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Robust Reversible Watermarking Using Normalized Correlation Based QIM Combined with LSB and DCT Techniques

[1]M. Subbulakshmi and [2] M. Vijayaraj
[1]Department of ECE, National College of Engineering, 627151 Maruthakulam, Tamil Nadu, India
[2]Department of ECE, Government College of Engineering, 627007 Tirunelveli, Tamil Nadu, India

Abstract: Researchers consider the problem of embedding one signal within another host signal to form a third, "composite" signal. The embedding is calculated to achieve among the three conflicting goals of reduce the distortion, increase the information-embedding rate, between the host and composite signal and improve the robustness of the embedding. We introduce new modules of embedding methods, termed Normalized Correlation based Quantization Index Modulation (NCQIM) Combined with Least Significant Bit (LSB) and Discrete Cosine Transform (DCT) techniques and improve suitable realizations. The proposed method is simulated on different images and the watermark imperceptibility is achieved by using the parameter Peak Signal to Noise Ratio (PSNR). The robustness is increased by reducing Bit Error Rate (BER). This proposed technique achieves high embedding capacity in high noise environment, high robustness when compared to conventional Quantization Index Modulation (QIM) methods.

Key words: Bit error rate, imperceptibility, peak signal to noise ratio, uniform, quantizer

INTRODUCTION

Digital image processing is an emerging area with various floating applications in engineering fields. This techniques are used in human computer interface, medical visualization, image enhancement, illustration effects, image restoration and digital watermarking for security data from purpose. Digital image processing has many beneficial properties over the analog image processing. It plays an increasingly important role in many aspects of our daily life. The processing of images is faster in digital image processing. It is accomplishing variant computer operations on digital imaging for various resolutions like enhancing image quality, filtering images from noise. A digital image is a representation of two dimensional images as a finite set of digital values known as picture elements or pixels. The digital communication technology, confronts various issues related to the privacy and security of the data (Cox *et al*., 1999). Various Security systems are required as a result of illegal access of data without permission. Therefore, it is necessary to protect data in the all relevant technology. Steganography means science of writing hidden messages (Cox *et al*., 2008). The digital watermarking is an application of the digital image processing. It is a process of information hiding. It is a very developing field and used in various applications.

In digital image watermarking, a secret information or symbol is embedded in another image in an imperceptible manner (Moulin and Kotter, 2005). This secret information or symbol is called watermark and it contains some data, like security about the main image. The main image in which the watermark is embedded is identified as cover image since it covers the watermark. Watermarking system should be designed by considering the following factors: imperceptibility of the watermark: Imperceptibility means that the watermarked content is perceptually indistinguishable from the original. This is perhaps the most important property of all watermarking schemes. The watermark must be embedded in the image in such a way that the resulting watermarked image is not visually distorted. This property is related to the robustness of the watermark and hence an optimal balance between imperceptibility and robustness must be achieved by the watermarking scheme. Robustness of the watermark: Robustness refers to the ability that the watermark survives various attacks, like compression, additive noise, filtering, etc.

There are many types of attacks for a watermarking scheme including noise, filtering, resizing, image compression, cropping and the robustness to such attacks depends on the type of watermarking. Payload is the amount of information to be embedded into host data. It is described as the total amount of watermark

Corresponding Author: M. Subbulakshmi, Department of ECE, National College of Engineering, 627151 Maruthakulam, Tamil Nadu, India

information bits that can be stored in the image. It is generally considered that the more the watermark bits (payload) in an image the higher the robustness of the watermark. Efficiency: It is the speed with which an algorithm performs the insertion and the detection of a watermark. The importance of each property is application dependent (Wu and Liu, 2003).

Frequency domain watermarking methods may use several different domains, such as DCT, i.e., discrete cosine Transformation domain, Discrete Fourier Transformation domain (DFT), Discrete Wavelet Transformation (DWT) domain, Fast Hadamard Transform (FHT) domain. The watermarking algorithms can be named according to the embedded multimedia data such as text, image, audio and video watermarking. In the existing method, Spread Transform Dither Modulation (STDM) (Chen and Wornell, 2001a, b; Perez-Gonzalez *et al*., 2005), QIM, Rational Dither Modulation (RDM), Logarithmic Quantization Index Modulation (LQIM) techniques are used to extract the watermarked signal (Perez-Gonzalez *et al*., 2005). In the STDM method, watermark data is coded with pseudo random code sequence to spread power spectrum in the image. It allows reliable communication in noisy environments. Spread Spectrum (SS) methods are restricted by host signal interference when the host signal is not known at decoder (Zareian *et al*., 2013). In the QIM method, the amplitude of single pixel or a vector of pixels are quantized using quantizes. This method reduces square error distortion constrained intentional attacks.

QIM leads to poor fidelity (Cox *et al*., 1999). The RDM method uses Watson's perceptual model to change the quantization step size for improving fidelity. It is achieved for improving robustness in high noise regions. It is used to deal with quantization noise. It uses pseudo random dither signal to produce a superior quantized signal. In the LQIM method, the logarithmic function is initially applied to the host or input signal. Then the transformed signal is quantized using uniform quantization to embed the watermark data. Using inverse transform, watermarked signal is obtained. This method is used for only vector quantization and it is less efficient method (Kalantari and Ahadi, 2010). Problems in existing method is STDM leads to poor fidelity (Bartolini *et al*., 2004). Robustness is not achieved in highly nonlinear amplitude changes for example gamma correction method. Even small changes in brightness of an image can result in dramatic increases in bit error rate.

Normalized Correlation based Quantization Index Modulation (NCQIM) is the extension of QIM (Zhu and Ding, 2012; Kalantari *et al*., 2010). In this study, we refer to as Normalized Correlation based Quantization Index Modulation (NCQIM) Combined with Least Significant Bit (LSB) and Discrete Cosine Transform (DCT) techniques that is, in general, many specific situations optimal. Where the feature signals for modulation is the Normalized Correlation formed by the host signal and a random signal. To perform the information modulation, the structured codebooks are designed using uniform quantizes. The watermarked signal is produced by the embedding function in order to form the modulated NC with the random signal. The LSB and DCT method is used before embedding the watermarked message. The watermark imperceptibility and robustness of this method is achieved using the parameters Peak Signal to Noise Ratio (PSNR) and Bit Error Rate (BER) respectively.

Literature review: In digital watermarking, the side information is knowledge of the host signal which is available to the watermark embedded. The channel distortion creates an unknown noise source. For this issue, Costa (1983) shows that the capacity of a channel with additive Gaussian noise and power input is not affected if some additional Independent Identically Distributed (IID) noise sequence is added to the output channel, as long as full knowledge of this additional noise sequence is given to the encoder. The optimal decoder will not have a good estimation of the transmitted signal nor will he have a good estimate of the sequence. It will decode a linear combination of the transmitted signal and the sequence. Costa's effect implies that it is possible to design a watermarking system that obtains null host signal interference (Eggers *et al*., 2003; Fridrich *et al*., 2002). A lot of implementations have been presented, most of which consist of quantization procedures. He presents a theoretic scheme that involves a random codebook. The ideal Costa scheme is not practical due to the involved huge random codebook.

The side information is knowledge of the host signal which is available to the watermark embedded. This leads to several novel characteristics and insights regarding embedded signaling. Cox *et al*. (1999), Li and Cox (2003) suggested that perceptual modeling had significant utility for watermarking.Severalexisting watermarking algorithms assume knowledge of the original, unwatermarked overdata at the detector. It needs more sophisticated algorithm to develop watermark.

Miller and Bloom show that, if the Probability Density Function (PDF) of vectors that arise from random, unwatermarked media is a zero mean, spherical Gaussian and then such a detector will give a false detection which is given exactly by a simple ratio of two definite integrals. A critical issue for many applications is the likelihood that the watermark detector incorrectly identifies some unwatermarked media as containing a watermark. Such an error can lead to the erroneous prevention of a valid operation. The exact formula used for computing the detection measure is critical to determining the probability of false detection.

A new class of embedding methods, termed QIM and Distortion Compensated QIM (DCQIM) was introduced by Chen and Wornell (2001a, b), using deterministic models to evaluate digital watermarking techniques, they illustrate that QIM is provably very good against arbitrary bounded which arise in several copyright applications and also it achieves provably better information rate distortion robustness than currently popular SS and Low Bit Modulation (LBM) methods. Both LBM type strategies and additive SS are, in general, not good selections for most digital watermarking applications and information embedding system. QIM methods are probably better than additive SS and generalized LBM against limited perturbation and are near-optimal. Furthermore, Dither Modulation (DM) is a practical implementation of QIM that exhibits many of the attractive performance properties of QIM.

The adaptive quantization step size is used, instead of a fixed one, for the SCS. Oostveen propose an adaptation method based on Weber's law (Ourique *et al*., 2005). This allows for a more effective embedding which is also shown to the watermark robustness against sample value scaling. A model for the bit error probability due to the estimate of the adaptive quantization step size at the detector side is derived, it provides the required precision of estimating the step size of the quantization in the detector. The QIM schemes are optimal from an information theoretical capacity maximize point of view; their robustness may be too limited for widespread practical usage. A sample step size is taken proportional to the average value of a number of neighboring samples. This allows the approach for perceptual shaping of the watermark techniques according to Weber's law. Moreover it leads to robustness against value scaling. The model for the effect of step size assessment errors on the bit error probability is developed (Lan and Tewfik, 2006). This model can be used to calculate the needed precision of estimation of the adaptive quantization step size.A quantization scheme is insensitive to amplitude scaling attacks, known as Angle Quantization Index Modulation (AQIM) (Mankar *et al*., 2009), (i.e.,) embedding information by quantizing the amplitude of pixel values, AQIM technique works by quantizing the anglevalue formed by the host signal vector with the origin of a hyper spherical coordinate system. Experimental results are obtainable for the bit error rate performance of AQIM under AWGN attacks. A new QIM scheme is provably insensitive to amplitude scaling attacks. It is exposed that AQIM is robust against any amplitude scaling parameter. This robustness problem was the main drawback of QIM based modulation, where even small scaling parameters could severely compromise correct message decoding.

A new method for LQIM is proposed by Kalantari and Ahadi (2010), in this a logarithmic function is first applied to the host or input signal. Then the transformed signal is quantized using uniform quantization as conventional QIM to embed watermark data within that. Finally using inverse transform the watermarked signal is achieved. The watermark extraction is done using minimum distance decoder. The optimum parameter for data embedding with minimum quantized distortion is derived. And also the probability of error is analytically calculated and verified by simulation. It is used for only vector quantization.

MATERIALS AND METHODS

In this study, the NC-QIM, LSB and DCT techniquesare combined for embedding and extracting the watermarked message. This method is used to increase the robustness of the watermarked image. The robustness is one of the characteristics of watermarking. Most schemes require that the watermark be recovered even if the watermarked image is distorted and this distortion may be accidental or deliberate. So, the watermarked image should be robust against any attacks. Figure 1 explains that, the host signal or input signal is transformed into the feature signal. In this transformation (Zhu and Peng, 2012), the normalized correlation is calculated between the host signal and the random signal. Then the modulation is performed on the feature signal and watermark message. The LSB method is applied in this modulated signal. Then DCT method is applied. Then the embedding function is performed to produce the watermarked signal. This watermarked signal goes through the channel. At decoder side, the received signal is transformed into feature signal by using NCQIM technique which is done at embedded side and LSB method is used. Then, the watermarked message is extracted from feature signal.

Normalized correlation based quantization index modulation: The design of NCQIM has two main functions:

- Feature selection
- Information modulation

In the design of the feature modulation watermarking, a serious issue is to generate the feature signal from the

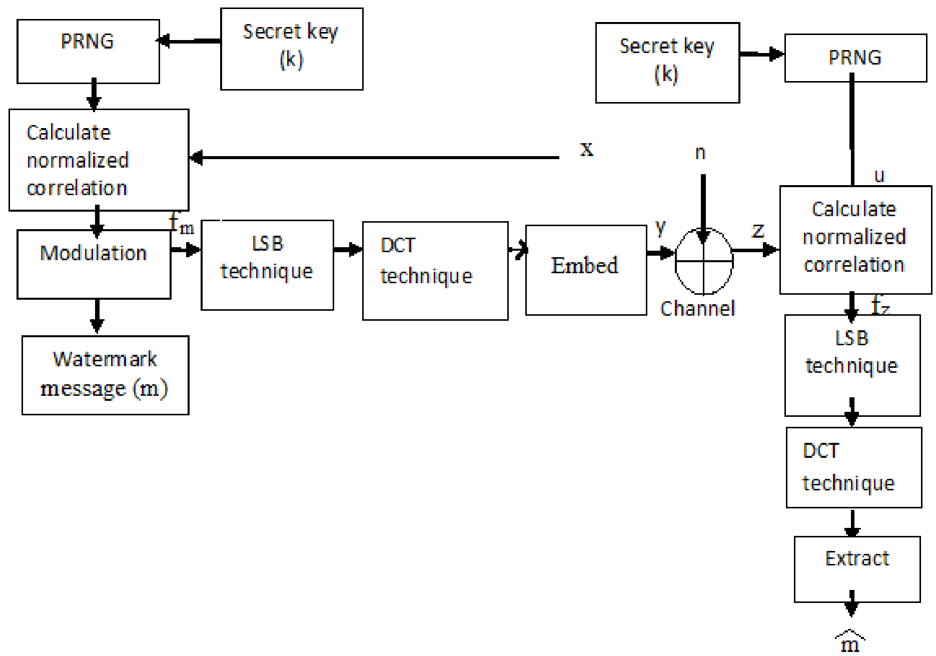


Fig. 1: Block diagram of the watermarking model

host signal. For this purpose, the features should be selected by taking into account the properties of the utilized modulation technique. The feature signals are obtained by using PRNG seeded with the secret key. Moreover, this process helps to improve the robustness against other types of attacks. Feature should be constructed for modulation. The host feature signal (f_x) by computing the normalized correlation of the host vector (x) and a random vector (u) is:

$$f_x = x^T u/||x||\ ||u|| \qquad (1)$$

Where, the vector (u) is obtained by a PRNG initialized with the key (k).

Pseudo random number generator: PRNG is an algorithm for creating a sequence of numbers whose properties almost equal to the properties of sequences of random numbers. Pseudo random numbers are numbers that are not truly random, produced by some mathematical system called PRNG. It is completely calculated by a small set of initial values called the PRNG's seed. Pseudo random numbers are generated by providing an arbitrary seed value to PRNG. In watermarking, the PRNG seeded with the secret key (k). The value of k is increased toincrease the robustness of the watermarked image.

Normalized correlation: Normalization is a process that changes the range of pixel intensity values. The normalized correlation has been commonly used as a metric to evaluate the degree of relationship (or) difference between two compared images. Advantage of normalized correlation is less sensitive to linear variations in the amplitude of illumination in the two compared images. In water marking, the normalized correlation is calculated between the host signal and random signal. The random signals are made by a PRNG seeded with the secret key and also used for the generation of host signals and watermarked signals. This increases the probability of correct detection.

Quantization index modulation: The information modulation is accomplished by a quantization operation in NCQIM. The QIM refers to embedding information by modulating a sequence of indices with the embedded information and then quantizing the input signal with the associated sequence of quantizes. In this method the amplitude of single pixel (or) a vector of pixels is quantized using quantizes.

Given the quantization step Δ and a dither value d [-Δ/4, Δ/4], the sets σ_0 and σ_1 are, respectively represented by:

$$\sigma_0 = \{k\Delta+d/k\ \sigma z\}\cap[-1, 1] \qquad (2)$$

$$\sigma_1 = \{k\Delta+d+1/2\cap|k\ \sigma z\}\cap[-1, 1] \qquad (3)$$

This is used for normalized correlation. The normalized correlation f_x is then modulated with the hidden symbol m by selecting a code word f_m from the corresponding codebook σ_m to replace f_x. This can be implemented by a quantization operation. Uniform quantizer is used in this study for QIM to reduce distortion or losses.

LSB based watermarking: Images are represented/stored in spatial domain along with in transform domain. The transform domain image is represented in terms of its frequencies, whereas in spatial domain it is represented by pixels. In spatial domain, the watermark can be embedded by modifying LSB values of each pixel in the images. The best known watermarking method that works in the spatial domain is the LSB which replaces the LSB of pixels selected to hide the information. It is the simplest data-embedding method (Celik *et al*., 2005). In this well-known method, the LSB of each signal value is replaced by a payload data bit embedding one bit of data per input value. During extraction process, these bits are read in the same scanning order and payload data is reconstructed. LSB modification is a simple, robust embedding technique with a high embedding capacity. It is desirable that the watermark cannot be removed from the host image. However, several intentional attacks and unintentional operations with the watermarked image may provide possibility for deactivating the watermark. Generally, these operations are referred as attacks against watermarks.

DCT based watermarking: The DCT is an orthogonal transform for digital image processing and also signal processing with some advantages such as small bit error rate, good information integration. Discrete Cosine Transform allows an image to be broken up into various frequency bands namely the high level, middle level and low level frequency bands thus making it easy to choose the band in which the watermark content is to be inserted. Two locations from the frequency band middle level are chosen as the region. The selection of the two locations is based on the JPEG quantization given below in Table 1 with original and watermarked images. The two locations with same quantization values are selected for embedding one watermark bit of information.

The DCT block will encode a “0” otherwise it will encode a “1”.Then the coefficients are swapped if the relative size of each coefficient does not settle with the bit that is to be encoded. The number of watermark bits that embedded is directly in need of on the number of pairs of locations in quantization table also with similar values. This scheme is hiding watermark content by means of interpreting “0” or “1” with absolute values of two fixed locations in middle level frequency region. Swapping of coefficients will not alter the watermarked image. The robustness of the watermark can be enhanced by introducing a watermark strength.

Watermark embedding and extraction function: The embedding function Em (.) is designed to produce a watermarked signal. In this model, the information modulation is not directly done on the input signal itself but on a feature signal transformed from the host signal which is quite different from the existing watermarking methods. The performance improvement can be brought about if an appropriate feature is utilized. The watermark signal is embedded in the original image after applying LSB technique. The watermarked signal goes through a particular channel where it might be subjected to various common signal processing manipulations. The Gaussian noise is added in the channel to reduce the losses. This Gaussian noise is added in the channel to produce distorted watermarked signal. The distorted watermarked signal can be written as:

$$z = y+n \tag{4}$$

Where:

z = Distorted watermarked signal
Y = Watermarked signal

Watermark extraction: At the decoder side, the received signal z is first transformed into the feature signal f_z as done at the embedded side. Then, a message m is extracted from f_z according to the correspondence

Table 1: The original image and corresponding watermarked images

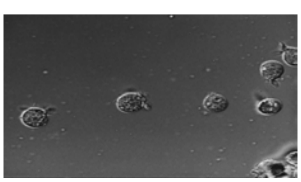
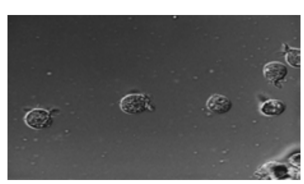
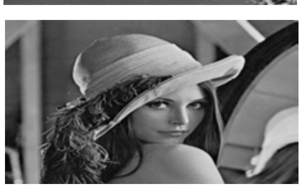
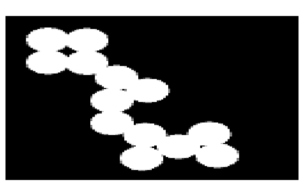
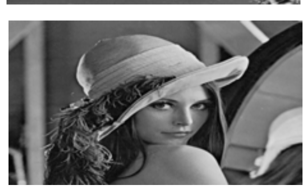
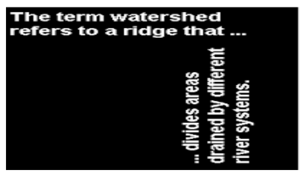
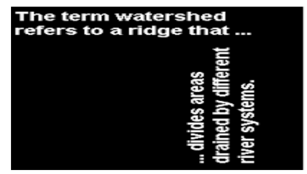
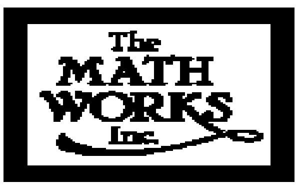
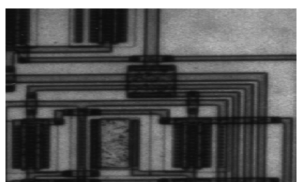
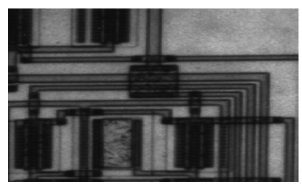
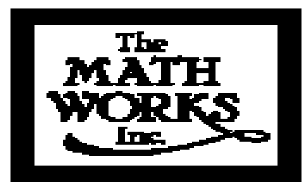
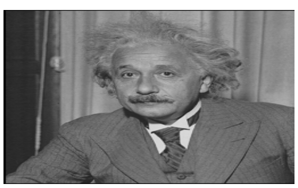
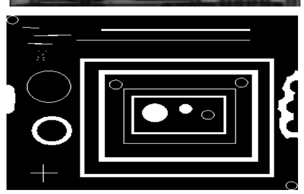
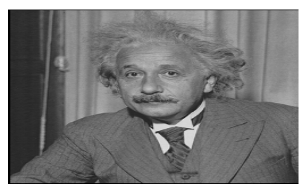
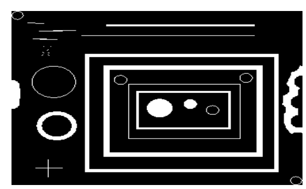
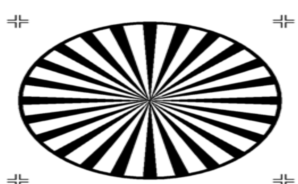
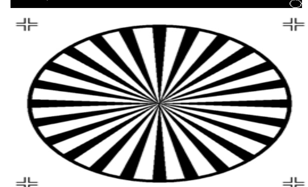
Original Images	Original watermark	Watermarked images	Recovered watermark
			
			

Table 1: Continue

Original Images	Original watermark	Watermarked images	Recovered watermark
			
			
			
			
			
			
			
			

between the watermark message and the utilized feature which is established during the information modulation process and a message is extracted from f_z.

Parameter analysis

Watermark imperceptibility: Imperceptibility means that the watermarked content is perceptually indistinguishable from the original image. This property is related to the robustness of the watermark and hence an optimal balance between imperceptibility and robustness must be achieved by the watermarking scheme. Imperceptibility can be measured using Peak Signal to Noise Ratio (PSNR) between host and watermarked image and Root Mean Squared Error (RMSE). The PSNR value is calculated by using Mean Squared Error (MSE).

Peak Signal to noise ratio: The visual quality of the embedded images can also be measured using the PSNR. It is the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. It is used to measure the distortion between an image and its watermarked version. It is the most easily defined via the Mean Squared Error (MSE).The PSNR is defined as:

$$\text{PSNR} = 10\log_{10}(\text{MAX}^2/\text{MSE}) \text{ in decibels} \quad (5)$$

Where:
MAX = Maximum pixel value of the frame
MSE = Mean Squared Error and
R = Maximum possible pixel values

The MSE measures the statistical difference in the pixel values between the original and the reconstructed image. The MSE is defined as,

$$\text{MSE}(x,y) = \frac{1}{MN}\sum_{y=1}^{M}\sum_{x=1}^{N}[I(x,y) - I'(x,y)]^2 \quad (6)$$

Where:
X = Original image
Y = Watermarked image
M, N = Size of the original image

A lower MSE value means a better image quality, (i.e.,) lesser distortion in the cover image. While the higher the PSNR value means the better image quality. The PSNR value should be high to increase the imperceptibility of the watermark.

The RMSE is a quadratic scoring rule which measures the average magnitude of the error. RMSE is most useful when large errors are particularly undesirable. It is calculated by using Eq. 7:

$$\text{RMSE} = \text{sqrt}(\text{MSE}) \quad (7)$$

Robustness: Robustness refers to the ability that the watermark survives many attacks, like additive noise, compression, filtering. This is required to ensure the reliable extraction of the embedded data. This is another important property of a good watermarking scheme. Most schemes require that the watermark be recovered even if the watermarked image is distorted and this distortion may be accidental or deliberate. The robustness can be achieved by using the parameter BER. Bit Error Rate is determined by Inverse of PSNR values:

$$\text{BER} = \frac{1}{\text{PSNR}} \quad (8)$$

The more is BER lesser will be the quality of the Watermarking technique. So BER is inversely proportional to PSNR. More the value of BER lesser will be PSNR value.

RESULTS AND DISCUSSION

In this study, the simulation process is implemented in MATLAB using different types of host images and watermark images. For analysis purpose gray scaled image is used. Table 1 describes the original and watermark images are as follows.

The performance evaluation can be analyzed by using the Peak Signal to Noise Ratio (PSNR). The following figures represent the extracted watermark images with several attacks of the proposed scheme. The different levels of values of PSNR & MSE for different images are listed in Table 2 and 3.

Figure 2 and 3 describes, the PSNR and MSE performance of various images for NCQIM, NCQIM with LSB and DCTtechnique to indicate the robustness level.

Also for different images the values of RMSE and bit error rate also changes. The different values of root mean square error and bit error rate for different images have been listedin Table 4 and 5.

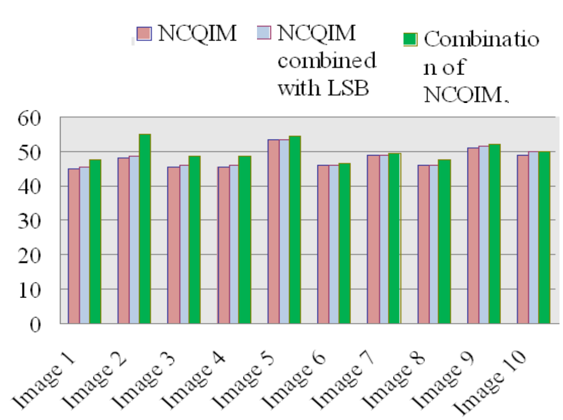


Fig. 2: PSNR performance of various images

Table 2: Comparison of PSNR value

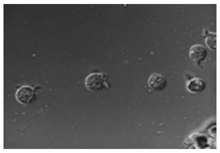
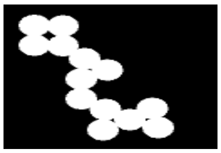
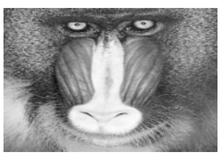
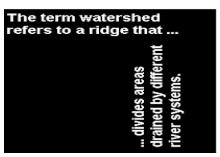
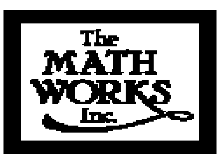
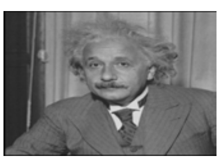
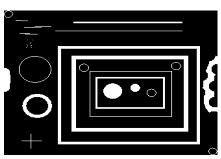
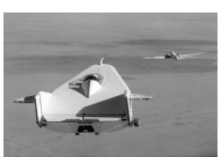
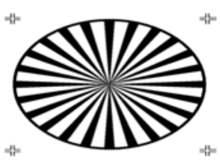
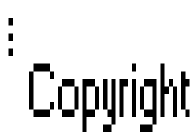
Original images	Watermark Images	PSNR value of NCQIM	PSNR value of NCQIM, LSB	PSNR value using NCQIM, LSB, DCT
		44.9600	45.6650	47.4760
		48.0021	48.6051	55.2451
		45.4116	45.9504	48.4412
		45.4745	45.9944	48.3075
		53.5258	53.7265	54.5780
		45.9297	46.2213	46.4321
		48.7510	49.2098	49.3802
		45.9314	46.1259	47.6234
		50.9812	51.7258	51.8354
		49.2315	49.7821	50.2154

Table 3: Comparison of mean squared error

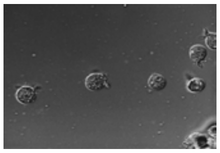
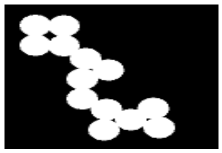
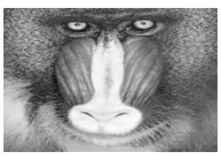
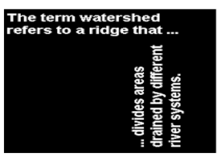
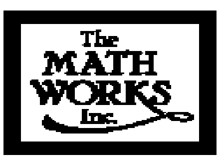
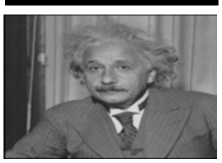
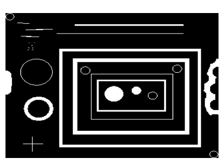
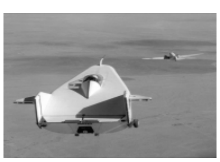
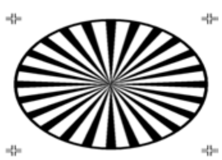
Original images	Watermark images	MSE value of NCQIM	MSE value of NCQIM, LSB	MSE value of NCQIM, LSB, DCT
		2.09	1.78	1.17
		1.03	0.89	0.20
		1.88	1.66	0.94
		1.86	1.65	0.97
		0.28	0.27	0.23
		1.66	1.55	1.48
		0.87	0.78	0.75
		1.65	1.59	1.12
		0.52	0.43	0.42
		0.77	0.67	0.61

Table 4: Comparison of root mean squared error

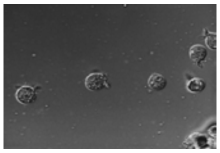
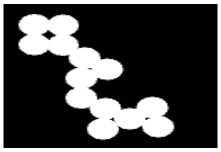
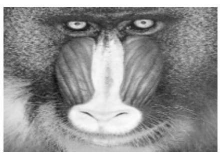
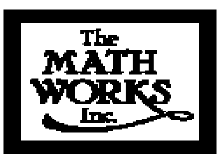
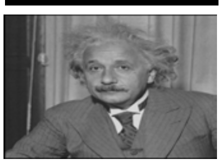
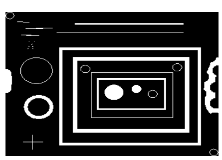
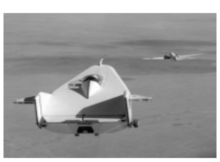
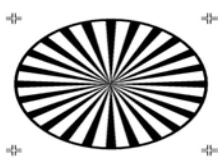
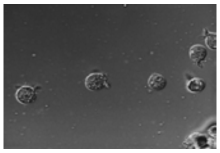
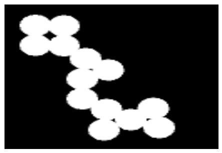
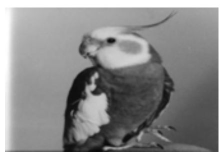
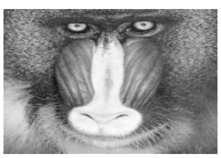
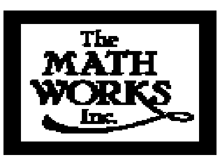
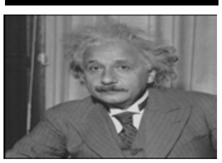
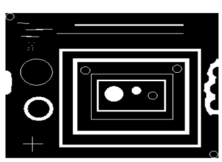
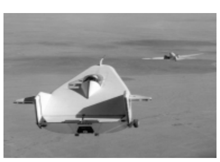
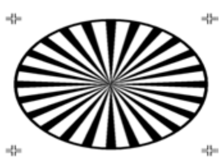
Original images	Watermark images	MSE value of NCQIM	MSE value of NCQIM, LSB	MSE value of NCQIM, LSB, DCT
		1.4457	1.3342	1.0825
		1.0149	0.9434	0.4425
		1.3711	1.2884	0.9686
		1.3638	1.2845	0.9837
		0.5292	0.5196	0.4796
		1.2884	1.2449	1.2165
		0.9327	0.8832	0.8660
		1.2845	1.2609	1.0583
		0.7211	0.6557	0.6481
		0.8774	0.8185	0.7810

Table 5: Comparison of bit error rate

Original images	Watermark images	MSE value of NCQIM	MSE value of NCQIM, LSB	MSE value of NCQIM, LSB, DCT
		0.0222	0.0219	0.0210
		0.0208	0.0206	0.0181
		0.0220	0.0218	0.0206
		0.0219	0.0217	0.0207
		0.0187	0.0186	0.0183
		0.0218	0.0216	0.0215
		0.0205	0.0203	0.0202
		0.0218	0.0217	0.0209
		0.0196	0.0193	0.0192
		0.0203	0.0200	0.0199

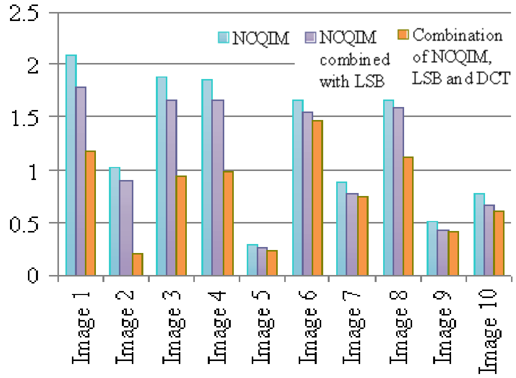


Fig. 3: MSE performance of various images

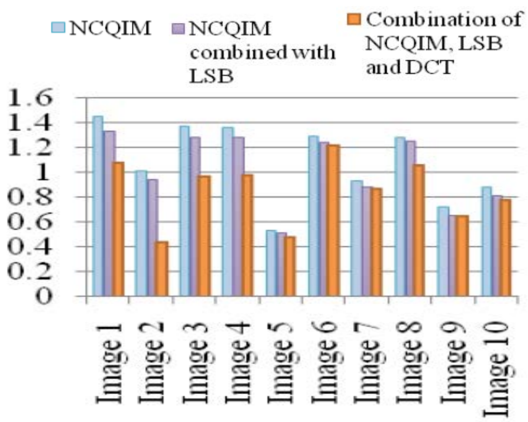


Fig. 4: RMSE performance of various images

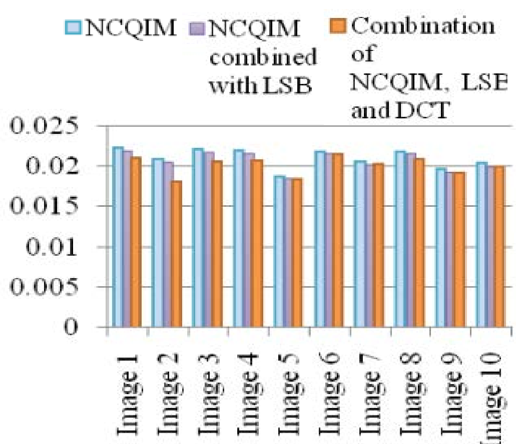


Fig. 5: BER performance of various images

Figure 4 and 5 describes, the RMSE and BER performance of various images for NCQIM, NCQIM with LSB and DCT technique to indicate the robustness level.

CONCLUSION

In this proposed method, the analysis of different host images like Lena, cameraman and baboonare taken for comparing the difference between PSNR, MSE, RMSE and BER values. In all the cases the value of PSNR is well above 47dB which shows the good quality of embedding algorithm in comparison of other techniques like LQIM, NCQIM, DWT watermarking and SVD watermarking. By embedding the watermark into the decomposition of host image, it provides better imperceptibility as well as reliability in the quality and recovery of image. The embedding distortion is a monotonically decreasing function of the quantization step. NCQIM with LSB has been also extensively tested on the image and the Peak Signal to Noise Ratio (PSNR) was calculated and imperceptibility is achieved. The robustness is increased by reducing Bit Error Rate (BER). Therefore, the experimental results demonstrate that the proposed method yields superior robustness against a wide range of common image processing operations. This proposed method further can be extended with various embedding algorithm to enhance the robustness level.

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