Performance Analysis of Hiding Techniques in Digital Image Watermarking

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Abstract- Piracy is a big threat to the original contents. This multi-model approach interleaves some frequency domain watermarking strategies to counteract shortcomings of one strategy by the advantages of others. The original image is divided into spatially disjoint blocks. Watermarking is a way of embedding a mark that hides information in a multimedia carrier. Major issues in Image watermarking are to increase the robustness visual attacks. In this paper, a Review of different watermarking technique are analyzed.

Keywords — Watermarking, DCT, Wavelet Transform, DWT, IWT.

I. INTRODUCTION

With the rapid growth of internet, it is easier for digital data owners to transit multimedia files across the internet. Thus, there is a huge increase in concentration over copyright protection of media [1]. Traditionally, encryption and control access techniques were used to protect the intellectual property rights [2]. These techniques do not protect against unauthorized copying after the media have been successfully transmitted and decrypted [3]. The advantage of hybrid strategies lies in the combination and robustness of the chain of the methods. If any of these methods are affected by any attack Whole chain of watermarking information is lost since the next level information is dependent upon the watermarking information received from previous method [4]. The scheme proposed by Houmansadr [5] is based on visual cryptography watermark which is scrambled before embedding. Watermark is split into various shares and then each share is embedded into different video frame.

II. RELATED WORKS

2.1 LSB Based Hiding Technique

Least significant bit (LSB) insertion is a common, simple approach to embedding information in a cover image. if a bit 1 is hidden in pixel value then pixel value is converted into binary. For Example if pixel value is 10 then (10)10 → (00001010)2. The secret bit is embedded by replacing of lsb bit of pixel value. So for example 00001010 is converted into 00001011 which is 11 in decimal. So in LSB-1 technique maximum value difference is 1 and effect is not perceptible by human eyes. In a well chosen image, one can even hide the message in the least as well as second to least significant bit and still not see the difference. Consecutive bytes of the image data – from the first byte to the end of the message are used to embed the information in the above example.[6]

2.2 Discrete Cosine Transformation based Hiding technique

In the discrete cosine transform based hiding technique, first the image is converted from space domain to frequency domain using DCT transformation using the following equation (1)

\[ f(x, y) = \sum_{u=0}^{N-1} \sum_{v=0}^{N-1} \alpha(u) \alpha(v) F(u, v) \cos \left( \frac{\pi(x+1)u}{2N} \right) \cos \left( \frac{\pi(y+1)v}{2N} \right) \]

Where \( u = 0, 1, 2, \ldots, M - 1 \) and \( v = 0, 1, 2, \ldots, N - 1 \)

\[ \alpha(u) and \alpha(v) = \begin{cases} 1 & \text{for } u, v = 0 \\ \frac{1}{\sqrt{N}} & \text{for } u, v \neq 0 \end{cases} \]

2.3 Discrete Wavelet Transformation based hiding technique

In wavelet transform technique based hiding, the image is converted into frequency domain using discrete wavelet transform. The Discrete wavelet transformation convert the image matrix into four bands: LL (Lowest frequency sub band), LH (low medium frequency sub band), HL (high medium frequency sub band), HH (highest frequency sub band) [7]. In the embedding process, the wavelet coefficient is converted into binary then lsb of coefficient is replace by secret bit and embedded coefficient is converted into decimal. When all information is embedded, the image is transformed in space domain using inverse wavelet transformation.

2.4 Integer Wavelet Transformation based hiding technique

Integer Wavelet Transform is more efficient approach to lossless compression of integer transforms. The
Transform coefficients exhibit the feature of being exactly represented by finite precision numbers, and this allows for truly lossless coding. Integer Wavelet Transform is much faster than the floating point arithmetic in almost all general purpose computers because the floating point wavelet transform demands for longer data length than the integer wavelet transform does[9].

<table>
<thead>
<tr>
<th>LL (Approximation)</th>
<th>LH (Horizontal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HL (Vertical)</td>
<td>HH (Diagonal)</td>
</tr>
</tbody>
</table>

Figure 2.1 Frequency sub band of Discrete Wavelet Transformation

2.5 Combined DWT-DCT Technique

Transform domain watermarking schemes based on the Discrete cosine transform (DCT) the Discrete wavelet transform (DWT) provide higher image imperceptibility and are much more robust to image manipulations. The DCT domain watermarking schemes have the ability to sustain the digital image compression method, such as JPEG. The wavelet transform has several advantages: Multi-resolution description of an image is DWT: the decoding can be processed sequentially from low resolution to higher resolutions. The DWT is nearer to human visual system than DCT. Hence, the artifacts introduced by wavelet domain coding with high compression ratio are less annoying than those introduced at the same bit rate by DCT. In the DWT-DCT method, the most proper sub-bands are selected to take these benefit of DWT in case of robustness and imperceptibility. Then, the block based DCT is applied on these selected band to embed watermark in middle frequencies of each block to improve further robustness of watermarked image against different attacks. By combing the two common frequency domain methods, we could take the advantageous of both two algorithms to increase robustness and imperceptibility. Improvement in the performance in DWT-based digital image watermarking algorithms could be achieved by combing DWT with DCT[10]. Two transforms are combined to make up for the disadvantages of each other, so as to increase the effectiveness of watermarking algorithm.

III. PROPOSED WORK

For hiding secret information into image, the approach is divided into two classes (1) space domain and (2) frequency domain hiding. The space domain approach include least significant bit hiding technique while frequency domain secret hiding technique include Cosine transform and wavelet transform technique. Each technique have their pros and cons. The Imperceptibility, payload capacity and robustness against statistical attacks are the major issues with hiding in image. In this paper, different approaches and technique of hiding secret information in image is reviewed on performance parameter of payload capacity, imperceptibility and robustness.
IV. RESULTS

<table>
<thead>
<tr>
<th>Sno.</th>
<th>Technique</th>
<th>Payload Capacity</th>
<th>Robustness against Visual Attack</th>
<th>Robustness Against Statistical Attacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>LSB Based Technique</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>2</td>
<td>Cosine Transform based Technique</td>
<td>Mid</td>
<td>Mid</td>
<td>Mid</td>
</tr>
<tr>
<td>3</td>
<td>Discrete Wavelet Transform Based Technique</td>
<td>Low</td>
<td>Mid</td>
<td>High</td>
</tr>
<tr>
<td>4.</td>
<td>DCT+ DWT Based Technique</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>5.</td>
<td>DCT+ IWT Based Technique</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

V. CONCLUSION

From the table 4.1 it is conclude that LSB technique have most payload capacity of hiding information but least robust against attacks and detection. While cosine transform based technique have moderate payload capacity and moderate robustness against visual and statistical attacks. For achieving most robustness against visual attacks and statistical attacks, IWT based technique is better than other two techniques with high payload capacity.

REFERENCES