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A Survey of Digital Image Watermarking

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Abstract:-- **Nowadays, Internet has made our life easy and convenient. The accessibility of multimedia data such as audio, images and videos has been increased. But due to this explosive growth in this technology, the data can be deleted, modified or plagiarized easily without proper authorization and authentication. So multimedia security has become a extreme concern in this internet technology. Digital watermarking is the field of information hiding [1] which hides the crucial information in the original data for protection, illegal duplication, distribution of multimedia data. It increases the robustness to various attacks and should ensure that this watermark is imperceptible. This paper presents a literature survey of digital watermark used for the images, including the analysis of various watermarking techniques and their applications.**

Keywords:-- **Digital Watermarking, Spatial Domain Watermarking, Least Significant Bit (LSB), Transform Domain Watermarking, Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT), Discrete Fourier Transform (DFT)**

1. INTRODUCTION

Digital image processing plays a vital role in human life with various applications in the field of engineering, communication, documentation, healthcare and many more. The expansion in this field increased the usage of internet which resulted in many opportunities for the creation and delivery of content in the digital media such as audio, video and image. This raised issues like authentication, information security and many more. Therefore, digital watermark has been proposed as a way to tackle this security issue. Digital watermarking can be mainly divided into three methods- cryptography, stenography and watermarks. Cryptography is the process of converting information to an unintelligible form so that only the authorized person with the key can decipher it. With the advanced technology it became so simple to decrypt a cipher text. So methods were designed which would produce better security than cryptography. This led to the discovery of stenography. Stenography is the process of hiding information over a cover object such that the hidden information cannot be perceived by the user. Thus even the existence of secret information is not known by the attacker. Watermarking is somewhat closely related to stenography. Watermarking is the process of embedding information over a related cover object. So it is mainly used for copyright protection and owner authentication. An important characteristic of digital watermarking is robustness and imperceptibility against like various types of attacks like rotation, filtering, scaling, cropping and compression. It is also used for tamper proofing.

2. DEFINITIONS OF TERMS

2.1 Schemes of Watermarking

The two main techniques of digital watermarking are spatial domain watermarking and transform domain watermarking.

2.2 Spatial Domain Watermarking

Spatial domain watermarking modifies the pixel of one or two randomly selected subsets of an image. These modifications may include flipping the low-order bit of each pixel. But this technique is not reliable for the normal media operations such as lossy compression.

2.3 Least Significant Bit Coding (LSB)

It is one of the earliest methods. It can be applied to any form of watermarking technique. In this method the Least Significant Bit Coding (LSB) of the carrier signal is substituted with the watermark. The bits are embedded in a sequence this bits will act as the key. In order to retrieve it back the sequence should be known. But in this technique the robustness of the watermark will be too low. With LSB coding watermark cannot be retrieved without a noise component.

2.4 Transform Domain Watermarking

The main aim of this watermarking method is to embed the watermarks in the spectral coefficients of the image. The most commonly used transforms are Discrete Cosine Transform (DCT), Discrete Fourier Transform (DFT), and Discrete Wavelet Transform (DWT). Transform domain Transform is better than spatial domain techniques while comparing the robustness and imperceptibility.

3. DIGITAL WATERMARKING TECHNOLOGY

Digital image watermarking is the technique which is used in the digital image processing for embedding information into multimedia data. The working of this technology includes two algorithms [2]. One is the embedding algorithm and other is the detecting algorithm. Figure 1 shows the Digital Watermark embedding process which includes the watermark

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embedding algorithm and Figure 2 shows the watermark detection process in which the embedded watermark is recovered using the watermark detection algorithm.

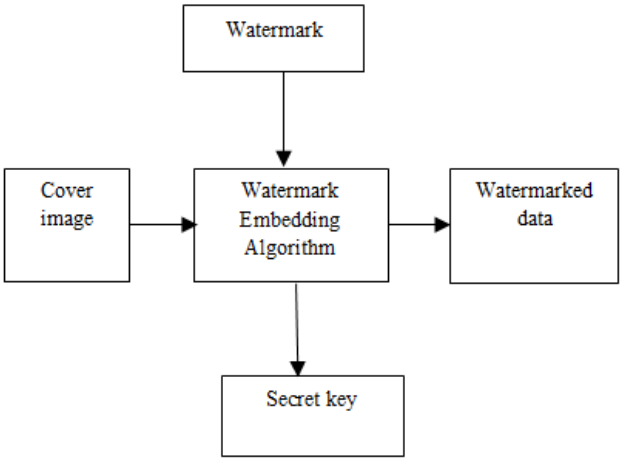

Figure 1. Watermark Embedding Process

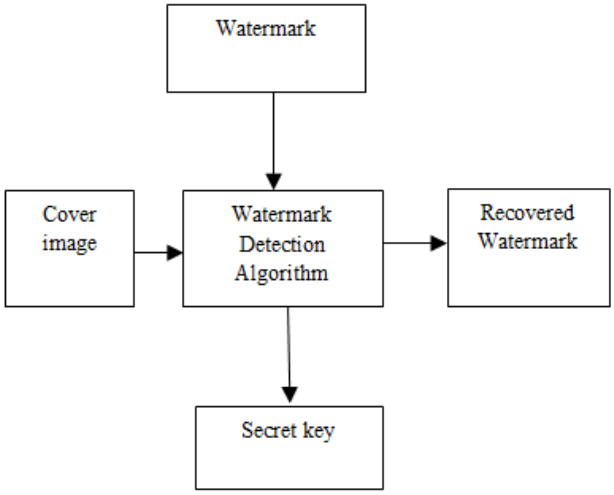

Figure 2. Watermark Detection Process

4. DIFFERENT TYPES OF WATERMARKING TECHNIQUES

Digital Watermarking is very much popular and attracted a lot of researches for two important reasons: one is that it is easily available and other is that it conveys redundant information that is used to embed watermarks. The Digital watermarking techniques always work on two domains: spatial domain watermarking and transform domain watermarking. The spatial domain techniques works directly on the pixels. On the other hand, transform domain watermarking embeds the watermark by modifying the transform domain coefficients. Most commonly used transform domain techniques are DCT, DWT and DFT. The transform domain watermark is more effective than spatial domain watermark in achieving the robustness and imperceptibility.

4.1 Spatial Domain Watermarking

The spatial domain techniques works directly on the pixels. The spatial domain watermarking embeds the watermark by modifying the intensity and color of some selected pixels [3]. The main advantage of this technique is

- Easy to use.
- Less complex
- Less time consuming.
- Low computational complexity.

The main disadvantage of this technique is that it is not robust for various attacks. The most important method which is used by the spatial domain watermarking is Least Significant Bit (LSB).

Least Significant Bit (LSB)

This is the simplest spatial domain technique and one of the earliest methods. This technique embeds a watermark in the least significant bit of some randomly selected pixel of the cover image. The bits are embedded in a sequence. This sequence acts as a key. In order to retrieve back, this sequence should be known. Example of Least Significant Bit (LSB) is given [9]:

Image:
10010101 00111010 11001101 01010101….
Watermark:
1 0 1 0……
Watermarked Image:
10010101 00111010 11001101 01010100…..

Following steps are used to embed the watermark in the original image by using the LSB:

- Convert RGB image to grey scale image.
- Then make double precision for image.
- Shift most significant bits to low significant bit.
- Now make least significant bits of host image as zero.
- Finally, add the shifted bits of the watermarked image to the modified host image.

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The main disadvantage of LSB is poor robustness to common signal processing operations.

4.2 Transform Domain Watermarking

Transform domain watermark is preferred over the spatial domain watermarking because the watermark which is placed by this technique cannot be easily destroyed and changed by the attackers. The image is represented in the form of frequency. First the conversion takes place by predefined transformation. Then embed the watermark in the transformation. Then embed the watermark in the transformation coefficient. Finally take the inverse transform to obtain the watermarked image. Commonly used transform domain watermarking techniques are Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT) and Discrete Fourier Transform (DFT).

Discrete Cosine Transform

Discrete Cosine Transform is generally used for the signal processing. It transforms the image into the frequency domains, which is used in any areas like data compression, image processing and pattern recognition. It is robust when compared to the spatial domain watermarking techniques .

The steps used in DCT [6] are:

- Segment the image into non-overlapping 8*8 blocks.
- Calculate forward DCT to each of these blocks.
- Apply some selection criteria like HSV.
- Use the highest coefficient selection criteria.
- Then embed the watermark by modifying the selected coefficient.
- Now take inverse DCT transform for each block.

Discrete Wavelet Transform

Discrete wavelet transform (DWT) provides the multi resolution representation of image. It gives a simple framework for interpreting the image foundation. This technique analyses the signal at multiple resolution. It divides the image into high frequency quadrants and low frequents. This process is repeated until the signal has been entirely decomposed. If we apply single level DWT on two dimensional images, it divides into four parts, i.e.

LL: The low frequency details of the original image.
LH: The vertical details of the original image.
HL: The horizontal details of the original image.
HH: The high frequency details of the original image.

Since the original image lies in the low frequency coefficients, we embed the watermark in it. By applying IDWT [5], the reconstruction of the original image from the decomposed image takes place. This technique is scalable in nature. Hence it is more frequently used.

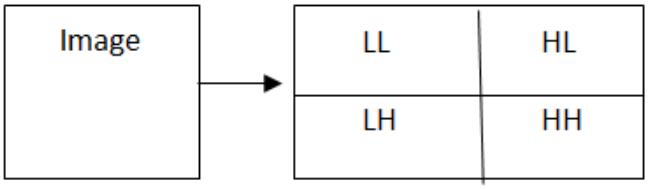

Figure 3. Single Level Decomposition

Discrete Fourier Transform

Discrete Fourier Transform (DFT) has robustness against the geometric attacks like rotation, scaling, translation, cropping, etc. The DFT decomposes the images into sine and cosine form. It is based on two techniques, one is direct embedding and other is template based embedding. In direct embedding the watermark is embedded by modifying the DFT magnitude and phase coefficients. The template based embedding technique includes the concept of templates. This template is embedded in the DFT domain in order to estimate the transaction factor. Finally, spread spectrum watermark [4] is extracted using the detector.

5. APPLICATIONS

Digital watermarking has various applications, they are discussed below [7, 8].

Broadcast Monitoring

Watermark can protect the content ownership during the broadcasting of information over internet, TV or telephone line.

Fingerprinting

It is used to trace authorized users who violate the license agreement and distribute the copyrighted material illegally.

Tamper proofing

Digital content such as image, audio, video can be embedded with fragile watermarks which get destroyed whenever any sort of modifications are made to the content. Hence it is used to authenticate the content.

Copyright protection

Digital watermarking techniques is used to identify and protect copyright ownership as well as illegally replicated.

Access control

It is desirable in some systems to have a copy and usage control mechanism to prevent illegal copy of the content. This watermarking is used for such purpose to allow access with the control capacity.

6. CONCLUSION

The Digital Watermarking techniques widely provide security to the digital content on the internet technology. This paper shows the literature survey of different various Digital watermarking methods based on spatial domain (LSB) and the transform domain (DCT, DWT, DFT) and their applications. The transform domain based techniques provides robustness for different attacks when compared to spatial domain techniques. From the research point of view, watermarking technology is an interesting field because many technologies is emerging for the protection of the data and many still have to come.

REFERENCES

[1] Ajinkya Kawale and Shubham Gaidhan, "Digital Image Watermarking", International Journal of Scientific & Engineering Research, ISSN: 2229-5518, vol.4, no. 5, (2013).

[2] Ankita Singh and Dr. A.K. Sharma, "Digital Image Watermarking Techniques: A Survey", International Conference on Science, Technology & Management (ICSTM), ISBN: 978-93-86171-30-6, (2017).

[3] Nirpama Tiwari, Manoj Kumar Ramaiya and Monika Sharma, "Digital Watermarking using DWT and DES", 3^rd IEEE International Advance Computing Conference, (2013)

[4] Preeti Parashar and Rajeev Kumar Singh, "A Survey: Digital Image Watermarking Techniques", International Journal of Signal Processing, Image Processing and Pattern Recognition (IJSIP), ISSN: 2005-4254, vol. 7, no. 6, (2014).

[5] Sonam Tyagi, Harsh Vikram Singh, Raghav Agarwal and Sandeep Kumar Gangwar, "Digital Watermarking Techniques for Security Applications, "International Conference on Emerging Trends in Electrical, Electronics and Sustainable Energy Systems (ICETEESES), (2016).

[6] Aaqib Rashid, "Digital Watermarking Applications and Techniques: A Brief Review", International Journal of Computer Applications Technology and Research (IJCAT), ISSN: 2319-8656, vol. 5, no. 3, pp. 147-150, (2013).

[7] H.B. Basanth Kumar, "Digital Image Watermarking: An Overview", Oriental Journal of Computer Science & Technology, ISSN: 0974-6471, vol. 9, no. 1, pp. 07-11, (2016).

[8] Naina Choubey and Mahendra Kumar Pandey, "Transform based Digital Image Watermarking: An Overview", International Journal of Computer Trends and Technology (IJCTT), ISSN: 2231-2803, vol. 24, no. 2, (2015).

[9] N. Chandrakar and J. Baggaa, "Performance Comparison of Digital Image Watermarking Techniques: A Survey", International Journal of Computer Application Technology and Research, vol.2, no. 2, pp.126-130, (2013).