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A Watermark Technique based on SVD and DWT composite Function with QR-code

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ABSTRACT

Nowadays, due to development in digital image and internet technology common users can easily copy important data and produce illegal copies of image. So digital multimedia data exchange through internet is main idea which requires protection to enhance security, to resolve the copyright protection problem of various multimedia data and image, we propose different watermark technique used for data hiding by applying the QR Code technique. By using QR code we have propose DWT (Discrete-Wavelet-Transform), SWT (Stationary-Wavelet-Transform), SVD (singular-value decomposition) methodology for watermarking technique. The 2D barcode with a digital watermark is a widely interest research in security. The combination of DWT and SWT with SVD give better security, robustness and imperceptibility.

Keywords: Quick response, Discrete-Wavelet-Transform, Stationary-Wavelet-Transform, Singular-value decomposition

1. INTRODUCTION

Two important requirements in watermarking are perceptual transparency and robustness [1]. Transparency means that watermark should neither be noticeable to the viewer nor should introduce a significant degree of distortion in the host image. Robustness refers to the ability of watermark to resist intentional or unintentional image modifications such as filtering, geometric transformations, noise addition, etc. [2].The large number of digital multimedia data transmitted over internet through various applications which requires more security and authenticity due to rapid growth of multimedia and internet technology. The rapid expansion of the Internet and digital technologies in the past years has sharply increased the ease of the production and distribution of digital media[3]. The main idea of steganography is the embedding of secret information into data under the assumption that others cannot know the secret information in data. The main idea of watermarks is to check the logo embedded in data or not [4]. In this, the data hiding process is more important. Data hiding shows processes used to embed data, such as copyright information, various companies important documents etc. transfer over internet link and convert into various forms of media such as image, audio, or text with a minimum amount of perceivable degradation to the "host" signal; so that embedded data should be invisible and inaudible to a human observer, So that data can be prevent. Its goal is not to restrictor regulate access to the host signal, but rather to ensure that embedded data remain inviolate and recoverable. Data hiding in audio signals is especially challenging, because the human auditory system (HAS) operates over a wide dynamic range. The HAS perceives over a range of power greater than one billion to one and a range of frequencies greater than one thousand to one [5]. Based on the type of document to be watermarked Text Watermarking: Line shift coding, word shift coding, feature coding. Visible Watermark: The information is visible in the picture or video. Typically, the information is text or a logo which identifies the owner of the media. Invisible Watermark: An invisible watermark is an overlaid image which cannot be se en, but which can be detected algorithmically. Dual Watermarking: Dual watermark is a combination of a visible and an invisible watermark. In this type of watermark, an invisible watermark is used as a backup for the visible watermark [4]. Another classification of watermarking system is based on the domain in which the watermark is embedded. If watermark is embedded by modifying the intensity value of the pixels then it is called spatial domain watermarking, if the frequency coefficients are changed then it is called transform domain watermarking system. Many transformation techniques are used for transforming image from spatial to frequency domain which includes Discrete Fourier Transform (DFT), discrete cosine Transform (DCT), Discrete wavelets transform (DWT) and Discrete Hadamard Transformation (DHT) [7].QR Code is a type of 2-D (two-dimensional) Symbology developed by Denso Wave (a division of Denso Corporation at that time) and released in 1994. It is capable of handling all types of data, such as numeric and alphabetic characters, Kanji, Kana, Hiragana, symbols, binary, and control codes. Up to 7,089 characters can be encoded in one symbol. It has large Kanji- and Kana-holding Capability, and has error correction capability. Data can be restored even if the symbol is partially dirty or damaged [6].In this paper, we present method of watermarking by using combination of DWT and SWT with SVD with the help of different technology based on QR code. In the literature survey, many technique uses the SVD-DWT based embedding for gray scale mage watermarking. The color image is represented by Red (R), Green (G) and Blue (B) channels. Out of these three channels, change in the intensity of R channel is the most sensitive to human eyes

whereas for B channel it is least sensitive [17]. Hence, in the proposed scheme the blue channel is considered for embedding. The wavelet transform of image gives four frequency sub-band coefficients. In image processing each subband is resistant to different types of attacks or transformations. For example, the low frequency subband coefficients are less robust to geometrical distortions and histogram equalization [16]. This paper Organized as following sections. Theory is described in section 2; Section 3 introduced the Proposed Model. Testing and Performance Analysis and the results are discussed in section 4. Section 5 shows Conclusion and finally References are given in the last Section.

2.THEORY

2.1QR Code

QR Code is a matrix symbol that consists of an array of nominally square modules arranged in an overall square pattern. QR Code includes unique finder pattern located at three corners of the symbol and intended to assist in easy location of its position, size and inclination. A wide range of sizes of symbol is provided together with four levels of error correction. Symbol structure of QR Code is as following [8].

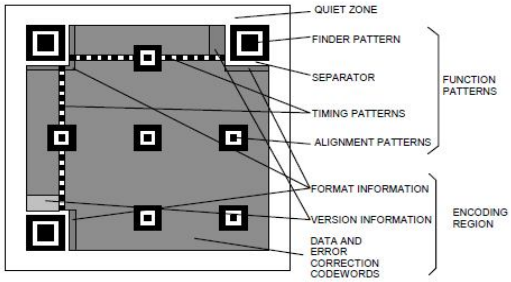

Figure 1 Symbol structure of QR code

Figure1 shows the structure of the QR Code, which includes:

1) Finder Pattern is consisting of three identical structures which are located to three corners excepting lower right corner. This is used to detect the position of QR Code for Application to the decoder.

2) Format Area consists of 15 bit. It is used to store data, Data Type and Data Mask; this is involved in transcription and also information about the error correction level of QR code.

3) The alternate black and white modules of timing Pattern help the decoder software to determine the width of single module. It is helpful to detect the coordinates of the symbol for decoding.

4) Alignment Pattern supports the decoder software in compensating. The alignment pattern in the images can be read correctly by Decoder Application.

5) In data area, the data is converted into 8 bit part called as code words. The data Area generally store data, QR Code, which is the most space.

6) Quiet Zone is a region of the spec demolishing the white space which helps to boost the Finder Pattern to Detect quickly.

Table 1. General capacity of QR codes

Encoding mode	Maximum capacity
Numeric	7089
alphanumeric	4296
binary	2953
Kanji	1817

In version 1 measures 21 modules × 21 modules, Version 2 measures 25 modules × 25 modules and so on increasing in steps of 4 modules per side up to Version 40 which measures 177 modules × 177 modules. Four levels of Reed-Solomon error correction (referred to as L, M, Q and H in increasing order of capacity) allowing recovery for the code words in 7%, 15%, 25% or 30% respectively [8]. Barcodes, which are considered as an automatic recognition method with high-speed reading, high accuracy, low-cost and high-reliability, is widely applied in commodity labels, data security, anti-counterfeiting, electronic commerce and many other fields. It can be classified into two types, one-dimensional (1D) barcode and two-dimensional (2D) barcode [7].

Figure 2 One dimensional bar code

Figure 3 The QR code (2d barcode)

Above figure shows the structure of both 1D and 2D barcode which are used in digital watermarking technique for data hiding purpose In this section we are also going to study detailed information about DWT, SWT and SVD methodology of watermarking scheme based on technology used for different approach:

A. Singular value decomposing (SVD*):-* SVD decomposes an MxN real matrix A into a product of 3 matrices A=USV where U and V are mxm and nxn real and complex unitary matrices, respectively. S is an mxn diagonal matrix. The elements of S are only nonzero on the diagonal and are called the SVs of A. The watermarking procedures are described as follows [9]:

2.1.1 Watermark embedding:- Without loss of generality, let the size of the host image (I) and watermark (W) is NxN

1. Apply SVD to the host image:

$I=USV$ **(1)**

2. Modify the S with the W:

$S_M=S+kW$ **(2)**

3. Apply SVD to the S_M

$S_M=U_W S_W V_W$ **(3)**

4. Compute watermarked image:

$I_W=US_WV$ **(4)**

2.1.2 Watermark Extracting:- Generally, the extraction process is nothing but the inverse of the embedding procedure. In the watermark extraction process, a possibly distorted watermark W is extracted from the possibly distorted watermarked image by I^*_W essentially reversing the above watermark embedding steps. The watermark extraction can be shown as follows:

1. Apply SVD to the watermarked (possibly distorted) image:

$I^*_W=U^*S^*_WV^*$ **(5)**

2. Compute possibly corrupted S^*_M:

$S^*_M=U_WS^*_WV_W$ **(6)**

3. Extract the watermark (possibly distorted) image:

$W^* = (S^*_M-S) / k$ **(7)**

Discrete Wavelet Transform (DWT):- Discrete Wavelet transform (DWT) is a mathematical tool for hierarchically decomposing an image [10]. It is useful for processing of non-stationary signals. The transform is based on small waves, called wavelets, of varying frequency and limited duration. Wavelet transform provides both frequency and spatial description of an image. Unlike conventional Fourier transform, temporal information is retained in this transformation process [11]. The basic idea of discrete wavelet transform (DWT) in image process is to multi-differentiated decompose the image into sub-image of different spatial domain and independent frequency district [12] [13]. Then transform the coefficient of sub-image. After the original image has been DWT transformed, it is decomposed into 4 frequency districts which is one low-frequency district(LL)and three high-frequency districts(LH,HL,HH). If the information of low-frequency district is DWT transformed, the sub-level frequency district information will be obtained. A two-dimensional image after three-times DWT decomposed can be shown as Fig.4. Where, L Represents low-pass filter, H represents high-pass filter. An original image can be decomposed of frequency districts of HL1, LH1, and HH1. The low-frequency district information also can be decomposed into sub-level frequency district information of LL2, HL2, and LH2 andHH2. By doing this the original image can be decomposed for *n* level wavelet transformation [14].

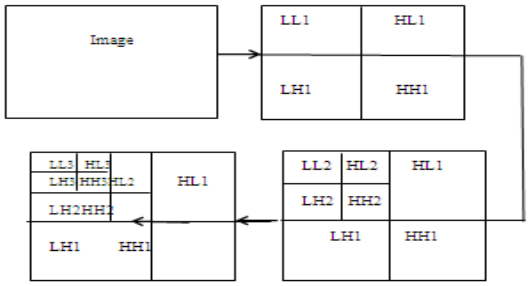

Figure 4 Discrete wavelet decompositions

DWT is currently used in a wide variety of signalprocessing applications, such as in audio and videocompression, removal of noise in audio, and the simulation of wireless antenna distribution [15].

3.PROPOSED METHOD

3.1. Embedding Process:- In embedding process video file is taken as input file and convert that input file in number of frames. Make the frame separation into RGB channels. We have taken B-frame as a input frame and apply SVD to it. Insert logo image by applying SVD to it. Then apply DWT on both B-frame and logo image. Take QR code image and apply DWT to it. Next apply IDWT to obtain the watermarked image. Finally add watermarked B-frame in a video file.

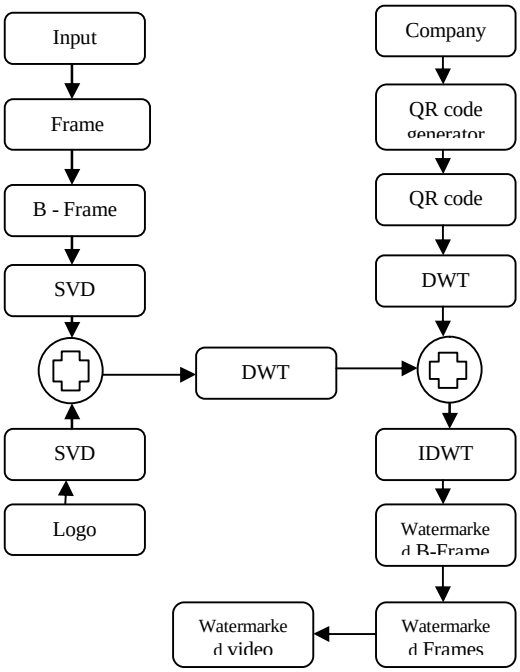

Figure 5 Block diagram of embedding process

1) Algorithm for embedding process:
Step1: Read the input video file and convert into number of frames.
Step2: Separate RGB channels, R-frame, G-frame, and B-frame
Step3: Take B-frame image as a input image (cover image)
Step4: Add logo and apply SVD to it, to get SVD cover image of original logo image.
Step5: Add both SVD cover image and SVD logo image i.e. watermarked image.
Step6: Apply DWT on watermarked image.
Step7: Take the QR code image and apply DWT to it
Step8: Combine both DWT images i.e. watermarked and QR code DWT image.
Step9: Take the inverse DWT on the combined image to get watermarked B-frame.
Step10: Finally watermarked frame images to get watermarked video files.

3.2 Extracting Process:- In the extracting process, SVD is applied to watermarked image and recover the logo image. Apply DWT on original image and watermarked B-frame extracted. Take the IDWT to obtain the QR code image. Logo is extracted by using singular value component. Above same process can also be done by using SWT instead of DWT. We will see only the comparisons of result after performing same process for both SWT and DWT in the section of result and performance analysis.

4.TESTING AND PERFORMANCE ANALYSIS

The series of experiments are conducted to analyze the effect of embedding and extraction algorithm on the color image. In our experimental Video sequence.avi in 256X256 and gray format are used for watermarking embedding. The length of Video sequence is depending upon the size of video file. In this input video is converted into numberofframes.Depending upon size of the video number of frames is different for different video. In this every time size of the image can be resize into 256x256 formats. The performance of the proposed method is evaluated by using Matlab 7.6 R2008a version.

4.1 Testing of various parameters for image quality using DWT

(a) The input frame is taken from input video by converting input video into number of frames.

Figure 6 Input frame

(b) B-panel image is obtained by using R-G-B separation technique which is used to hide the authorized data.

Figure 7 B-panel image

(c) The logo image is that image which is an important image of an authorized customer. The logo image is then hiding into B-frame image in order to increase the security of data.

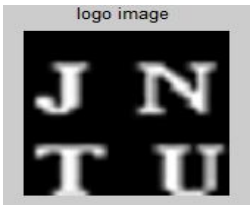

Figure 8 Logo image

(d) The watermarked image is obtained by applying SVD on both B-frame and logo image

Figure 9 Watermarked image

(e) This watermarked DWT image is obtained by applying DWT on the watermarked image.

Figure 10 Watermarked dwt image

(f) QR image generated through internet which contain important data or name of the company. Apply DWT on QR image to get image in DWT form.

Figure 11 QR image

Figure 12 Watermarked DWT image

(g) Then again hide this watermarked DWT image into first watermarked image which contain logo.

Figure 13 Watermarked image

(h) This reconstructed image is again obtain by applying IDWT

Figure 14 Reconstructed image

(i) This reconstructed of video by adding total number of frames.

Figure 15 Reconstructed video

(j) The logo and QR image is extracted by using inverse IDWT.

Figure 16 Extracted logo

Figure17 Extracted QR image

Above all are the outputs obtained based on SVD and DWT technique in future it is also possible by using SWT.

4.2 Results and analysis of various parameters:- In this method, first select B-frame for hiding the authorized data. The B-frame can obtain by making the R-G-B separation of selected input frame from number of frames of input video. So here some of parameters of the image quality have been illustrated in the table 5.2 The image quality parameters like MSE, RMSE and PSNR are calculated using their equations as:

1) Mean Square Error (MSE):- It is defined as the square of the error between cover image B-frame and watermarked image. The distortion in the image can be calculated using MSE equation.

$$\text{MSE} = \frac{1}{MN}\sum_{j=1}^{M}\sum_{k=1}^{N}\left(x_{j,k} - x'_{j,k}\right)^2$$

2) Root mean square error (RMSE):- It is defined as the square root of mean square error. Also defined as square root of the distortion in cover B-frame and watermarked image.

$$\text{RMSE} = \sqrt{\left(\frac{1}{MN}\sum_{j=1}^{M}\sum_{k=1}^{N}\left(x_{j,k} - x'_{j,k}\right)^2\right)}$$

3) Peak Signal to Noise Ratio (PSNR):- It is defined as the measure of the quality of the image by comparing the cover B- frame image with the watermarked image. The statistical difference between cover B-frame image and watermarked image is calculated using equation as:

$$\text{PSNR}=10\frac{log_{10}(255)^2}{MSE}db$$

Table 2. Analysis of parameters of watermarked image

Video file as input	Video file size (MB)	MSE	RMSE	PSNR
1.avi	6.76	15.5516	3.9435	36.2131
2.avi	7.19	15.0598	3.8807	36.3525
3.avi	8.90	16.2554	4.0318	36.0208
4.avi	75.6	14.1500	3.7616	36.6232
5.avi	75.6	14.8221	3.8499	36.4216
6.avi	75.6	11.2804	3.3586	37.6075
7.avi	75.6	10.4349	3.2303	37.9458
8.avi	75.6	6.8409	2.6155	39.7796
9.avi	75.6	6.8014	2.6079	39.8047
10.avi	75.6	13.0772	3.6162	36.9656
11.avi	42.7	3.9653	1.9913	42.1481

(Noisy video)				

The various parameters of the image quality like MSE, RMSE and PSNR are calculated using their formulae and observed. Therefore the quality of proposed method is better than existing method.This dual method provides new way of hiding data more securely in watermarking techniques. The logo is hide with QR image which contain same important text like company name, college name etc. for security purpose. In this process robustness of watermarked image is high which avoid various image processing attacks like noise addition, rotation etc.

5.CONCLUSION

In this proposed methods of embedding a digital watermark QR Code in a still image which is spread online. This dual method has described the improved imperceptibility (means very slight) and security watermarking. In this, QR code encoding and decoding process has excellent performances. In this technique first of all watermark (logo) was embedded in the diagonal element by applying SVD on logo image.In the other technique text messages is embedded in the QR code image. So, the dual process is obtaining two authentication and secure detail information. The logo image is hided very safely in the QR code image. This method is very simple, convenient, and feasible and practically used for providing copyright protection against the data hackers. The described method is highly robust to compression and additive noise. In this, we also describe technique by using DWT and SVD and gives result for the methods by showing their practical result, which increase more robustness and authentication. By using this we are able to transfer data more securely.7. From the Experimental results finally it is concluded that by using this system can achieve acceptable certain robustness to video processing which is hardly possible with the other method.

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Ashwini Kor Contributing significant value to an organization with my academic record, theoretical knowledge and practical know-how with my ability to deliver original concepts in the field of Electronics Engineering and to create path breaking mile-stones in the company with my exemplary sports caliber I have completed Electronics and Tele-communication engineering from Pune University. Currently, I am doing M.E. from SSBT's COLLEGE OF ENGINEERING AND TECHNOLOGY, Jalgaon. I already have industrial knowledge and wasworked in Adeypt Fluidyne Pvt. Ltd, Pune as Production Engineer.