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A Review Paper on Digital Watermarking Techniques & Its Applications

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Abstract: ***As we know current era is based on internet, here everything is online like banking, shopping, video transmission, audio transmission. Now for online subjects the biggest challenge is security, so there is need of security applications which will resolve the problem of the user. For this purpose there is a need of Digital watermarking system which will provide a good platform for these kind of applications. In this paper basically the comparative study about the previous existing approaches of digital watermarking is done. Here we also discuss the applications and need of the digital watermarking applications.***

Keywords: DWT, Algorithm, FLOW, Communication, Latency, Watermarking.

1. Introduction

In recent years, the global developing applications using digital multimedia technologies have emphasized the need to protect digital multimedia data from illegal issues. Authentication and information hiding, copyright protection, content identification and proof ownership have also become important issues. Watermarking technology is used to solve these issues. These kinds of work in this field have several watermarking techniques such as spatial domain and transform domain. In transform domain basic transforms used are discrete cosine transform (DCT), discrete wavelet transform (DWT), singular value decomposition (SVD) and their cross relation. Watermarking techniques is a process of embedding secret information into a multimedia data, such as image, audio and video in such a way that it is imperceptible to a human. Before the development of digital image watermarking, it was very difficult to achieve copyright protection, authentication, data hiding, content identification and proof ownership. But currently it is very easy to give these kinds goal using watermarking techniques. A digital watermark is a pattern of bits inserted into a digital image, audio or video file that identifies the file's copyright information (author, rights, etc.). In addition, the bits representing the watermark must be scattered throughout the file in such a way that they cannot be identified and manipulated. And finally, a digital watermark must be robust enough to survive changes to the file its embedded in, such as being saved using a compression algorithm eg: JPEG. Digital Watermarking works by concealing information within digital data, such that it cannot be detected without special software with the purpose of making sure that the concealed information is present in all the copies of data that is being made whether legally or otherwise, regardless of attempts to damage/remove it. Every watermarking scheme consists of two processes embedding and extraction. During the embedding process, the watermark is embedded into the multimedia digital data. The original data will be modified after embedding process, this modified data is known as a watermarked data. In extraction process embedded watermark is extracted from the watermarked data and original multimedia data is recovered. The extracted. watermark is then compared with original watermark; if the watermark is same then result is authenticated data. During the sending of the watermarked data on network, the attacker may have destroy the data, if any changes in the data is detected by comparing the extracted watermark with the original watermark. Watermarking technique have two main properties imperceptibility and robustness. If we cannot distinguish between host image and watermarked image then this is called imperceptibility. Imperceptibility depends on similarity between the host image and watermarked image. On the other hand robustness measures the difficulty in removing or destroying watermark from watermarked image. In this paper we proposed a digital watermarking technique based on DWT, DCT and SVD transform. These schemes provide a good imperceptibility and high robustness against various kinds processing attacks. The rest of the paper focuses on overview of Transforms for watermarking schemes, gives the details of proposed watermarking algorithms, and gives evolution parameters and experimental results.

1.1 Purpose of Digital Watermarking

Watermarks added to digital content serves a variety of purposes. The main purposes of digital watermarking are as following:

- **Ownership Assertion:-** To establish ownership of the content (i.e. image)
- **Content Labelling:-** Bits embedded into the data that gives further information about the content such as a graphic image with time and place information
- **Usage Control:-**added to limit the number of copies created whereas the watermarks are modified by the hardware and at some point would not create any more copies (i.e. DVD)
- **Content Protection:-**Content stamped with a visible watermark that is very difficult to remove so that it can be publically and freely distributed.

1.2 Characteristics of Water Marking

- **Imperceptibility:** The watermark should not affect the quality of the original signal, thus it should be invisible/ inaudible to human eyes/ ears.
- **Robustness:** The watermarked data should not be removed or eliminated by unauthorized distributors, thus it should be robust to resist common signal processing

manipulations such as filtering, compression, filtering with compression. Piracy attacks or image processing should not affect the embedded watermark.

- **Readability:** A watermark should convey as much information as possible. A watermark should be statistically undetectable. Moreover, retrieval of the digital watermark can be used to identify the ownership and copyright unambiguously.
- **Security:** A watermark should be secret and must be undetectable by an unauthorized user in general. A watermark should only be accessible by authorized parties. This requirement is regarded as security and is usually achieved by the use of cryptographic keys. As information security techniques, the details of a digital watermark algorithm must be published to everyone. The owner of the intellectual property image is the only one who holds the private secret keys. A particular watermark signal is related with a special number used for embedding and extracting. The special number is kept secret and is used for confirming legal owners of digital products later. If we lay strong stress on robustness, then invisibility may be weak.
- **Capacity:** The number of bits that can be embedded in one second of the host signal.

1.3 Classification of Watermarking

Digital Watermarking techniques can be classified in a number of ways depending on different parameters. Various types of watermarking techniques are enlisted below.

- **Robust & Fragile Watermarking:** Robust watermarking is a technique in which modification to the watermarked content will not affect the watermark. Contrary to this, fragile watermarking is a technique in which watermark gets destroyed when watermarked content is modified or tampered with.
- **Visible & Transparent Watermarking:** Visible watermarks are ones, which are embedded in visual content in such a way that they are visible when the content is viewed. Transparent watermarks are imperceptible and they cannot be detected by just viewing the digital content
- Public & Private Watermarking In public watermarking, users of the content are authorized to detect the watermark while in private watermarking the users are not authorized to detect the watermark.
- **Asymmetric & Symmetric Watermarking:** Asymmetric watermarking (also called asymmetric key watermarking) is a technique where different keys are used for embedding and extracting the watermark. In symmetric watermarking (or symmetric key watermarking) the same keys are used for embedding and extracting watermarks.
- **Steganographic & Non-Steganographic:** Steganographic watermarking is the technique where content users are unaware of the presence of a watermark. In non steganographic watermarking, the users are aware of the presence of a watermark. Steganographic watermarking is used in fingerprinting applications while non steganographic watermarking techniques can be used to deter piracy.

2. Literature Review

As we have already been through the introduction of water marking now here the previous work of the water marking techniques is presented. **Yongjian Hu, Sam Kwong and Jiwu Huang** : In 2004(ICAs) presented a literature survey on watermark protection by using an invisible watermark to protect visible watermarked image to overcome the problem of watermarking removal and unauthorized insertion. To achieve this The Dual watermarking technique is used. The Dual watermarking technique attempts to establish the owner's right to the image and detect the intentional and unintentional tempering of the image. In this the algorithm first used a DCT based visible watermarking algorithm to embed gray level watermarked image and then regarded the resulting image as new image to carry out invisible watermarking which is performed in spatial domain. in this the watermark is chosen in the form of binary image of the embedded watermark so that extracted logos can indicate the owner ship without additional computing and the security of invisible watermark image is shuffled with some chaotic mapping technique before embedding(here Arnolds cat map is used to transform the binary logos). Although the algorithm scarifies the embedding amount of the watermark.

Ali Al-Haj, Tuqa Manasrah In 2007 proposed a literature survey on Non-Invertible Copyright Protection of Digital Images Using DWT and SVD and proposed a non-blind imperceptible and robust digital image watermarking algorithm. The algorithm is based on cascading two powerful mathematical transforms; the Discrete Wavelet Transform (DWT) and the Singular Value Decomposition (SVD). Both techniques were combined to exploit their respective attractive features: the spatio-frequency localization of the DWT and compact capturing of semi-global features and the geometric information of images by the significant Components of the SVD. Simulation results demonstrated the effectiveness of the proposed method with regard to the essential watermarking requirements; imperceptibility, robustness and non inveritbility.

Ruizhen Liu and Tieniu Tan: In 2002 proposed An SVD-Based Watermarking Scheme for Protecting Rightful Ownership. As One of the main purposes of a watermark is to protect the owner's copyright. However, for many existing watermarking schemes, an attacker can easily confuse one by manipulating the watermarked image (or video, audio) and claim that he or she is the legitimate owner. SVD is a numerical technique used to diagonalize matrices in numerical analysis. It is an algorithm developed for a variety of applications. To demonstrate the robustness of proposed watermarking the resistance of the algorithm to various distortions was studied in a series of experiments on gray scale images and the method is compared with the Spread Spectrum Communication method in order to put the performance investigation of the algorithm in proper context. The results shows that the method provides much more robustness under six practical conditions: adding noise, low-pass filtering, JPEG compression, scaling, image cropping, and rotation.

Feng Liu, Yangguang Liu: In 2008(CISP) Proposed A Watermarking Algorithm for Digital Image Based on DCT

and SVD. The algorithm can satisfy the transparency and robustness of the watermarking system very well. The SVD transform and the DCT are performed on the watermark and the original image, respectively. Only the SVs of the watermark are embedded into the DCT coefficients of original image. In this study, the cover image size is 512×512 and DCT block size is 8×8. Then the size of approximate image generated with DC values is 64×64 and so the size of watermark. MATLAB and Image Processing Toolbox are used for the experiments and attacks. The experiment based on this algorithm demonstrates that the watermarking is robust to the common signal processing techniques including JEPG compressing, noise, low pass filter, median filter, contrast enhance. Experimental results show that the proposed watermarking scheme is more robust than the SVD methods.

Navas k a, Ajay mathews cheriyan and Lekshmi.m :- In 2008 presented a literature survey in which they proposed a method of non-blind transform domain watermarking based on DWT-DCT-SVD. The DCT coefficients of the DWT coefficients are used to embed the watermarking information. This method utilizes the wavelet coefficients of the cover image to embed the watermark in which any of the four sets of wavelet coefficients can be used to watermark the image. The DCT coefficients of the wavelet coefficients are calculated and singular values are decomposed. The same procedure is applied to the watermark also. The singular values of the cover image and watermark are added to form the modified singular values of the watermarked image. The modified DCT coefficients form the singular value decompositions triangular matrices. Then the inverse DCT transform is applied followed by the inverse DWT. This is the algorithm that clubs the properties of SVD, DCT and DWT. This is a technique that has never been used before. Watermark embedded using this algorithm is highly imperceptible. This scheme is robust against all sorts of attacks. It has very high data hiding capacity.
One advantage of using SVD-based watermarking is that there is no need to embed all the singular values of a visual watermark. Depending on the magnitudes of the largest singular values, it would be sufficient to embed only a small set. This SVD property can be exploited to develop algorithms for lossy image compression. This method of watermarking is found to be robust and the visual watermark is recoverable without only reasonable amount of distortion even in the case of attacks. Thus the method can be used to embed copyright information in the form of a visual watermark or simple text.

Zhenwei Shang, Honge Ren and Jian Zhang:- In 2008 presented a comparative study about a block location scrambling algorithm of digital image based on Arnold transformation. Image scrambling is a commonly used digital image encryption method, it directly performs to set a given digital image into a chaotic image, and image scrambling includes location scrambling and gray scrambling. Location scrambling from the name can infer that it achieves the objective of image encryption by changing the position of pixels and Gray scrambling is carried out through changing the gray of each pixels to achieve encryption. Currently popular image scrambling methods are Arnold transformation, Magic transformation, Tangram algorithm, Conway game, Gray Code transformation etc. Arnold transformation algorithm is simple and has a cyclical, so it finds a good application in the information hiding of image. However the scrambling effect of traditional Arnold transformation is worse with low iteration times.

This paper presents a location scrambling algorithm of digital image by using improved Arnold transformation combined with Logistic chaotic map, and carry out the location scrambling on the block digital image. This algorithm achieves very good scrambling effect; it can be used as a method of encryption and also can be used as to be the pre treatment process of further information hiding.

CAI Yong-mei, GUO Wen-qiang and DING Hai-yang: - In 2013 presented literature survey on An Audio Blind Watermarking Scheme Based on DWT-SVD algorithm. In order to protect the digital audio and video products copyright in the network, an improved audio blind watermarking algorithm scheme based on discrete wavelet transform (DWT) and singular value decomposition (SVD) is proposed. In the algorithm, first, the audio signal is divided into sections. Each section audio is decomposed on discrete wavelet transform for two degree. Then each approximate component is singular value decomposed. Last the watermark image is embedded into the relative singular values chosen. In this method original audio is split as blocks and each block is decomposed on discrete wavelet transform for two degree, then first quarter audio approximate sub-band coefficients are decomposed on SVD transform to obtain a diagonal matrix. The watermarking information is embedded into this diagonal matrix. The transparency of the proposed algorithm is better, and robustness is strong against the popular audio signal attack such as resampling, Low-pass filtering, requantization, Gaussian white noise, MP3 compression and other popular audio signal attacks. This method has stronger robustness and transparency and average normalized correlation coefficient NC > 0.950, average BER<0.048.

Satyanarayana Murty P. and Rajesh Kumar P.:- In 2013 presented an approach towards a robust reference image watermarking scheme in Discrete Wavelet Transform (DWT) using Singular Value Decomposition (SVD) and edge detection. Here the cover image has scrambled and then segmented into number of blocks. Based on number of edges in each block a reference image is formed. Then the singular values of DWT applied to reference image and the watermark image is modified. The proposed algorithm provides good robustness against various attacks. In this algorithm the Eigen matrix in the singular value decomposition is explored for data embedding. The perceptibility of the watermarked image is enhanced by embedding the watermark image in some selected and most complex blocks of the host image. A block is said to be a complex block, if the number of edges in the block is more than a predefined threshold. In the frequency based watermarking technique based on DWT, the watermark is added to the low and high frequency values of the DWT coefficients. In some schemes only the LL band is modified while in others the watermark is added to the all bands. A robust and semi-blind watermarking scheme using DWT and SVD is proposed. The host and watermark images are gray

scale images of size N × N and m × m respectively Also the proposed method results were compared with other existing algorithms, which have been used DWT-SVD. The results shows that the proposed method superior to all the existing algorithms, When the proposed results were compared with the existing algorithm, the results for JPEG compression were degraded, but other attacks the proposed algorithm has shown high robustness this algorithm can conceal watermark well. And the PSNR is 50.0285 db.

Mei Jiansheng, Li Sukang and Tan Xiaomei:- In 2009 presented a journal on A Digital Watermarking Algorithm Based On DCT and DWT. In this journal they introduced an algorithm of digital watermarking based on Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT). In this DCT-DWT algorithm, the information of digital watermarking which has been discrete Cosine transformed, is put into the high frequency band of the image which has been wavelet transformed. Then distils the digital watermarking with the help of the original image and the watermarking image. The watermarking image will be discrete Cosine transformed at first, because these DCT modulus contain the low frequency information of watermarking image. As long as these information do not lose or loose little then the watermarking image can be renewed well. This enhance the robustness and concealment. The host image is decomposed through DWT transform, then choose the appropriate wavelet modulus in the high frequency level. The watermarking information are embedded into the corresponding position. This paper introduces a discrete wavelet transform (DWT) digital watermark algorithm based on human vision characters. By using the block technology, watermarking signal is embedded into the high frequency band of wavelet transformation domain. And before embedding this watermark image has been dicrete cosine transformed in order to improve its robustness. This watermarking scheme not only keeps the image quality well, but also can be robust against many common image processing operations of filer, sharp enhancing, adding salt noise, image compression, image cutting and so on. This algorithm has strong capability of embedding signals and anti-attack. But it shows little bad response for rotation attack and it should be improved for it.

Preeti Sharma and Tapan Jain:- Presented a literature survey on Robust Digital Watermarking for Coloured Images using SVD and DWT Technique. The idea behind using a hybrid transform is that the cover image is modified in its singular values rather than on the DWT sub bands, therefore the watermark makes itself vulnerable to vivid attacks. In this paper a hybrid watermarking scheme using SVD and DWT has been introduced, where the watermark is embedded in the singular values of the red component of the cover image's DWT sub-bands and then combined with the other two i.e. green and blue components to yield the watermarked image. DWT enumerates the high and the low frequency components by splitting the image into its respective frequency components. The high frequency components bequeath for the edge detection whereas the low frequency components are again bifurcated into high and low frequency components. The purpose of watermarking is served by the high frequency components as the human eye is sensitive on the edge variations. The method adopted fully exploits the features of the SVD and DWT transform. The intrinsic algebraic properties of the image represented by SVD and the spatio-frequency localization of DWT are well utilized. Experimental results are available which depict the improved imperceptibility and robustness under attacks and preserve copyrights by using this technique.

3. Problems in Previous Research

In the field of digital watermarking, digital image watermarking has attracted a lot of attention in the research community for two reasons: one is its easy availability and the other is that it conveys enough redundant information that could be used to embed watermarks. Digital watermarking contains various techniques for protecting the digital content. The entire digital image watermarking techniques always works in two domains either spatial domain or transform domain. The spatial domain techniques works directly on pixels. It embeds the watermark by modifying the pixels value. Most commonly used spatial domain techniques are LSB. Transform domain techniques embed the watermark by modifying the transform domain coefficients. Most commonly used transform domain techniques is DCT(discrete cosine transform) and DWT(discrete wavelet transform). The spatial domain watermarking is simple as compared to the transform domain watermarking. The robustness is the main limitation of the spatial domain watermarking. It can survive simple operations like cropping and addition of noise. Another limitation of spatial domain technique is that they do not allow for the subsequent processing in order to increase the robustness of watermark.

Basically there are mainly three challenges being faced by the currently available Watermarking schemes and those challenges are:
1) Time Complexity
2) Quality Complexity
3) Watermarking Standards

Here according to these challenges first one increase the algorithm latency which in turn will increase the complexity in hardware unit and will also result in more power consumption. Now about quality complexity some times due to watermarking the original quality of image is changed which becomes a crucial problem for any application. Third one is watermarking standard this challenge is being faced when watermarking level does not suffice with its encryption levels. Hence these three are the main challenges which are to addressed and are being faced by the previous and existing works.

4. Future Scope on CORDIC Algorithm

As we have already seen the previous approaches of digital water marking. According to those researches we got lots of research gaps. Now for resolution of those issues there is number of future scopes on this area. Here we can reduce the time complexity issues as this is the main problem which is being faced by previous works.

5. Conclusion

According to current technology future is totally based on virtual world. Right now every thing is based on online like shopping, movies, images, educations eta. So for these type of application there is need of some other supportive system which are know as communitarian system, networking, Internet of things etc. now all these systems are based on some mathematical functions which are known as trigonometric function. Now as we are talking about online approach hence there is need to resolve security issues which can only be handled by use of Digital watermarking. So in this work a comparative study about the Digital watermarking and its applications is done.

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