Digital Watermarking using Wavelet Transform Algorithm

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ABSTRACT

Digital watermarking is the newfangled idea in digital media. As the replication and modification of digital media content is done frequently and without any significant obstruction, secrecy and authenticity become vulnerable to attacks.

In the information hiding community digital watermarking has achieved immense popularity due to its righteous stronghold against piracy and non-repudiation. Many watermarking algorithm has been developed in recent years. From the context of the purposes, as they serve, they differ from each other. In this paper we focus on digital watermarking technique & algorithm for digital watermarking technique using discrete wavelet transformation.

Keywords— **Digital Image, Watermarking, DWT, Copyright protection.**

I. INTRODUCTION

During the past decade, with the development of information digitalization and internet, digital media increasingly predominate over traditional analog media. However, as one of the concomitant side-effects, it is also becoming easier for some individual or group to copy and transmit digital products without the permission of the owner. The digital watermark is then introduced to solve this problem. Covering many subjects such as signal processing, communication theory and Encryption, the research in digital watermark is to provide copyright protection to digital products, and to prevent and track illegal copying and transmission of them. Watermarking is embedding information, which is able to show the ownership or track copyright intrusion, into the digital image, video or audio. Its purpose determines that the watermark should be invisible and robust to common processing and attack. Currently the digital watermarking technologies can be divided into two categories by the embedding position——spatial domain and transform domain watermark. Spatial domain techniques developed earlier and is easier to implement, but is limited in robustness, while transform domain techniques, which embed watermark in the host's transform domain, is more sophisticated and robust. With the development of digital watermarking, spatial techniques, due to their weakness in robustness, are generally abandoned, and frequency algorithm based on DCT or DWT becomes the research focus.

II. DIGITAL WATERMARKING

Digital Watermarking is a process of embedding unobtrusive marks or labels into digital content. These embedded marks are typically imperceptible (invisible) that can later be detected or extracted.

II.1 Purpose of Watermarking

The watermarks added to digital content serve a variety of purposes, as follows:

- Authentication & integrity verification
- Ownership assertion
- Fingerprinting
- Content Labelling
- Content Protection
- Usage Control- added to limit the number of copies created whereas the watermarks are modified by the hardware & at some point would not create any more copies like DVD.

II.2 Digital Watermarking Techniques

The most important properties of any digital watermarking techniques are robustness, security, complexity, imperceptibility & verification.

Robustness can be defined as if the watermark can be detected after media (normal) operations like filtering, lossy compression, geometric modifications, or colour correction. Security means the embedded watermark cannot be removed beyond reliable detection by targeted attacks. Complexity can be described as the effort & the time required for the watermark embedding & retrieval.

Imperceptibility means the watermark is not seen by the human visual system (HVS). Verification is the procedure where there is a private or public key function is used.

Spatial & frequency domain watermarking are applied to the images & the text.

Spatial domain watermarking slightly modifies the pixels of one or two randomly selected subsets of an image. Modifications might include flipping the low-order bit of each pixel. But this technique is not reliable when subjected to normal media operations like Filtering or Lossy compressions.

Frequency domain watermarking is also called as transform domain technique. Values of certain frequencies are altered from their original frequency values. Typically, these frequency alterations are done in the lower frequency levels, since the alterations at the higher-frequencies are lost during compression. T he Verification can be difficult since this watermark is applied indiscriminately across the whole image.

III. WAVELET TRANSFORM

III.1 Theory

Wavelet transforms decompose a given signal into several scales at different levels of resolution. At each scale, the wavelet transform coefficients that correspond to a particular disturbance event are exclusively larger than those do not correspond to the event in the question. So, related coefficients used to be kept, while others are discarded.

Wavelet transforms consists of a pair of transformations from one domain to another domain. The original domain is the time domain in Wavelet transformations, while the transformed domain is called the time-scale domain. The transformation process from time domain to time-scale domain is a forward transform, because a given signal is decomposed into several other signals with different levels of resolution.

It's possible to recover the original time domain signal without losing any information. This reverse process is called as the inverse wavelet transform or signal reconstruction. These two processes compose the wavelet transform.

Let x(t) be the time domain signal to be decomposed or analysed. The dyadic Wavelet transform (DWT) of x(t) is then defined as,

$$DWT_{\psi}x(m,n) = 2^{\frac{-m}{2}} \int_{-\infty}^{\infty} x(t)\psi^{*}\left(\frac{t - n2^{m}}{2^{m}}\right)dt$$

Where * denotes a complex conjugate, m & n are scale & time- shift parameters ψ(t) is a function of mother wavelet.

A. *Methods*

The spatial domain method & proposed discrete wavelet transform domain method are illustrated in figure1 & 2.
In this proposed algorithm for digital watermarking we are using discrete wavelet transform domain. In the transform domain analysis, replacement method and binary representation method have almost equal performance.
To validate the effectiveness of the algorithm, two images i.e. one is an original (cover) image & other is a logo image are taken, which are shown in figure 3 (a) & (b) respectively. Then the DWT algorithm is applied to the cover image & these two images are embedded. This will result in a watermarked image; & hence for the image extraction the IDWT needs to apply, which will give the original (reconstructed) image. The flowchart for the same process is shown in the figure 2.

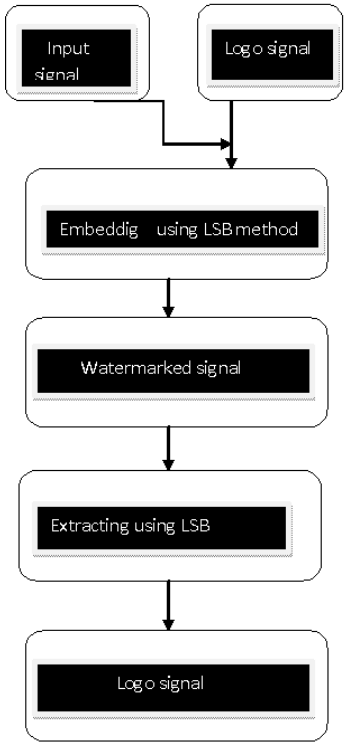
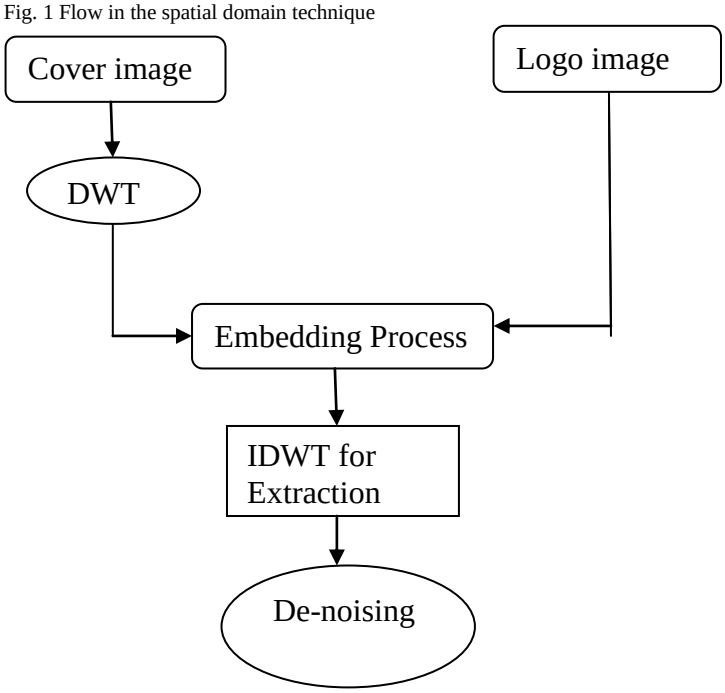


Fig. 1 Flow in the spatial domain technique



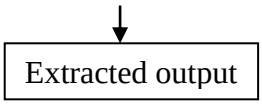


Fig. 1 Flow in the Proposed Discrete Wavelet Transform domain technique

Fig. 3 (a): A Cover Image

Fig. 3 (b): A Logo Image

IV. RESULT

For effectiveness of the algorithm, two images of the same scene have to be taken at different times & then these images should be tested by applying the proposed algorithm. For comparison purpose, the general clarity based algorithm without using wavelet enhancement can also be applied upon the same & results can be compared for the specific results. This comparison should be based on the following evaluation criteria: the image entropy, standard deviation and clarity. Image entropy and standard deviation reflects the amount of information contained in the image; the spatial resolution performance reflects the representation ability of the image.

The proposed algorithm uses the wavelet transformation technique; generally will give larger values of the PSNR, fusion image entropy, standard deviation than the general methods without using wavelet transformation.

Entropy and standard deviation is increasing, indicating that the integration based on wavelet enhancement. This can broaden the image intensity distribution, increase the amount of information and dig the hidden information into the fused image to the maximal extent. The wavelet enhanced fusion image is expected to give better overall result. From the aspect of objective criteria or visual effect, the proposed fusion algorithm based on wavelet enhancement will be better than the algorithm without enhancing the original images.

The obtained results are as follows;

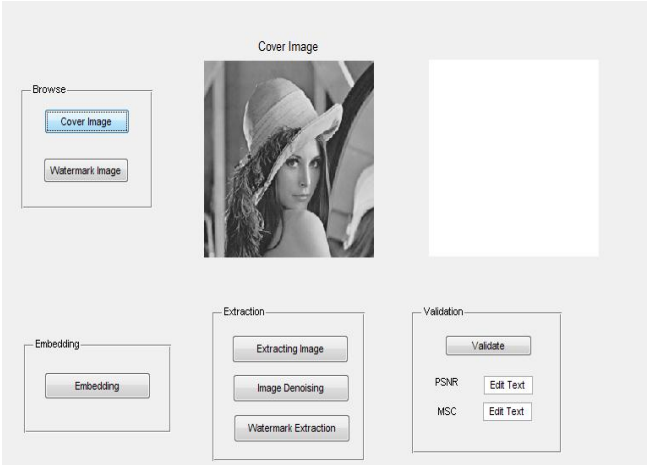


Fig.4: Capturing cover Image

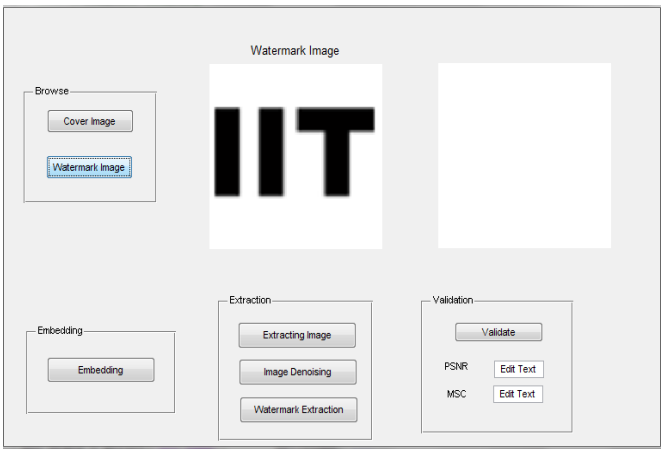


Fig.5: Capturing Watermark Image

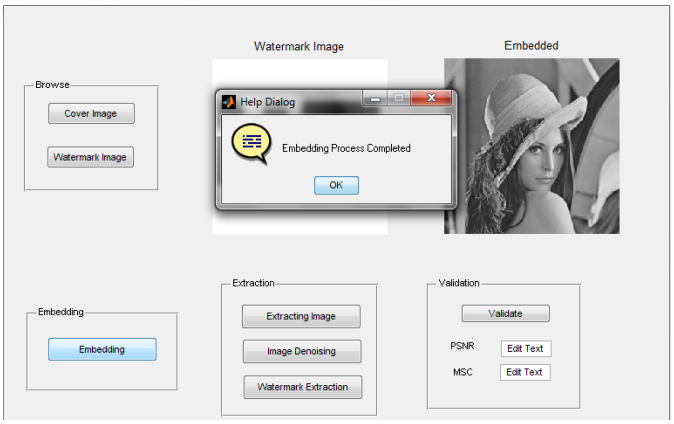


Fig.6: Embedding Process

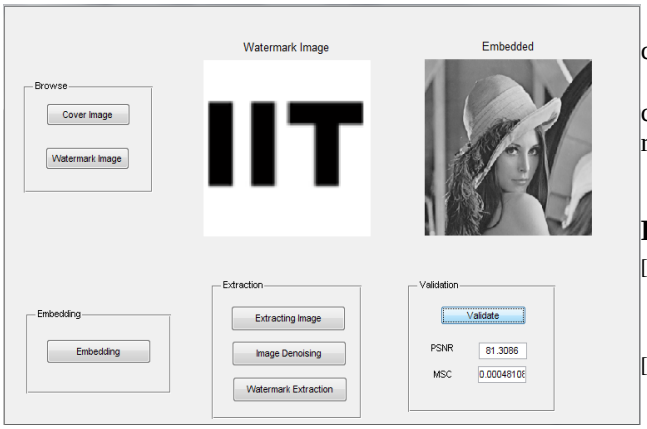


Fig.6: Result displaying PSNR & MSC values

V. CONCLUSION

The proposed algorithm uses the wavelet transformation technique; generally will give larger values of the PSNR, fusion image entropy, standard deviation than the general methods without using wavelet transformation.

Entropy and standard deviation is increasing, indicating that the integration based on wavelet enhancement. This can broaden the image intensity distribution, increase the amount of information and dig the hidden information into the fused image to the maximal extent. The wavelet enhanced fusion image is expected to give better overall result. From the aspect of objective criteria or visual effect, the proposed fusion algorithm based on wavelet enhancement will be better than the algorithm without enhancing the original images.

This proposed method is reliable, highly secured compared to the spatial domain method.

As a future scope, the comparative results & comparative statistics is to prepare to validate the reliability, authenticity of the proposed algorithm.

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