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COMPARISON OF WATERMARKING TECHNIQUES DWT, DWT-DCT & DWT-DCT-PSO ON THE BASIS OF PSNR & MSE

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ABSTRACT

*Protection of digital multimedia content has become an important issue for content owners. This paper proposes an algorithm for Digital Watermarking which is used extensively for copyright protection. The algorithm proposes using Discrete Wavelet Transform (DWT) and Discrete Cosine Transform (DCT) with Particle Swarm Optimization (PSO) for protecting digital media copyright. One level DWT is applied to watermark image and 8*8 DCT is applied to input image. After that PSO run bock to find best DCT coefficient. After finding best coefficient watermark image bit is embed into best coefficient. Now performance of proposed scheme is measured by using four parameters Peak Signal to Noise Ratio (PSNR), Mean Square Error (MSE).*

Keywords: Digital Watermarking, Discrete Cosine Transform, Discrete Wavelet transform, PSNR, PSO, MSE.

I. INTRODUCTION

The technique Digital Watermarking is one of the best methods for copyright protection. With the rapid growth of internet downloading, a new challenging problem is introduced in copyright protection regarding the illegal distribution of privately owned image and security [2]. Watermarking is a best method for protecting own data while using in the internet. Digital watermark embeds copyright information into user data. Each watermark method consists of an embedding algorithm and extracting algorithm. Embedding algorithm merge the watermark information in the data and extracting algorithm decodes the watermark information.

Types of digital watermarking based on human perception can be divided into two parts visible and invisible watermark. Visible watermarking can see directly by the viewers. Invisible watermark cannot be seen by the viewers and it is more robust than visible watermark [3]. According to domain, Watermarking technique can be divided into two main groups [2]:

1) Spatial Domain Watermarking-Spatial Domain mostly modifies the image pixels and directly merges the watermark image into host images pixel. Some examples of this algorithm are SSM modulation and LSB.

2) Frequency Domain Watermarking-As compared to Spatial Domain, Frequency Domain are most widely used technique. It transforms the images into different frequency bands. Examples of this technique are DWT, DCT, and DFT.

1.1 Terminology

Before discussing the detail analysis of watermarking, it is necessary to know some important terminology used in the watermarking technique.

- **Cover Image:** The original image of user in which watermark is added is called host or cover image. This is an image without being watermarked.
- **Watermark:** Watermark is user information, which is to be added to the host image. Hence user can privilege that the image which is to be stolen is theirs.
- **Embedding:** It is the process by which watermark is inserted into the cover image using different algorithm.
- **Extraction:** This is the process by which the watermark is subtracted from the cover image.
- **Watermarked Image:** Images which are obtained after embedding is called as watermarked image.

1.2 Requirement

Robustness-A watermark should be impossible and difficult to remove by any thrust, and also should not diminish the nature and virtue image. A watermark should present in any type of image modifications. Robustness refers to the ability to detect the watermark, even if the quality of the host data is degraded, intentionally (malicious) or unintentionally (non-malicious).

Readability-Readability is an important feature of watermark. A watermark should have as much information as possible.

Security-A watermark should be undetectable by the unauthorized person and also should be secret as much as possible. A watermark should only be accessible by authorized person.

Complexity-Complexity describes the expenditure to detect and encode the watermark. It is important to design the watermarking procedure and algorithm as complex as possible so that different watermark can be integrated.

Imperceptibility-It refers to perceptual similarity between the original and watermark image. That is quality of host image should not be destroyed by the presence of watermark.

Capacity- The capacity of the watermarking model is refers the ability to verify and compare between different watermarks with a small number of error.

The basic requirements listed above are related to each other. The mutual dependencies between these requirements are shown in Fig. For instance, a very robust watermark can be obtained by making many large modifications to the host data for each bit of the watermark. Large modifications in the host data will be noticeable; however modifications in watermark bit will limit the maximum amount of bits that can be stored in an object. The robustness of the watermarking method increases, the capacity also increases where the imperceptibility decreases. The security of a watermark influences the robustness enormously. If a watermark is not secure, it cannot be a very robust. Hence, a tradeoff should be considered between the different requirements. That's why Optimal Watermark for every application can be developed.

There are different types of algorithms used to embed watermark into the host image. A robust multimodal watermarking techniques using Particle Swarm Optimization is one of the latest algorithms for watermarking [4]. Hybrid Discrete Wavelet Transform (DWT) and Singular Value Decomposition (SVD) is one of the best

methods for user's law protection [5]. Also hybrid DWT and DCT is the best method for one level watermark embedding [6].PSO provides an intelligent approach for watermarking techniques [7]. There is also a technique for watermark embedding, in which three algorithms DWT, DCT and SVD are merged and new technique are proposed [8]. Qualified Significant Wavelet Tree (QSWT) is one of the method which is derived from Embedding Zero Tree (EZW) [9]. The quality of watermark image depends upon the perceptibility and robustness. Providing good balance between given two requirements is most important issue for any watermark algorithm [10].

II. PROPOSED INTELLIGENT WATERMARKING ALGORITHM

2.1 Particle Swarm Optimization

PSO was developed by Eberhart and Kennedy.PSO is population based optimization model which is generated by the behavior of fish schooling or bird flocks.In particle swarm optimization, particles move in the search area. Each particle searches for positions which are best in the search area. PSO takes the behavior of birds and searches for the best position in the search area. The algorithm is initialized with particles at random positions, and then it explores the search area to find better solutions. Each particle adjusts its velocity to follow two best solutions.

The first part is cognitive, where the particle follows its own best solution. This value is called particle best (pbest). The other best value is the current best solution of the swarm. This value is called global best (gbest).

Let Y_{ij} (t) is position of particle I with dimension j=1….n at time t. than in the next time step t+1 position and velocity of the particle is measured by:

$$Y_{ij}(t+1) = Y_{ij}(t) + V_{ij}(t+1) \quad \text{……..(1)}$$

$$V_{ij}(t+1) = w * V_{ij}(t) + C_1 r_1(t)[pbest_i - Y_{ij}(t) + C_2 r_2(t)[gbest - Y_{ij}(t)]] \quad \text{……..(2)}$$

Y_{ij} (t) is the position and V_{ij} (t) is the velocity of particle, C_1 and C_2 areacceleration constant. $r_2$and r_1 are random values having ranges from 0 to 1.

2.2 Proposed Watermarking Algorithm

For protecting digital images PSO based watermarking with DCT and DWT is adopted in this research. Firstly 1 level DWT is applied to Watermark Image after that the input image is divided into 8 × 8 sized blocks. To achieve best DCT coefficient PSO run block wise in input images. After finding best DCT coefficient, watermark image is embedded into it. Watermarked image is obtained after embedding. The performance of the proposed technique has been evaluated and compared with recent watermarking techniques.

The better values of quality metrics like Mean Square Error (MSE), Peak signal Noise Ratio (PSNR) depict the effectiveness of the proposed technique in maintaining imperceptibility and good watermarked image quality. All the experiments concerned to this thesis are performed using MATLAB version 13.0. Figure 1 shows the methodology of Proposed watermarking technique.

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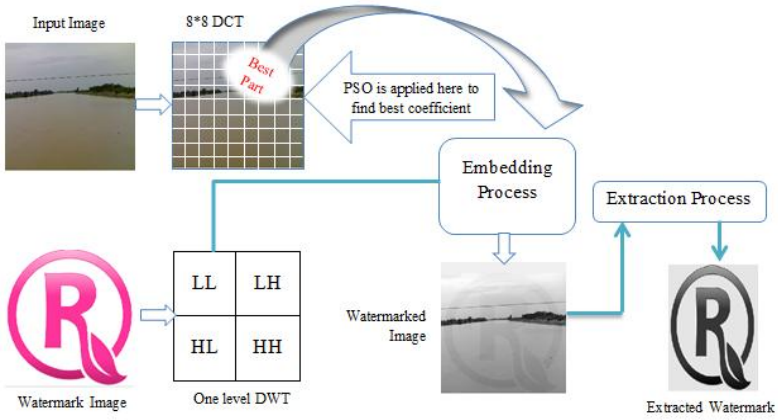

Fig.1Proposed Watermarking Algorithm

In this research PSO based watermarking is also copmapred to proposed DWT watermarking & DCT watermarking on the basis of two paramaters Peak Signal to Noise Ratio (PSNR)&Mean Square Error (MSE).

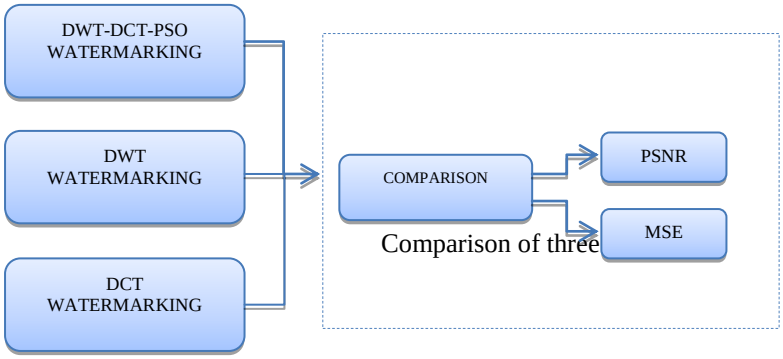

Fig.2 Flow Diagram Illustration of Comparison of Proposed Techniques

The schemetic daigram of this propsed work is shown by figure 2. Which shows that there is a comparison between three techniques DWT, DCT AND DWT-DCT-PSO.For comparison input image is selected which is shown by figure 3 and also one watermark image is selected which are shown by figure 4. These images are selected for performing watermarking techniques. Watermark image is embedded into the input image.

III. RESULT

For simulation, input images are selected which are shown by fig 3 and for embedding watermark images are selected which are shown by fig 4. watermark images are embedded to their corresponding host images. Firstly DWT embedding and extraction takes place then DCT based embedding enad extraction of images are performed. After DWT and DCT, PSO based watermarking technique is appied. Figure 3 and 4 below shows the host images and watermark images respectively which are used for implementation-

Fig.3 Input Images **Fig. 4 Watermark Images**

DWT based watermarking gives PSNR=62.2656 MSE=0.03897. DCT based watermarking gives PSNR=52.6024 MSE=0.3599 and DWT-DCT-PSO Watermarking gives PSNR=69.657 MSE=0.00708. Result shows that PSO based watermarking algorithm gives better result than DWT and DCT.

Table 1. Results and Comparison of Proposed Method

ALGORITHMS	PSNR	MSE
DCT	62.26	0.0389
DWT	52.6024	0.3599
PSO	69.657	0.007

Table 1 shows the simulation result of three proposed algorithms DCT, DWT & DWT-DCT-PSO on the basis of two performance evaluation Peak Signal to Noise Ratio& MSE. Result shows that PSO based algorithm gives better result. Peak Signal to Noise Ratio of PSO based proposed scheme is much higher and MSE is much less than other two techniques. This is better for good quality of images.

IV. CONCLUSION

The work in this thesis, primarily focus on to provide good tradeoff between perceptual quality of the watermarked image and its robustness to different attacks. For this purpose, robust and imperceptible watermarking scheme called Particle Swarm Optimization (PSO) is adopted which is based on one level Discrete Wavelet Transform (DWT) and 8*8 Discrete Cosine Transform (DCT). Through computer simulation, analysis of performance of the algorithms against different attacks such as, noise, cropping, and image resizing takes place. The simulation results show that proposedalgorithm is effective in improving imperceptibility. Here the proposed watermarking algorithm is implemented on Matlab 13.0 and experimental result shows that this technique is more robust and imperceptible and gives better Peak Signal to Noise Ratio (PSNR), and much less Mean Square Error (MSE). The following are the conclusion regarding this work:

- The result of comparison shows that proposed method is not only better visually but also performs better with the result of other methodologies, in terms of various image quality metrics.
- Proposed algorithm gives much higher PSNR usually more than 50 db, which is far better than other watermarking algorithms.
- This watermarking technique gives less MSE when compared to other watermarking techniques.

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