A HYBRID APPROACH TO PROVIDE ROBUSTNESS AND SECURITY IN VIDEO

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Abstract
In recent years, everything becomes digitized. Thus there must be some security needed for ownership identification of the transferred digital data over the internet. Digital image watermarking is the solution of that security problem which provides legal authentication of the transferred image over the internet. This paper includes the basic fundamentals of watermarking system, types of watermarking system, different techniques used for image watermarking and also literature survey on the some new work done in the field of digital image watermarking.

Keywords: Digital watermark, Discrete Wavelet Transform, Discrete Cosine Transform, Singular Value Decomposition, Spa-tial Domain, Frequency Domain

I. INTRODUCTION

Digital watermarking is the art of embedding secret infor-mation (which may exist in the form of text, image, audio or video) related to the actual content of the digital data within the original data itself. [13]

It is a two-step process namely embedding process and extracting process. In embedding process, watermark is added to the original image and resultant image which we get is known as watermarked image that will slightly modify after embedding. While in extraction process this embedded watermark is extracted from the watermarked image and recovers the original image back. Then that achieved extracted watermark is compared with the original watermark which we added at earlier stage, if both are same then we can say that the data we get is an authentic data.

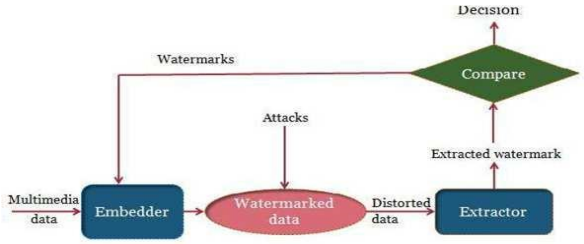

Fig. 1. Block diagram of watermarking system

Watermarking system must follow some properties such as imperceptibility, robustness, capacity and security. Impercep-tibility ensures the transparency. Imperceptibility: It confirms that there is not much degradation on the original image after embedding watermark [12]. Robustness: It defines as the capability of survival of watermark against different kinds of attacks [12]. Capacity: It describes how much data should be embedded as a watermark to successfully detect during extraction [11]. Security: Hacker should not be in the position to extract the watermark without having the knowledge of embedding algorithm.

This paper is structured as follow: Section 2 describes the types of digital watermarking system, section 3 discuss about the various techniques of the image watermarking system, section 4 contains literature review of different research papers related image watermarking and at last section 5 holds the limitation of current system and future scope in the field of digital image watermarking.

II. TYPES OF WATERMARKING SYSTEM

Watermarking system is mainly divided into following four types:

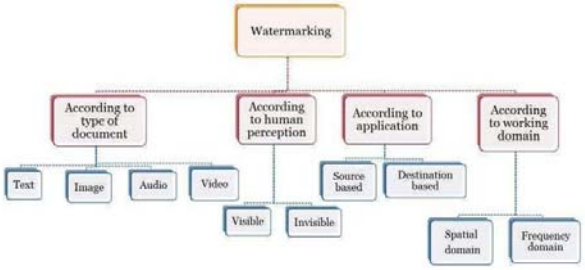

Fig. 2. Types of watermarking system

A. Based on types of documents:

There is four types of image watermarking based on types of documents on which watermark is embedded known as text image, audio and video watermarking.

1) Text watermarking.
2) Image watermarking.
3) Audio watermarking.
4) Vedio watermarking.

B. Based on human perception:

The image watermarking system is mainly classified in two categories based on human perception described as follow:

1) Visible watermarking: In this type of watermarking, the inserted watermark can be easily appears to the human eyes. This is very simple and easy technique for content authentication but the main drawback of this technique is that it is easily removed from the original host image.

2) Invisible watermarking: In this type of watermarking technique, the inserted watermark may not observed by human eyes. Most of the applications of digital image watermarking use this type of watermarking approach.

C. Based on application:

1) Source based watermarking: It is used for ownership authentication, where unique watermark is embedded to all copies of data.

2) Destination based watermarking: It is used in the application where there is need for tracing buyer for the purpose of illegal reselling.

D. Based on working domain:

1) Spatial domain watermarking: This category of water-marking is very simple and also easier to implement. It hides the watermark directly into original data by pixel modification. It has low complexity and high capacity for embedding more number of bits into host data. But these techniques are less resistant to different types of attacks. The techniques use in spatial domain is LSB (Least Significant Bit), ISB (Intermediate Significant Bits) and many more.

2) Frequency domain watermarking: This category of water-marking embeds the watermark in frequency values rather than intensity values. DFT (Discrete Fourier Transform), DCT (Discrete Cosine Transform) and DWT (Discrete Wavelet Trans-form) are the main methods for transformation in frequency domain watermarking. These are complex but having good imperceptibility and robustness. Most of the watermarking applications use frequency domain watermarking.

III. REVIEW OF WATERMARKING TECHNIQUES

LSB: LEAST SIGNIFICANT BITS

LSB technique is the 1st technique which is implemented under spatial domain technique. LSB technique is more im-perceptible but very less robust with different attacks. Water-marked image which is generated by using LSB technique can not detected by normal eyes. Sometimes histogram also not able to detect that any other image embedded in host image or not [9].

ISB: INTERMEDIATE SIGNIFICANT BITS

In these technique bits of watermark image pixel is inserted in the middle bit of the cover image pixel. ISB technique is less imperceptible but this technique success to enhance the robustness of spatial domain technique. ISB is more robust than LSB [10].

DWT: DISCRETE WAVELET TRANSFORM

The DWT separates an image into four sub-bands:

1. Approximate low frequency component (LL)
2. Horizontal middle frequency components (HL)
3. Vertical middle frequency components (LH)
4. Diagonal high frequency components (HH)

The LL sub-band is the result of low-pass filtering both the rows and columns and contains a rough description of the image. The HH sub-band is high-pass filtered in both directions and contains the high-frequency components along the diagonals. The HL and LH images are the results of low-pass filtering on one direction and high-pass filtering in other direction [6].

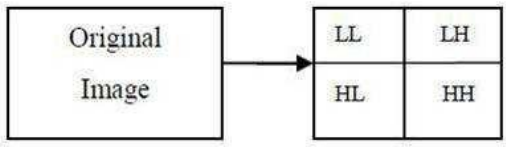

Fig. 3. Decomposition of DWT into sub-bands

DCT: DISCRETE COSINE TRANSFORM

DCT function is a transformation technique which trans-forms the input image from spatial domain to frequency domain. In DCT-based watermarking, the DCT coefficients are modified to embed watermark data. DCT is used in many standardized image, audio, and video compression methods. It has shown its superiority in reduction of the redundancy of a wide range of signals. In proposed method block DCT is used to increase the robustness [4].

DFT: DISCRETE FOURIER TRANSFORM

The Fourier transform implemented in different image pro-cessing applications. When we apply DFT on image low frequency band shifted in the corners of images. To embed watermark into DFT shifting operation is performs on the image to make low frequencies in center [2].

SVD: SINGULAR VALUE DECOMPOSITION

It can be seen as a method for transforming correlated variables into a set of uncorrelated ones that better expose the various relationships among the original data. In SVD, a given matrix A is decomposed into three matrices as

$$A = U\ S\ V^T$$

Where, U and V are orthogonal matrices and S is singular value.[7]

SVD provides good noise immunity property but major problem with SVD is that it is very complex task to embed the watermark using SVD alone.

IV. LITERATURE SURVEY

In research paper [1]authors used 4-level DWT and DCT independently for embedding and extraction of watermark.

And then both the DWT and DCT results are compared with respect to PSNR at different thresholds. And according to that comparison they concluded the better technique from these two based on image quality in terms of PSNR. It was clear from literature survey that at lower threshold values, performance of DCT is almost similar as DWT. But for higher thresholds, DWT gives better image quality than DCT. So authors highlighted on the fact that hybridization of DWT and DCT may overcome the drawbacks of both DWT and DCT method and also can be used to improve imperceptibility.

Fig. 4. Comparison of DCT and DWT

In research paper [2], Authors proposed a secure and non-blind digital image watermarking technique by hybridization of DWT and DCT. Imperceptibility, robustness and capacity were the main focus of authors for the system to be im-plemented. They used gray scale image as host image and binary image as watermark image of the size 512512 and 3232 respectively. They applied the same algorithm for various three host images having different extensions such as TIF, PNG and BMP. In proposed algorithm, host image was first decomposing by DWT and then apply DCT technique on LL sub band. After complete embedding process, they apply inverse process for extracting the watermark from transmitted image. Proposed algorithm was then tested on various attacks such as, intensity adjustment, speckle noise, Poisson noise, Gaussian noise, resizing, and many more in terms of PSNR and SR values. By implementing this algorithm, it is clear that proposed algorithm was very imperceptible and also robust against certain number of attacks.

In research paper [3], authors put emphasis on frequency domain techniques than spatial domain techniques due to robustness. They proposed DWT-SVD based watermarking system which is robust and blind. They choose DWT for its property of multi scale representation of function and SVD for its good noise immunity property. They use one level Haar transformation for decomposition of host image into sub bands. They evaluated the

performance of proposed algorithm by using PSNR measure and robustness has been tested against 20 kinds of attacks such as Blur, Motion blur, Gaussian blur, sharpening, rotation, contrast, JPEG compression, Mosaic, cropping, etc. They applied the watermark to the various sub-bands (LL, HH, HL or LH) and attempt different results in each case. They verified that watermark embedding in different bands are resistant to different attacks. Proposed approach has high degree of robustness against major attacks. Past research said that any modification in LL band cant possible because it can be easily perceived by human eye, but here in the proposed system the authors not face any such problems with that. They also concluded that if the watermark was inserted in any of the sub band, then it makes image resistive to only some of the attacks, but if it will be inserted into all the sub bands then it would be very difficult to remove from all the frequencies.

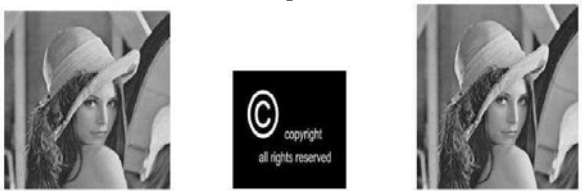

Fig. 5. Watermarking using DWT-SVD

In research paper [4], authors first enlisted the effects of the different removal watermark attacks in spatial and frequency domains. This analysis was carried out by using histogram and fourier spectrum tool. Authors compared the performance of the region adaptive approach with the original DWT-SVD based approach. This region adaptive approach embeds parts of the rectangular watermark image into selected regions of rectangular host image. This selection process matches the watermark and host image regions with same spectral distri-bution. For improving the speed of embedding and extraction process, they used non overlapping squares of different sizes. They used quad tree partitioning technique for division of host image but before that they use MRF (Markov Random Field) image segmentation algorithm on the host image. For the embedding and extraction process they use the hybrid concept of DWT and SVD after segmentation and partition algorithm. After that authors analyses the result of region based watermarking approach on the various attacks such as Gaussian noise attack, Salt and pepper noise attack, sharpen at-tack, rotation attack and GPEG compression attack. Proposed region based approach has higher image quality in almost all types of attacks. Thus by reviewing this research paper it is concluded that propose region based approach is more efficient and effective than original DWT-SVD algorithm.

In research paper [5], authors presented a novel approach for digital image watermarking algorithm named as NEA (New Embedding Algorithm). This new approach is non-blind and based on combination of DWT and DCT transforms. This algorithm was implemented for 2 level, 3 level and 4 level of DWT and also give comparative analysis for all levels. Authors also compared the performance of NEA with the coxs additive algorithm. For performance analysis, two parameters have been tested as imperceptibility and robustness. By performing this approach on image, authors concluded that NEA gives 3.04 dB and 9.33dB better PSNR compared to Coxs additive algorithm for 4 level DWT. It is 1.28dB and 2.44dB better in case of 3 level DWT, and 1.05dB and 1.94dB better PSNR in case of 2 level DWT with attacks and without attacks respectively. As well as, the NEA extracts the marked image 46 times better than Coxs additive algorithm in 2 level DWT and it is 7 times better for 4 level DWT and 2 times better in case of 3 level DWT

Authors of the paper [7] put emphasis on the security and capacity of the watermarking system. They proposed blind approach for image watermarking by hybridization of DWT and SVD. In which authors replaced the singular values of watermark image with the appropriate singular values of HH sub-band of original host image. They used gray scale image as host image. Moreover, in proposed system authors used key generation approach in embedding and extraction phase of watermark for security purpose. Then they tested the proposed approach against different types of attacks for check the robustness of the system.

In research paper [6], block based digital color image watermarking scheme was proposed using SVD in which authors divided an image into blocks which gives more space for embedding multiple watermarks. The host color image was first divided into Red, Green and Blue color spaces. Each color space was further divided into four blocks, and then four watermark images were embedded in each of these color space. Thus one can embed the multiple watermarks in

single host image by using this proposed skim. Here, authors divided host image into various sized blocks, thus it is possible to embed the watermark having different sizes. This proposed approach also works well for rectangular images as square images.

Fig. 6. Multiple watermarks of various size

Fig. 7. Multiple watermark embedding using SVD

Authors of the paper [8] highlighted on the fact that SVD provides much better robustness than DWT and DCT. They proposed blind watermarking approach in which they embeds the bits of singular values of watermark image into the wavelet coefficients of the original gray scale host image. They applied the proposed approach in block by block manner. After that, they tested the robustness of the proposed approach by applying various attacks on watermarked image.

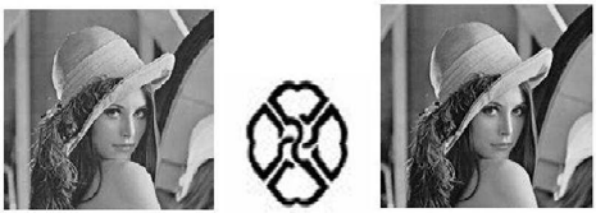

Fig. 8. Watermarking using SVD

V. CONCLUSION

Digital image watermarking must be needed in todays digitized world where digital image is most widely transferred file over the internet. After reviewing the papers, we can say that there are so many techniques in spatial and frequency domain for image watermarking from which DCT, DWT and SVD are most widely used techniques. SVD provides better noise immunity but the main drawback is that it cannot be used alone because of its large computations requirements. DWT provides good robustness but the visibility is average. In case of DCT, we can attempt acceptable visibility and average robustness. Hybridization of DCT and DWT gives much better result than independent DCT or DWT because it overcomes the drawbacks of each other. In future work, we will use the combine approach of DCT, DWT and SVD to improve imperceptibility and robustness on color images

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