
1. Message=0;
c. Process next block.

To enable the middle range frequency of embedded system of a PN sequence, this technology is used for particular block. In this technology, two uncorrelated data of different PN sequence is exist in the watermarking scheme as embedded into the images. This process is completed by the divide the images into many blocks and then it precede for each block working. The size of block is so that the entire messages can be built into this block and store respective image of embedded in watermarking scheme. Then it is proceeding for different computational techniques and different messages in form of 0 or 1 are generated. Then it is compared with PN sequence and other PN sequence for improvement the correlation of watermarking technology. The algorithm for the above method is given below:

To embed:

a. Generate two "PN" sequences for 1 and 0.
b. Find two highly uncorrelated sequences by generating two random PN sequences until the correlation between them is above a certain threshold.
c. For each image block
i. Transform the block using DCT.
ii. If message_bit is 0 1. Embed pn_sequence_0 to the image block.
iii. Else1. Embed pn_sequence_1 to the image block.
iv. Take the inverse DCT
d. Move to next block.

To recover:

a. Generate two "PN" sequences for 1 and 0.
b. Find two highly uncorrelated sequences
c. Process the image in blocks.
d. For each block
i. Transform block-using DCT.
ii. Extract the mid-band coefficients.
iii. Calculate the correlation of mid-band frequencies with both the sequences.
1. If correlation (mid-band, pn_sequence_0) > correlation (mid-band, pn_sequence_1)
i. Message=0;
2. Else
i. Message =1;
iv. Process next block.

III. PROPOSED METHODOLOGY

In this section, needs of digital watermarking and embedded with color images as well as methodology adopted for the same is discussed. In this aspect, the rights of property with intellectual images, color images and multimedia images in different plane are discussed. The different planes of watermarking scheme and other extra schemes are also used for the purpose and

methodology favour. Finally, the watermarking with authentification and intersection is also observed and applied to the different color planes with embedded system. [16]

This technique of watermarking transforms the images and data with some special transform features including embedded system and transformation coefficients. Then for obtain the digital image, reverse process is applied for particular project and data. This technique has many advantages such as robustness against transformations. The work is aimed to study several techniques of digital watermarking and suggest an appropriate technique for communicate the secure and reliable data and also to synthesize the importance of proposed work against other techniques.

To enable the middle range frequency of embedded system of a PN sequence, this technology is used for particular block. In this technology, two uncorrelated data of different PN sequence is exist in the watermarking scheme as embedded into the images. This process is completed by the divide the images into many blocks and then it precede for each block working. The size of block is so that the entire messages can be built into this block and store respective image of embedded in watermarking scheme. Then it is proceeding for different computational techniques and different messages in form of 0 or 1 are generated. Then it is compared with PN sequence and other PN sequence for improvement the correlation of watermarking technology. The algorithm for the above method is given below:

To embed:

a. Generate two “PN” sequences for 1 and 0.

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c. For each image block

i. Transform the block using DCT.

ii. If message_bit is 0 1. Embed pn_sequence_0 to the image block.

iii. Else1. Embed pn_sequence_1 to the image block.

iv. Take the inverse DCT

d. Move to next block.

To recover:

a. Generate two “PN” sequences for 1 and 0.

b. Find two highly uncorrelated sequences

c. Process the image in blocks.

d. For each block

i. Transform block using DCT.

ii. Extract the mid-band coefficients.

iii. Calculate the correlation of mid-band frequencies with both the sequences.

1. If correlation (mid-band, pn_sequence_0) > correlation (mid-band, pn_sequence_1)

i. Message=0;

2. Else

i. Message =1;

iv. Process next block.

The threshold correlation technique of watermarking scheme consists of embedded system and many properties related to this. In these two techniques of watermarking, working in spatial mode is easy and less robust. In this mode of operation decoding and encoding of data and messages are selected with PN block sequence and then prepare a watermark stage with embedded system. The watermark sequence is to be checked by bit of message as 0 or 1. The procedure is to be repeated and expanded for all stages and then contributes with image of watermarking done. [19]

Then the algorithm related to pseudo-random noise is applied and correlation between noise and watermark is done with computer technique. No check the correlation for threshold value and detection of watermark is available in the exceeding stage. This method is repeated again and again for obtains accuracy of watermark. This is used for multiple bit checking and technology also. Now the correlation factors at mean values of particular block of watermarking scheme with the PN sequence is applied for detection of watermarking.

The size of watermark is depends on the blocks are to be used for embedding system. This technology is used as size of block either it is small or larger. The size of block declare the robustness and other positive attributes of correlation procedure as well as watermarking technology. By this methodology, the errors can be minimized and recovery is done in easily process. The frequency of image which is used in watermarking is generally complex and to make it easy, the technology used for this frequency into different frequency range. This technology is known as DCT based watermarking scheme. This technology is related to the Fourier Transform in which the data is working in spatial mode of operation. To enable the middle range frequency of embedded system of a PN sequence, this technology is used for particular block. In this technology, two uncorrelated data of different PN sequence is exist in the watermarking scheme as embedded into the images. This process is completed by the divide the images into many blocks and then it precede for each block working. The size of block is so that the entire messages can be built into this block and store respective image of embedded in watermarking scheme. Then it is proceeding for different computational techniques and different messages in form of 0 or 1 are generated. Then it is compared with PN sequence and other PN sequence for improvement the correlation of watermarking technology. [16]

III. SIMULATION & RESULT

In this methodology of image processing, MATLAB 7.1 is used for coding which consists of many computational programming with data embedded in watermarking scheme. The threshold correlation technique of watermarking scheme consists of embedded system and many properties related to this. In these two techniques of watermarking, working in spatial mode is easy and less robust.

Table 1 Result Analysis

	K=20			K=40			K=60		
	PSNR	BER (%)	Correlation Coefficient	PSNR	BER (%)	Coefficient of Correlation	PSNR	BER (%)	Coefficient of Correlation
Threshold based watermarking	80.36	1.2	.9410	58.47	.6	.9693	37.3	.3	.9799
DCT based watermarking	81.34	0	1	72.41	0	1	64.31	0	1
Correlation based DCT watermarking	60.37	0	1	48.63	0	1	35.44	0	1

The embedded design is used for reliable purpose and completed the whole process of watermark. The watermark has some basic features such as recoverable in different disturbances conditions and changeable situations, it must be assured that watermark is secure for a given embedded system and necessary codes for every place and entity. Accept this; it is also ensure that digital watermarking is not assurance for any undisturbed data and authentication and resist messages of unwanted with a scientific and significantly proof or evidence. Thus, DCT based watermarking technique gives better results for normal watermark embedding and extraction as indicated by lower bit error rates and higher peak signal to noise ratio.

IV. CONCLUSION

The advanced signal processing is very useful in digital watermarking concerns of theft of copyright and multimedia information. The research is going on digital watermarking in many institutes as applications.The form of embedded system is to be selected so as it is secret and understanding for the owner and respond ate of the original data such as in the image form, data form, text form or any other form. But there are some constraints to represent in this method for the person or any owning person. So it is necessary to robustness and secure for further processing.

The threshold correlation technique of watermarking scheme consists of embedded system and many properties related to this. The DCT image technique based on mid band coefficients is one of the type of watermarking in which the conversion is made about 0 or 1 for particular watermarking scheme. Then different type of images is to be divided into some blocks and then each block is choosing for watermarking scheme with definite pixels of embedding. This data in the form of digitally as 0 or 1 remains constant for whole process of embedding. The robustness of technology is achieved by changing the pixels of data of watermarking scheme. This is constraint that no visualise of images is present in this technology.

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