

MULTIPLE WATERMARKING FOR COPYRIGHT PROTECTION

Subathra Thangam B, Aarthi T, Chintha Tharun Kumar, Subhapradha P, Lakshmi C

SEEE, SASTRA Deemed to be University, Thanjavur.

subhapradha29@gmail.com

Abstract— Digital watermarking is the method of hiding information into the host image in the form of digital pattern which needs to be protected. To protect the interest of the content providers, owner's information can be watermarked. Typically, the hidden content may be a message or an emblem of a content owner or a fingerprint of an owner, which identifies the possessor of the image. This paper presents invisible robust watermarking which should not reduce user satisfaction and at the same time, it should increase the robustness of a watermark image. In the process of Reversible watermarking, hidden information can be restored by removing the embedded watermark. This process recovers image without loss. It is important to check host image quality after embedding and watermark quality after recovery. In order to verify the above mentioned criteria, Image Quality Metrics such as PSNR, MSE, NC are validated and tabulated.

Keywords: COPY RIGHT PROTECTION, DWT, ARNOLD TRANSFORM, QR CODE

INTRODUCTION

In the last decade, due to the enormous growth of network multimedia system created awareness

among society about data reproduction. The ideal copies of images, books, audios, and videos can be made easily which is illegal copying [1]. Many watermarking techniques have been proposed to achieve robustness, security, capacity, and imperceptibility where digital watermarking has a more significant role in the current trend. Reliability can be achieved based on authenticity and integrity [2]. Digital watermarking is used widely in many application including copyright protection, tampered detection, and information authentication. This algorithm is based on the HVS (brightness) masking characteristics and texture masking characteristics, and check the compatibility between imperceptibility and robustness [3]. The watermarking techniques are categorized as video-based watermarking [4], text watermarking techniques [5], audio-based watermarking techniques [6], image-based watermarking techniques [7], and 3-dimensional watermarking techniques [8]. Multimedia information may be the message, photo or music file of an owner. Watermarking can be used to conceal both content owners and authentication details into an image. A watermark which is used to communicate Ownership information, to carry caption or to verify

object content. Watermarking is a powerful plot for ownership right protection on the digital image. Utilization of watermarking technology is genuinely a straightforward approach and has likewise brought commercial usage by embedding the credentials of the owner. The motivation behind this product is the addition of identification codes of the owner's into the digitally fabricated image. The embedded watermark has the additional ability to be utilized for the owner's identification as well as for demonstrating the existence of ownership. This progression, as of late, has created awareness on piracy and on the significance of security of data being shared. A few investigations have been working around giving answers for copyright protection and authentication. These strategies essentially fall into three classes, to be specific, Steganography, Cryptography, and Watermarking. Of these, watermarking techniques have greater fame for demonstrating the owner to have better integrity and authenticity [9].

PROPOSED METHOD

In order to increase the robustness, multiple-watermarking is employed in this paper. Multiple watermarking has a different type of techniques which uses the different watermark to accomplish different goals. To indulge additional security for an image by hiding multiple secret multimedia information into an original color image are proposed which is called Multiple watermarking. Fingerprint or text message from the owner is hidden into a cover image. Converting an input

image into unpredictable form make the algorithm stronger. So, to change them into meaningless manner Arnold transform which is also known as Arnold's cat map transformation is used. QR code for a text input for a content owner is created and embedded in different part of an image and the thus watermarked image is created. An attack is nothing but any harm that is directed towards the watermarked material while being transferred in a watermarking technology. A few attacks are attempted on a watermarking to check the robustness and imperceptibility. The quick development of digitized innovation makes the advancements of trustworthy and robust technology for securing digitized static picture, audio, and video from piracy. Piracy attacks incorporate unlawful access to transmitted information in systems, data content modifications, fabrication and retransmission of restricted copies.

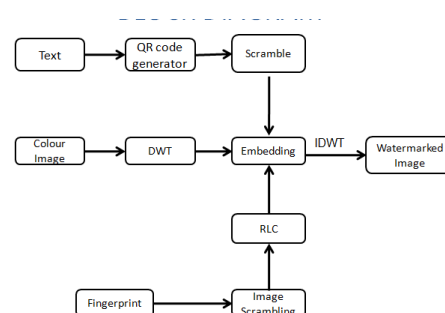


FIG1 : Block Diagram for Multiple Watermarking

Discrete Wavelet Transform

DWT is a tool for hierarchical decomposition of a cover image here which decomposes into a set of basic functions called wavelet. Analyzing a wavelet

can be used to image information into detailed sub signal an approximation. The signal at different frequencies giving different resolution can be obtained using Multi-Resolution Analysis (MRA). High and low-frequency parts of the signal are parted by DWT. Edge data of a signal are contained in the high frequency part while low-frequency part contains coarse data. Four sub-images was known as horizontal(HL), vertical(LH) and diagonal(HH) direction sub-images and low-frequency estimation sub-image(LL) are obtained by applying DWT to a digital image and each sub-images size is one-fourth of the original image's size



Fig 2: DWT of an Original Image

IMAGE SCRAMBLING

In this paper, we have used Arnold Transform for scrambling the pixel of a hidden image which confuses the pixel value of an image by of clipping and splicing. Hiding an information in a digital image is the main aim in watermarking so using a digital image scrambling can make an image into a completely different meaningless image during transformation, which also known as information disguise. Arnold transform is widely used in digital watermarking technology because of its periodicity and simplicity. The digital image is in the form of a two-dimensional matrix. When the size of the image is M, then I have $M \times M$ elements, the subscript A,

B stand for the position of the pixel, $A, B \in \{0, 1, 2, \dots, M-1\}$. Let A, B corresponds to the A, B of Arnold scrambling, for each pair A, B, after all do Arnold scrambling, become A' and B', which equivalent to the original image of the point from (A, B) move to the = (A', B'), so concluded the shift of pixels in the image, the image with Arnold scrambling traverse all the points to complete a picture of Arnold scrambling.

$$\begin{pmatrix} A' \\ B' \end{pmatrix} = \begin{pmatrix} 1 & 1 \\ 1 & 2 \end{pmatrix} \begin{pmatrix} A \\ B \end{pmatrix} \bmod M$$

Formerly Arnold transform is used only for images of the same size ($M \times M$). Nowadays it is also used for inputs of different size ($M \times N$). Anti Arnold transform can be computed using matrix's period. We can recommence original image by iterating a same number of times using anti- Arnold transformation.

$$\begin{pmatrix} A' \\ B' \end{pmatrix} = \begin{pmatrix} 2 & -1 \\ -1 & 1 \end{pmatrix} \begin{pmatrix} A \\ B \end{pmatrix} \bmod M$$



Fig 3: Scrambled image (Arnold Transform output)

RUN LENGTH ENCODING

In RLC compression technique, if a data item d occur in a consecutive number of times for the input stream, we replace the M with the single occurrence of MK. RLC is one of the simplest terms of data compression. Replace a run of the consecutive pixel

of the same color by a single copy of a color value and the count of the pixels. Run length coding is employed to reduce the total number of bits to represent specific information.

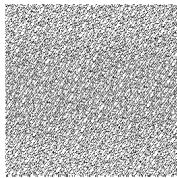


Fig 4: Output for Run Length Coding

QR CODE

Quick-Response code is abbreviated as QR Code. It is a type of Matrix barcode that can be digitally scanned by using a dedicated QR code scanning tool. QR codes grant direct access to URLs, Text, E-mail, Phone numbers and much more.

It is a hallmark name for the 2-dimensional barcode framework containing data and is an example of information matrix barcode. QR codes are often viewed as barcodes nonetheless, a critical distinction between the two is that while the barcodes hold data just in the horizontally, QR codes can store data vertically too. As of late QR codes are being utilized as one of the bill transactions options more which have prompted the development of the utilization of QR codes.

QR CODE FOR “HELLO WORLD”

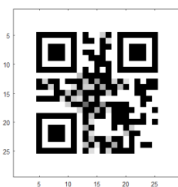


Fig 4: Generated QR Code

Proposed embedding Techniques

Invisible robust digital watermarking has many algorithms. Out of which Bit Insertion is the simplest form embedding algorithm, where every 8th least significant bit is overwritten with a bit of the watermark. Hiding an image in a busy area or embedded directly in a particular bit in regular manner gives imperceptibility for a watermarked image. The modification of Least Significant Bit embedding is fairly simple and effective. The grayscale bitmap image is in the form of 8-bit, we would need to add bits from hidden information cover image. In a grayscale image, each pixel is represented by 1 byte which is of 8 bits. The principle of encoding uses the bit on the far right side to far left side, Least Significant Bit of each of these bytes. The human retina becomes the limiting factor in viewing pictures which in turn increases the imperceptibility. For example, a selected bit of each pixel is used for embedding, if the pixel value is 162 which is 10100010 in binary and the selected bit place for embedding is 1 (LSB) and the bit which needs to be hidden is 1 then the pixel value will change to 163 which is 10100011 in binary.

Features of LSB (Least-Significant-Bit)

- simplicity and effective
- Easy implementation
- high visual fidelity.

Original Byte

1	0	1	0	0	0	1	0
---	---	---	---	---	---	---	---

Watermarked byte

1	0	1	0	0	0	1	1
---	---	---	---	---	---	---	---

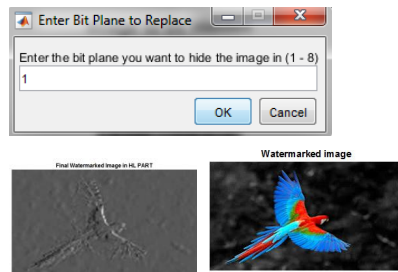


FIG 5: Final Watermarked image

PSNR

In this paper, three image metrics such as PSNR, SSIM and Nc are calculated to check the robustness of the image. In case of modifying an image or compressing an image PSNR value need to be calculated where signal is considered as original image and noise is due to modification or compression of an image. PSNR value reaches undefined when MSE reaches zero. This happens when original and watermarked image is indistinguishable. PSNR is expressed in logarithmic decibel scale.

$$MSE = \frac{1}{m \cdot n} \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} [I(i,j) - K(i,j)]^2$$

$$PSNR = 10 \log_{10} \frac{MAX_I^2}{MSE}$$

Error! Reference source not found. **SSIM**

Structural Similarity Index is the measure of calculating similarity between original and watermarked image which has a maximum value of 1. In short it quantifies image quality degradation.

Normalized Cross Correlation (NC)

NCC has been commonly used as a metric to evaluate similarity or dissimilarity between original and watermarked images.

$$NC = \frac{\sum_{i=1}^N \sum_{j=1}^M W(i,j) \cdot W'(i,j)}{\sqrt{\sum_{i=1}^N \sum_{j=1}^M [W(i,j)]^2} \cdot \sqrt{\sum_{i=1}^N \sum_{j=1}^M [W'(i,j)]^2}} \cdot \frac{1}{\sqrt{\sum_{i=1}^N \sum_{j=1}^M [W'(i,j)]^2}}$$

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Design Requirements

The watermark must be more sturdy in order to be exceedingly impervious to any distortion that can be presented during normal use (unintentional attack), or on purpose, that aims at modifying the watermark display in the information/picture (intentional attack). Value Change Attacks, for example, Noise addition and Simple lossy attacks, for example, trimming (Cropping in picture) and smoothing are checked. The second essential check in watermark is imperceptible; the last created watermarked picture ought to be same as that of info picture (Invisibility). Integrity and Security are additionally two basic necessities of perfect watermarking. The final watermark is one which can withstand a wide range of intrusions both incidental and purposeful (assaults pointed ordinarily to expel or debilitate the watermark).

RESULTS AND DISCUSSION





Fig 6: Final Multiple Watermarked output and output of each algorithm used. a)Input image b)DWT of an Image c)Scrambled image d)RLC output e)embedded output in LH part of an image f)QR Code for text g)image to be hidden h)embedded output in HL part of an image i)Final watermarked image

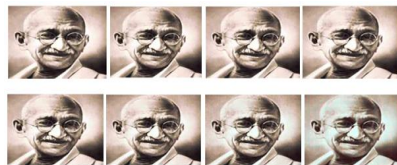


Fig 7: Final Watermarked image for each bit position (Bit 1 to Bit 8)

Image Name	1 st bit	2nd bit	3 rd bit	4 th bit	5 th bit	6 th bit	7 th bit	8 th bit
LEENA	118.8523	109.3921	96.1323	82.2600	68.5365	55.0721	42.2425	28.2556
PEPPERS	119.5597	109.8652	95.9881	81.3803	67.4039	53.6697	40.2167	27.9623
BOAT	119.4031	109.4296	96.3310	82.4826	68.4843	54.522	40.8529	28.0564
GANDHIJI	118.6054	108.7225	95.2546	81.2185	54.1050	53.6566	40.6558	28.6365

Table1: PSNR value for a watermarked image for each bit embedding

IMAGES	SSIM	NC
LEENA	0.999	1
PEPPERS	0.998	1
BOAT	0.995	1
GANDHIJI	0.997	1

Table2: SSIM value for 1st bit insertion and NC value comparison for different watermarked image

From the obtained result, This algorithm infer that by inserting a hidden information in different position of a pixel changes the PSNR value of an image and gave acceptable SSIM. As the bit position moves from left end of the pixel to right

end of the pixel which is in binary form PSNR value decreases which in turn increases imperceptibility. This embedding technique provides lesser visible distortion (imperceptibility) for a generated watermarked image till embedding the hidden data in 7th bit position (Tab 1).

Conclusion

This paper proposes a bit embedding technique for a watermarked image where the hidden data is inserted in a various bit position of a unique (original) picture. The values for the mean square error (MSE) and peak signal to noise ratio (PSNR) are estimated. The results demonstrate that the technique presents high PSNR and henceforth guarantees lesser visible distortions. The impersistency of the assessed watermarking has been estimated by the Peak Signal to Noise Ratio (PSNR) of the watermarked Image and by the comparability amidst original image and watermarked image utilizing Normalized Cross Correlation (NC) technique. In this paper, the proposed method is said to have accomplished a high PSNR (Table 1) and great SSIM and NC (Table 2) esteem for a produced watermarked images. PSNR value is reduced as a bit for embedding moves from left to right. The results demonstrate that the level of invisibility of the watermarked image i.e., imperceptibility obtained is adequate.

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