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Robust Image Watermarking Using Transform Functions

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ABSTRACT

To maintain the relationship between robustness and imperceptibility is very challenging for conventional digital watermarking methods. The proposed algorithm of digital image watermarking, efficiently manage the value of robustness and imperceptibility. The proposed algorithm applied lifting wavelet transform to extract features of the source image and symbol image. The LWT transform overcome the limitation of the wavelet transform. The proposed algorithm focusses on pattern-based embedding process of the watermark. For the generation and formation of pattern applied stack-based ensemble classifier. The stack-based ensemble classifier derived in two-stage and use three classifiers, SVM, KNN and DT. The glow-worm swarm optimization applied to the symbol image to select an optimal coefficient for the process of embedding. The proposed algorithm simulated in MATLAB software and measure these parameters such as PSNR, NC, SSIM and BER. The proposed algorithm compares with DWT-SVD, SVM. The results observed that the proposed algorithm is better than the previous algorithm of digital image watermarking.

Keywords: Watermarking, Images, Feature Extraction, wavelet LWT

I. INTRODUCTION

The advancement of the Internet has resulted in many new opportunities for the creation and delivery of content in digital form. Applications include electronic advertising, real-time video and audio delivery, digital repositories and libraries, and Web publishing. But the important question that arises in these applications is the data security. It has been observed that current copyright laws are not enough for dealing with digital data[1, 2, 3]. Hence the protection and enforcement of intellectual property rights for digital media has become a crucial issue. This has led to an interest towards developing new copy deterrence and protection mechanisms. One such effort that has been attracting increasing interest is based on digital watermarking techniques[4, 5, 6]. As steganography pay most attention towards the degree of invisibility, watermarking pays most of its attributes to the robustness of the message and its ability to withstand attacks of removal, such as image operations (rotation, cropping, filtering) etc in case of images being watermarked. Digital watermarking is the process of embedding information into digital multimedia content such that the information (which author call the watermark) can later be extracted or detected for a variety of purposes including copy prevention and control[7, 8]. Digital watermarking has become an active and important area of research, and development and commercialization of watermarking techniques is being deemed essential to help address some of the challenges faced by the rapid proliferation of digital content[14, 15].

II. FEATURE EXTRACTION

This section describes two processes, lifting wavelet transform and glow-worm swarm optimization algorithm.

a. Lifting Wavelet Transform (LWT)

The extraction of features in transform-based digital watermarking methods is the primary function. The process of feature extraction applied to lifting wavelet transform (LWT). The process of lifting wavelet transform proposed by sweldens in 1995[12, 13]. The lifting wavelet transform overcome the limitation of wavelet transform in terms of reducing computational complexity and requirements of memory. The lifting wavelet transform mapped the transform value integer to integer and, it also maintains the forwarded and reverse transform. The processing of lifting transform

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describes in three sections, as splitting, prediction and update. The more information about the LWT transform [8, 9]

b. Glow-Worm Swarm Optimization

Glowworm swarm optimization is bioinspired objective based optimization algorithm. The processing of algorithm based on the behaviors of glowworm [4, 5]. The position and sharing of information of glowworm based on flaring of attracters. The position of glowworm changes to their brightness factor[6, 7]. The distance between glowworm in influence factor of glowworm optimization algorithm. The position of glowworm updates according to their value of luciferin of glowworm agent. The major steps of glowworm algorithm are luciferin update, neighborhood selection, movement of glowworm, velocity and decision of radius update[16, 17, 18].

III. PROPOSED METHODOLOGY

The proposed algorithm based on the concept of stacking based ensemble classifier. The stacking-based ensemble classifier is very efficient instead of bagging, boosting and other methods of ensemble. The process of stacking applied three classifier support vector machines (SVM)[9, 10], nearest neighbors (KNN)[14] and decision tree (DT)[15]. The process of stacking applied in two stage, first stage combines two classifier KNN and SVM. In second stage applied decision tree (DT) classifier to predict the class on the guidance of leaf node. The support vector machine provides very efficient in digital image watermarking to increase the robustness and imperceptibility. The KNN and DT also contribute in the area of digital watermarking for the generation and formation of patterns for the process of watermark embedding.

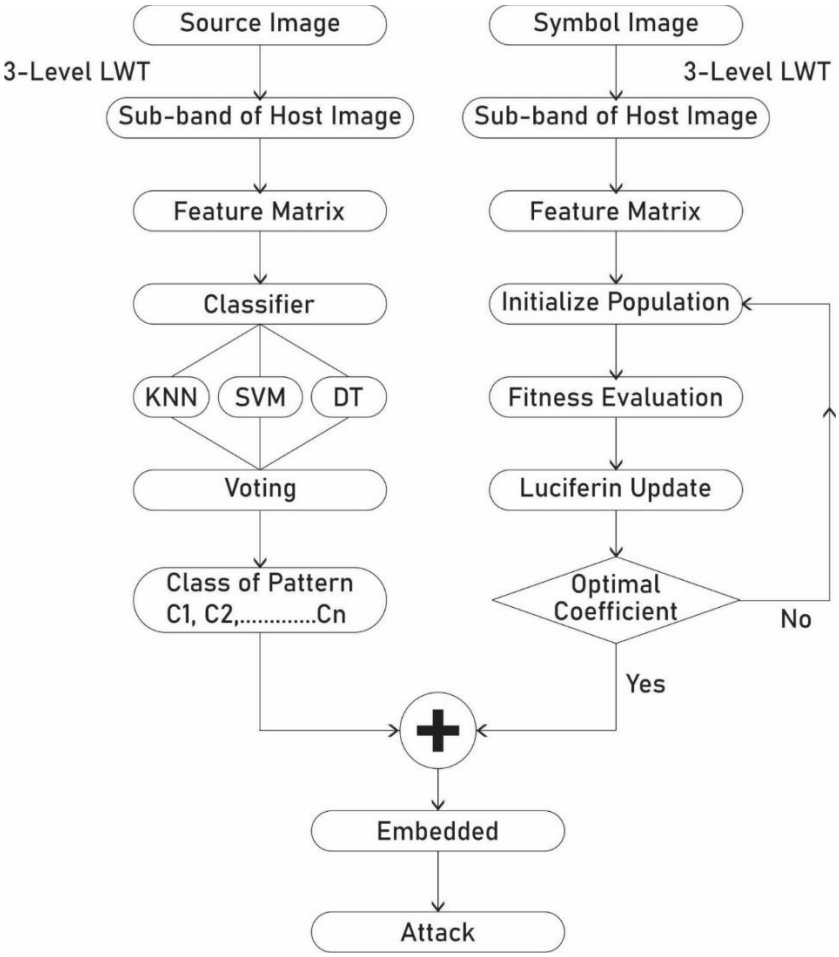

Figure 1: Process block diagram of proposed model of ensemble-based watermarking based on GSO.

Process of watermark embedding Begin

1. Apply 3-level LWT on source image and symbol image
2. The selected sub-band converted into feature matrix
3. The host image feature matrix passes through stack ensemble classifier (SEC)
4. Return the class patterns c1, c2,……..,cn
5. GSO apply on symbol image feature matrix
6. Update the position and luciferin value of new feature points
7. If feature value if high intensity mark as 1 and if low mark 0.
8. Randomized the value of 0 and 1
9. Select SEC pattern and optimal coefficient
10. Embedding done
11. Apply watermark attack
12. Measure NC
13. End

IV. SIMULATION & RESULT ANALYSIS

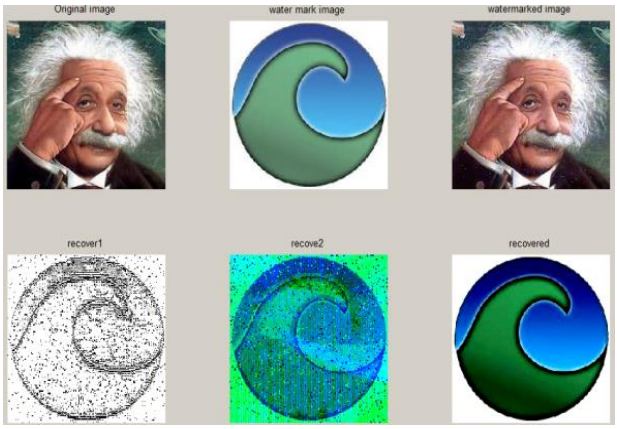

Figure 2: Shows that the Einstein image for Robust Digital image watermarking based on DCT method on Noise Attack.

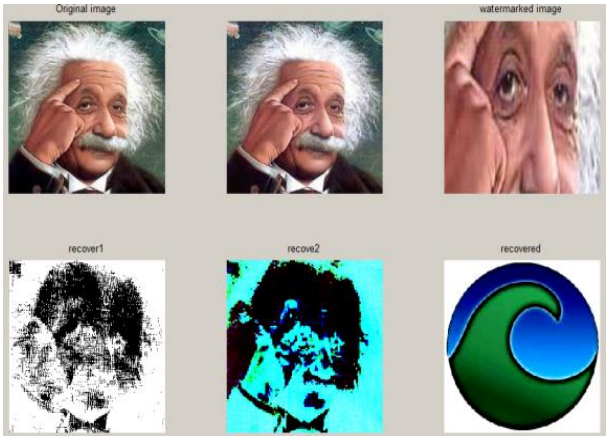

Figure Shows that the Einstein image for Robust Digital image watermarking based on DCT method on Cropping Attack.

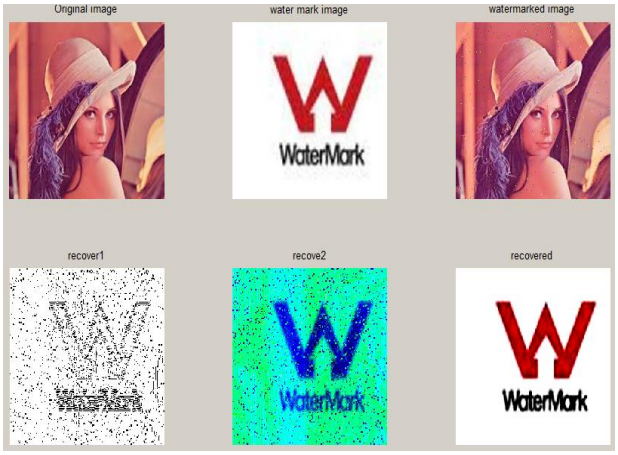

Figure 3: Shows that the Lena image for Robust Digital image watermarking based on DWT method on Noise Attack.

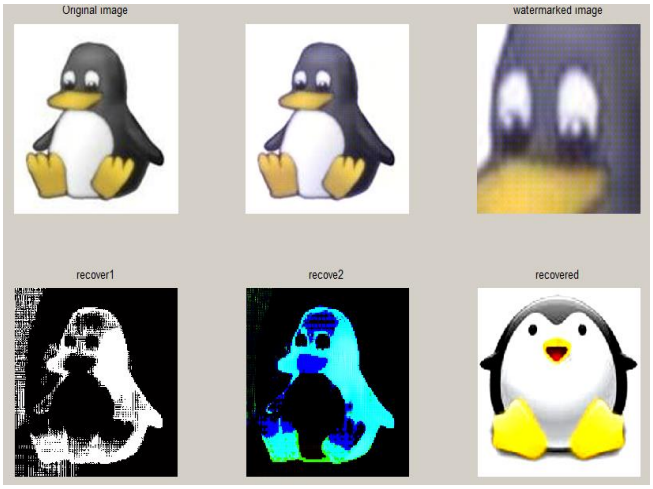

Figure 4: Shows that the Penguin image for Robust Digital image watermarking based on Proposed method on Cropping Attack.

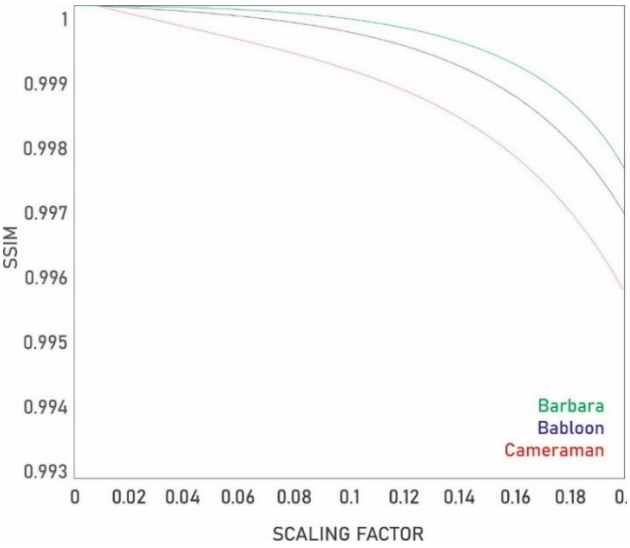

Figure 5: Performance analysis of Proposed techniques with Barbara, babloon, cameraman image using SSIM parameter with respect to scaling factor and range of scaling factor start from zero to 0.2.

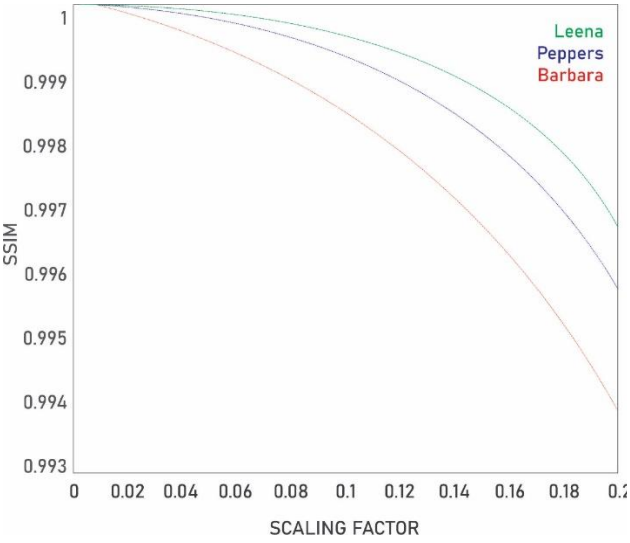

Figure 6: Performance analysis of Proposed techniques with leena, peppers, barbara image using SSIM parameter with respect to scaling factor and range of scaling factor start from zero to 0.2.

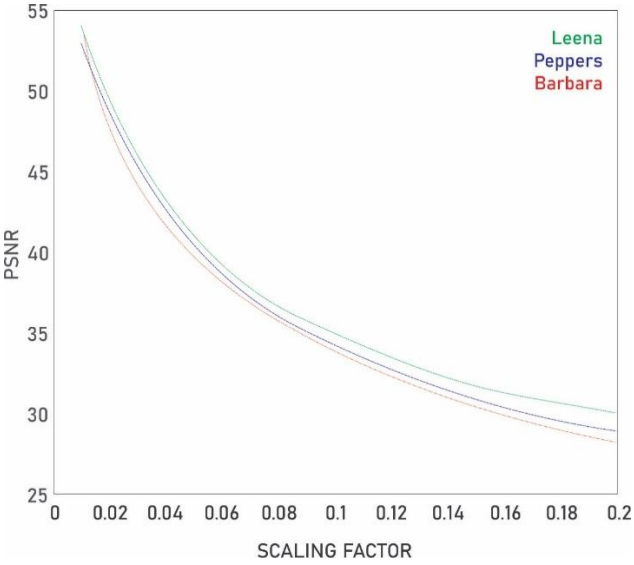

Figure 7: Performance analysis of Proposed techniques with leena, peppers, barbara image using PSNR parameter with respect to scaling factor and range of scaling factor start from zero to 0.2.

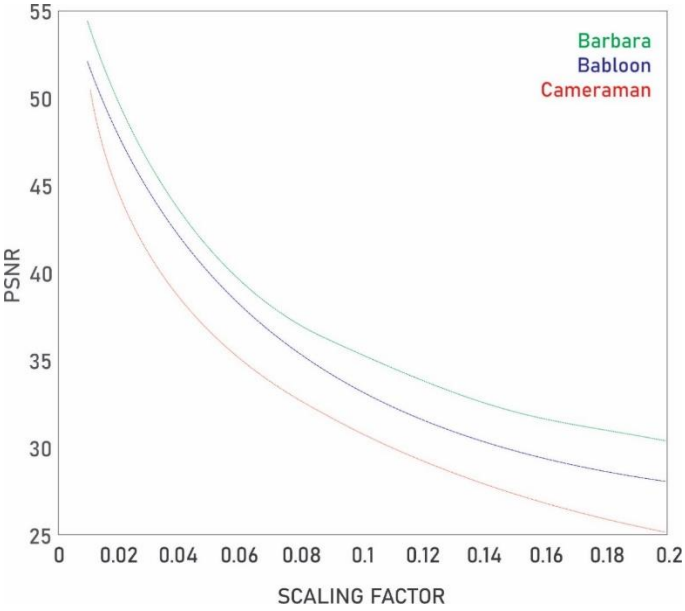

Figure 8: Performance analysis of Proposed techniques with Barbara, baboons, cameraman image using PSNR parameter with respect to scaling factor and range of scaling factor start from zero to 0.2.

V. CONCLUSION & FUTURE WORK

This paper proposed stack-based ensemble classifier for digital image watermarking. The proposed algorithm also encapsulates the lifting wavelet transform methods to extract the host image and

symbol image features. The process of embedding performs by GSO algorithm. GSO proceed with the update feature coefficient of symbol image and correlate with the ensemble class of pattern. The process of ensemble derives from 2 stage learning models. The two-stage learning model efficient the process of digital image watermarking. The proposed algorithm is very efficient in concern of imperceptibility and robustness factor. The increased value of NC, increase the robustness of digital image watermark. BER's minimized value shows that the processing of the transform function is fair in terms of scaling. The proposed algorithm compares with DWT-SVD and SVM algorithms. The analysis of results indicates that the proposed algorithm is efficient. The scaling factor controlled with GSO luciferin value. The controlled population of the position of watermark embedding mark as robust embedding. The strength of the algorithm measure with geometrical and non-geometrical applied attack. The applied attack decreases the value of NC. However, in the case of the proposed algorithm, the value of NC is remained constant and show the strength of digital image watermarking algorithm. The iteration process of transform and GSO increases the algorithm's time complexity, minimizing the number of iteration and increasing the efficiency of the algorithm.

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