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RESEARCH PAPER

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# Novel Method of Color Image Enhancement Based on Daubechies D4 Wavelet Analysis

Murtaza Saadique Basha
Research Scholar
Department of Computer Science & Engineering
Manonmaniam Sundaranar University
Tirunelveli
m_s_basha76@yahoo.co.in

Dr.M.Ramakrishnan
Professor & Head
Department of Information Technology
Velammal Engineering College
Chennai
ramkrishod@gmail.com

***Abstract:*** Wavelet transform is an important mathematical tool with strong application in signal processing. From the mathematical point of view, many different wavelet transforms are developed, where orthogonal wavelet transforms are more important. The main idea is to transform filter characteristics to wavelet Daubechies D4 representation before ANN training. The technique used is a new methodology to a multi-resolution digital signal analysis by discrete wavelet transforms. Our proposed method is to implement approximation digital signal scheme using Daubechies D4 wavelets. The present technique exhibits a revised procedure of removing distortion (loss) generated from the approximated double length digital signal presented in. For highly nonlinear digital signal, the technique fails to approximate the signal but the proposed revised technique can approximate the signal. At the beginning, a short mathematical introduction of the Daubechies D4 transform is presented. The proposed method not only enables approximating digital signals in a better way but also it approximates highly nonlinear digital signals. Texture patterns from seed clone images are then analyzed through wavelet's Daubechies D4 algorithm which produces discrete frequency coefficients representing the extracted features. Previous work only utilized three statistical parameters representing these coefficients such as mean, variance and standard deviation as the inputs for designing an intelligent identification model for various rubber tree seed clones.

***Keywords:*** Discrete Wavelet Transform (DWT), Digital watermarks, D4wavelet transforms, color space, histogram equalization, Spatial Domain Watermarking

## I. INTRODUCTION

With the rapid advancement of the Internet and multimedia systems in distributed environments, the transfer of multimedia documents across the Internet by the digital data owners has become simple. Thus, there is a raise in concern over copyright protection of digital contents. Protection of digital images has gained remarkable significance. The introduction of image processing tools has amplified the susceptibility for illegal copying, alteration, and dispersion of digital images[12][3]. Against this background, the data hiding technologies for digital data like digital watermarking have attracted enormous attention recently[12][2].

Watermarking may be described as the process of embedding the data into a multimedia element like image, audio or video[11]. It is possible to extract this data from, or detected in, the multimedia element at a later stage for diverse purposes including copyright protection, access control, and broadcast monitoring[12]. The watermark information is embedded directly into image pixels by the spatial domain methods[13]. Considering Image Watermarking, the frequency domain methods are the most successful ones. The frequency domain approaches are highly beneficial for Image Watermarking. An arbitrary sequence is added to the transformed image coefficients by the DCT (Discrete Cosine Transform), the DWT (Discrete Wavelet Transform), the DFT (Discrete Fourier transform) and the DHT (Discrete Hadamard Transform) are utilized in most of the Watermarking techniques.

## II. WAVELET TRANSFORM

Wavelets transform is an efficient tool to represent an image. It allows multi resolution analysis of an image. The aim of this transform is to extract relevant information from an image[14]. It is most powerful and widely used tool in the field of image processing. It divides the signal into number of segments; each corresponds to a different frequency band[14].

Wavelet transforms may be considered as forms of time-frequency representation for continuous-time (analog) signals and they are related to harmonic analysis[15]. Almost all practically useful discrete wavelet transforms use discrete-time filter banks[15]. These filter banks are called the wavelet and scaling coefficients in wavelets nomenclature. These filter banks may contain either finite impulse response (FIR) or infinite impulse response (IIR) filters. The wavelets forming a continuous wavelet transform (CWT) are subjected to the uncertainty principle of Fourier analysis respective sampling theory[4]: Given a signal with some event in it, one cannot assign simultaneously an exact time and frequency response scale to that event[14][15]. The product of the uncertainties of time and frequency response scale has a lower bound[4]. Thus, in the scaleogram of a continuous wavelet transform of this signal, such an event marks an entire region in the time-scale plane, instead of just one point. Also, discrete wavelet bases may be considered in the context of other forms of the uncertainty principle[4]. On the other hand, with the increasing use of internet and effortless copying, tempering and distribution of digital data, copyright

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protection for multimedia data is an important issue[5]. Digital watermarking emerged as a tool for protecting the multimedia data from copyright infringement[5][4].

## III. DISCRETE WAVELET TRANSFORM

A spatially localized basis is useful in signal processing because it provides a local analysis of a signal[3]. Let z(n) represent a signal with frequency n. If a certain coefficient in a series representation of z is large, we can identify the location with which this large coefficient is associated if the coefficients are spatially localized[3]. The previous approach was simply ignoring high pass components and hence could not yield the desired approximation. Various combinations have been carried out to get good approximation of a signal like considering individual series[3][1].

## IV. PREPARE YOUR PAPER BEFORE STYLING

### *A. Color Space :*

A color space is a method by which we can specify, create and visualize color [1][16]. As humans, we may define a color by its attributes of brightness, hue and colorfulness [16]. A computer may describe a color using various amounts of red, green and blue phosphor emission required to match a particular color[2]. A printing press may produce a specific color in terms of the reflectance and absorbance of cyan, magenta, yellow and black inks on the printing paper. A color is thus usually specified using three co-ordinates, or parameters[2][16]. These parameters describe the position of the color within the color space being used. They do not tell us what the color is, that depends on what color space is being used. An analogy to this is that I could tell you where I live by giving directions from the local garage, those directions only mean something if you know the location of the garage before hand. If you don't know where the garage is, the instructions are meaningless [5]. If the visible portion of light spectrum is divided into three components, the predominant colors are red, green and blue. These three colors are considered as the primary colors of the visible light spectrum. The RGB color space, in which color is specified by the amount of Red, Green and Blue present in the color, is known as the most popular color space[3][16]. RGB is an additive and subtractive model, respectively, defining color in terms of the combination of primaries[16].

Modern computer networks make it possible to distribute documents quickly and economically by electronic means rather than by conventional paper means[17]. However, the widespread adoption of electronic distribution of copyrighted material is currently impeded by unauthorized copying and dissemination[17]. In this paper, we propose techniques that discourage unauthorized distribution by embedding each document with a unique codeword. Research encoding techniques are indiscernible by readers, yet enable us to identify the sanctioned recipient of a document by examination of a recovered document. Author proposes three coding methods, describing one in detail, and present experimental results showing that our identification techniques are highly reliable, even after documents have been photocopied.

The watermarking of digital images, audio, video, and multimedia products, in general, has been proposed for resolving copyright ownership and verifying originality of the content. This paper studies the contribution of watermarking for developing protection schemes. A general watermarking framework (GWF) is studied and the fundamental demands are listed. The watermarking algorithms, namely watermark generation, embedding, and detection, are analysed and necessary conditions for a reliable and efficient protection are stated. Although the GWF satisfies the majority of requirements for copyright protection and content verification, there are unsolved problems inside a pure watermarking framework. Particular solutions, based on product registration and related network services, are suggested to overcome such problems.

One way of enhancing color image contrast is to feed back high-frequency spatial information from the saturation component into the luminance component[18]. A new algorithm, which uses a spatially variant measure of salience, is presented. This method offers key improvements to a previous saturation feedback technique. Experimental results confirm that an improved color image enhancement is achieved.

## V. PROPOSED METHOD

### *A. Digital signal scheme Parallel implementation :*

As our watermarking scheme is blind, it requires the watermarked image and the size of watermark image for extraction[7]. To begin with, the DCT is applied into the Digital signal scheme Parallel watermarked image as a result of the DCT transformed image. Then, the Daubechies 4 wavelet transform is applied into the Digital signal scheme Parallel transformed matrix to attain the hybrid transformed image. The proposed watermarking Digital signal scheme discussed in this research effectively embedded the watermark image into the original image and extracted it back from the watermarked image. The proposed Digital transmission frequency domain watermarking scheme makes use of hybrid transform, in which Discrete Cosine Transform is combined with Daubechies 4 wavelet transform. A new algorithm, which uses a spatially variant measure original image of salience, is presented. This method offers key improvements to a previous saturation feedback technique.

### *B. Spatial Domain Watermarking:*

Early watermarking schemes were introduced in the spatial domain, where watermark is added by modifying pixel values of host image[7]. Least Significant Bit insertion is an example of spatial domain watermarking. But, such algorithms have low information hiding capacity, they can be easily discovered and quality of watermarked image and the extracted watermark is not satisfactory as the pixel intensities are directly changed in these algorithms[7][8]. One sample Spatial Domain watermarking algorithm with Least Significant Bit insertion is given below. Any

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watermarking algorithm has two parts: embedding algorithm and detection (extraction) algorithm[7]. The LSB is the most straight-forward method of watermark embedding. Given the extraordinarily high channel capacity of using the entire cover for transmission in this method, a smaller object may be embedded multiple times. Even if most of these are lost due to attacks, a single surviving watermark can be considered a success.

LSB substitution, despite its simplicity, brings a host of drawbacks. Although it may survive transformations such as cropping, any addition of noise or lossy compression is likely to defeat the watermark[5] [8][9]. An even better attack would be to simply set the LSB bits of each pixel to one, which fully will defeat the watermark with negligible impact on the cover object[5][7][8]. Furthermore, once the algorithm is discovered, the embedded watermark could be easily modified by an intermediate party.

Compared to spatial-domain watermark, watermark in frequency domain is more robust and compatible to popular image compression standards[5]. Thus frequency-domain watermarking obtains much more attention[7][8]. To embed a watermark, a frequency transformation is applied to the host data. Then, modifications are made to the transform coefficients[8]. Possible frequency image transformations include the Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT) and others.

Most frequency-domain algorithms make use of the spread spectrum communication technique[5][11]. By using a bandwidth larger than required to transmit the signal, we can keep the SNR at each frequency band small enough, even the total power transmitted is very large[11]. When information on several bands is lost, the transmitted signal can still be recovered by the rest ones[11]. The spread spectrum watermarking schemes are the use of spread spectrum communication in digital watermarking[8][11]. Similar to that in communication, spread spectrum watermarking schemes embed watermarks in the whole host image[11]. The watermark is distributed among the whole frequency band. To destroy the watermark, one has to add noise with sufficiently large amplitude, which will heavily degrade the quality of watermarked image and be considered as an unsuccessful attack[8][11].

The first efficient watermarking scheme was introduced by Koch et al. In their method, the image is first divided into square blocks of size 8x8 for DCT computation[19]. A pair of mid-frequency coefficients is chosen for modification from 12 predetermined pairs[19][10].

After dividing the image into blocks of size 8x8, certain blocks are selected based on a Gaussian network classifier decision. The middle range frequency DCT coefficients are then modified, using either a linear DCT constraint or a circular DCT detection region.

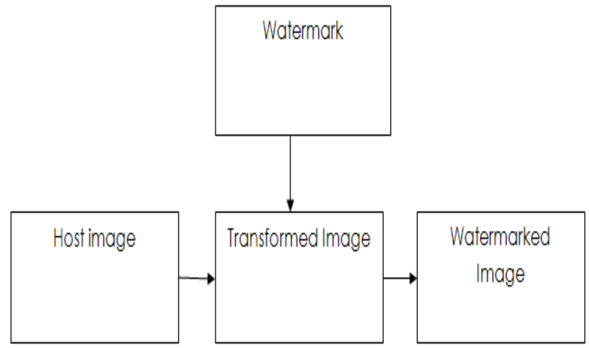



Figure 1. Watermark embedding in frequency domain

One major reason why frequency domain watermarking schemes are attractive is their compatibility with existing image compression standards, in particular, the JPEG standard[20]. The compatibility ensures those schemes a good performance when the watermarked image is subject to lossy compression

**Step 1**: Read gray scale Cover Image and Watermark.

**Step 2**: Consider binary of pixel values of Cover Image and make its n Least Significant Bits 0 e.g. for n=4, Binary of 143=>10001111 and Making 4 LSB 0 =>10000000=>128 is the decimal equivalent.

**Step 3**: Consider binary of pixel values of Watermark and right shift by k bits where k=8-n. For n=4, k will be 4. Binary of 36=>100100 and after right shift by 4: 000010=>2 is the decimal equivalent

**Step 4**: Add result of step 1 and step 2 to give watermarked image.
E.g. Add 128+2=>130. This gives pixel value of watermarked image=>10000010.

Here, pixel values or cover image get changed. Hence, the quality of watermarked image is degraded.

### *C. D4 wavelets Transform (Frequency) Domain Watermarking:*

In the Frequency domain, the watermark is inserted into transformed coefficients of image, giving more information hiding capacity and more robustness against watermarking attacks. Watermarking in frequency domain is more robust than watermarking in spatial domain because information can be spread out to the entire image[10].

### *D. Digital Image Watermark using Discrete Wavelet Transform:*

DWT has become researchers' focus for watermarking as DWT is very similar to theoretical model of Human Visual System (HVS). ISO has developed and generalized still image compression standard JPEG2000 which substitutes DWT for DCT[21]. DWT offers multi resolution representation of an image and DWT gives perfect reconstruction of decomposed image[20][21]. Discrete wavelet can be represented as

[Ψ] (f,k)(dt) = 0n1 (f(1), f(2), … f(n) Ψ t- kb10

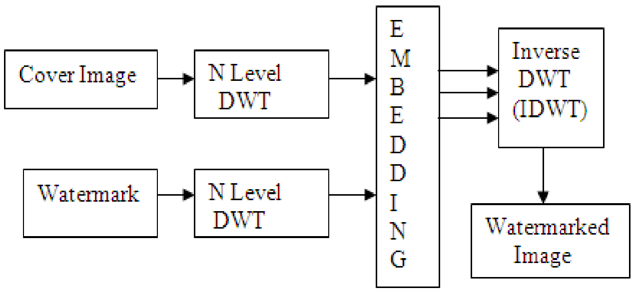
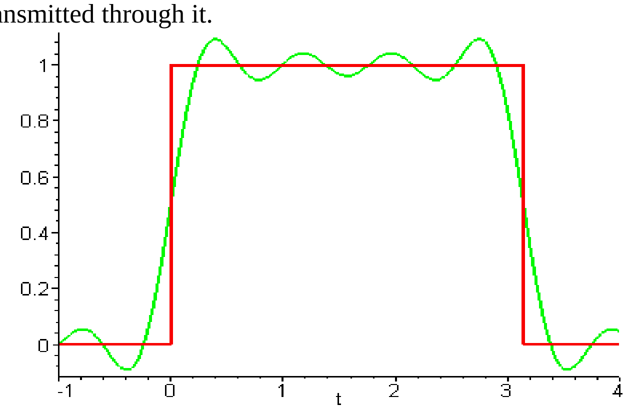



Figure 2. Discrete Wavelet Transform

Image itself is considered as two dimensional signals. When image is passed through series of low pass and high pass filters, DWT decomposes the image into sub bands of different resolutions. Decompositions can be done at different DWT levels. DWT offers multi-resolution representation of a signal. The generalized DWT based watermarking is shown in figure. Actually, 'embedding' will include 'specific algorithmic steps' those are to be implemented in wavelet domain.

In spread Spectrum communication, a narrow band signal is transmitted over much larger bandwidth such that signal energy present in any frequency is undetectable. The image in frequency domain is viewed as communication channel, and the watermark is considered as a signal that is transmitted through it.




This approach is very useful when dealing with periodic functions. However, if we wish to analyse non-periodic functions, then the focus on frequencies can lead to poor results.

Attacks and unintentional signal distortions are thus treated as noise. Spreading the watermark through spread spectrum of image ensures large measure of security. Many existing CDMA based Spread Spectrum Digital Image Watermarking are developed in spatial domain and frequency domain with DCT and DWT .But common problem with CDMA based Spread Spectrum methods is that they support low information hiding capacity.

## VI. CONCLUSION

Finally proposed method is to implement approximation digital signal scheme using Daubechies D4 wavelets. The present technique exhibits a revised procedure of removing distortion (loss) generated from the approximated double length digital signal presented in. For highly nonlinear digital signal, the technique fails to approximate the signal but the proposed, revised technique can approximate the signal. At the beginning, a short mathematical introduction of the Daubechies D4 transform is presented.

The proposed method not only enables approximating digital signals in a better way but also it can approximate highly nonlinear digital signals. Texture patterns from seed clone images are then analysed through wavelet's Daubechies D4 algorithm which produces discrete frequency coefficients representing the extracted features. The progressive retrieval strategy helps to achieve flexible compromise among retrieval indices. Finally we conclude from the results that wavelets achieve high retrieval performance in real time CBIR systems. The performance of the watermarking is evaluated in common image processing attacks such as additive noise, filtering, histogram equalization, JPEG compression, scaling and rotation. Experimental result demonstrates that watermark is robust against those attacks.

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