International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 12, Issue 9 [September. 2023] PP: 127-133

A hybrid DCT and DWT based invisible watermarking algorithm in RGB Color image

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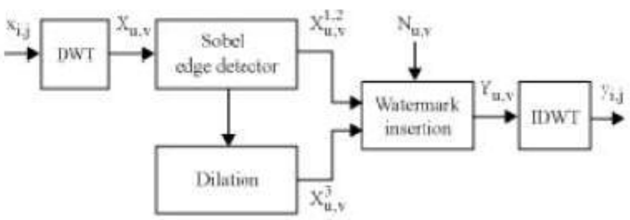
Abstract *Digital image watermarking is an essential technique for copyright protection and authentication of multimedia content. In this paper, we propose a novel hybrid watermarking algorithm based on the combination of Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT) for robust watermark embedding in color images. The proposed algorithm aims to achieve high imperceptibility of the watermark while ensuring robustness against various image processing operations and attacks.*
. To embed the watermark, a selected subset of DCT and DWT coefficients is modified based on the watermark information. The modification is performed by adding or subtracting a scaled version of the watermark signal to the selected coefficients. The watermark signal is generated based on a secret key and the desired imperceptibility and robustness requirements.
During the watermark extraction process, the watermarked image is reconstructed using the modified DCT and DWT coefficients. The original color image is then reconstructed by combining the reconstructed color channels. Finally, the watermark is extracted by comparing the original and extracted watermarked signals.
Key words: *Digital watermarking, Discrete Wavelet transform , NCC, NAE , PSNR, MSE.*

Date of Submission: 10-09-2023 Date of acceptance: 24-09-2023

I. INTRODUCTION

Digital image processing is concerned primarily with extracting useful information from images. Ideally, this is done by computers, with little or no human intervention. Image processing algorithms may be placed at three levels. At the lowest level are those techniques which deal directly with the raw, possibly noisy pixel values, with denoising and edge detection being good examples. In the middle are algorithms which utilise low level results for further means, such as segmentation and edge linking. At the highest level are those methods which attempt to extract semantic meaning from the information provided by the lower levels, for example, handwriting recognition.



Modern digital technology has made it possible to manipulate multi-dimensional signals with systems that range from simple digital circuits to advanced parallel computers. The goal of this manipulation can be divided into three categories:

* Image Analysis image in - measurements out
* Image Understanding image in - Image Processing image in -> image out
* High level description - out

Edge detectors are intended to detect and localize the boundaries of objects. In practice, it is clear that edge detection is an ill-posed problem. It is impossible to design an edge detector that will find all the true (i.e. object boundary) edges in an image and not respond to other image features. Examining real images, it is clear that edge detectors only give ambiguous local information about the presence of object boundaries. In future these edge detection methods will be used for the implementation of the Watermarking technique. This chapter gives the introduction of the watermarking and edge detection methods

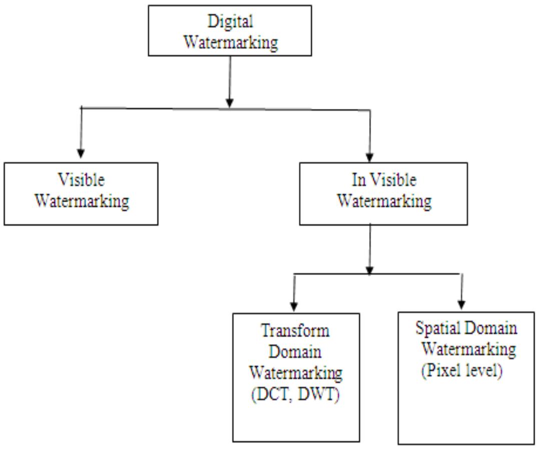


Fig. 1.1 Classification of Watermarking Techniques

In visible watermarking, the information is visible in the picture or video. Typically, the information is text or a logo which identifies the owner of the media where as in invisible watermarking, information is added as digital data to audio, picture or video, but it cannot be perceived as such (although it is possible to detect the hidden information). An important application of invisible watermarking is to copyright protection systems, which are intended to prevent or deter unauthorized copying of digital media. Various watermarking algorithms were proposed to create watermark

II .Digital Water Marking

The introduction of watermarking and the related publications date back to 1979. However, it was only in 1990 that it gained large international interest. Digital watermarking involves embedding watermark data into original information. In other words, a watermark is a pattern of bits inserted into multimedia data such as digital image, audio or video file that helps to identify the file's copyright information (author, rights, etc.). A simple example of a digital watermark may be a visible signature or seal placed over an image to determine the owner of that image. The name "watermark" is derived from the faintly visible marks imprinted on organizational stationery.

Unlike printed watermarks, which are intended to be somewhat noticeable, digital Watermarks are deliberate to be entirely imperceptible or in the case of audio clips, impossible to hear. In accumulation, the bits corresponding to the watermark must be scattered throughout the file in such a way that they cannot be identified and manipulated. The embedding technique must keep the original information perceptually unchanged and the watermark data should be detected by an extraction algorithm.

The Requirements of Digital Watermarking

It is clear that watermark information cannot be stored in the file header because anyone with a computer or a digital editing workstation would be able to convert the information to another format and remove the watermark at the same time. Thus the watermark should really be embedded to the multimedia signals.

Figure 2.1 depicts a watermark embedding scheme. The input data consists of the original multimedia and watermark data. The watermark data is produced by a production algorithm, which may uses a secret key, a signature, or a combination of several secret keys and the original data. In additional sense, the regular method of watermarking starts with an embedding step. At this level a cover media file is believed and the watermarking information is embedded using a secret key. Both watermark information and secret key

Transparency (Invisibility)

This refers to perceptual similarity between the watermarked image and the original image. The watermark should be imperceptible. It means that no visual or audio effect should be perceived by the end user. The watermark should not degrade the quality of the content, but in some applications we may accept a little degradation to have higher robustness or lower cost. Sometimes watermark is embedded to data in the way that can be seen without extraction. We called this visible watermark. The example of visible watermark is logos.

Robustness

A watermark algorithm is called robust if it can survive after common signal processing operations. In another words, it is measurable after universal signal processing operations such as lossy compression, spatial filtering, translation, and rotation operations. It is important to know that watermark can be robust against one process and fragile against another. A watermark just needs to survive the common signal processing that accrues between the time of embedding and detection of the watermark, and it also based on the use. If the watermark data is placed in significant coefficients of an image then the robustness against image distortion is enhanced accomplished. This is just because individual's coefficients do not change so much after common image processing and compression operations [24]. Contrary to robust watermark, a fragile watermark is not designed to be robust.

Capacity

A watermarking system must allow for a useful amount of information to be embedded into an image. The amount of information that can be embedded in a watermarked image is called data payload. The data payload in image watermarking means the number of bits encoded with the image. The payload of the embedded watermark information must be sufficient to enable the envisioned application.

Security

The watermark must withstand attacks that are aimed directly at the embedded information. It must not be probable for an aggressor to delete the watermark without rendering the multimedia data unusable. Especially it must not be possible to retrieve or even modify the watermark without knowledge of the secret watermark key.

Complexity

Depending on the application, the insertion is done only once and can be achieved off line. As a result, the complication of encoding plays a less important role than the complexity of the decoding. For example, we may have to need real-time decoding. Due to this reason, the complexity of the watermark algorithms should be in a simple form.

Application Area

Digital watermarking has so many applications. In this section, we discuss some more common application of digital watermarking. Copyright Protection: One of the most common applications of digital watermarking is copyright protection specially in image watermarking and it is to insert copyright information (the rules and data of using and copying) into digital object without loss of quality. This kind of applications needs high robustness. Owner Identification/Proof of Ownership: The identification information of the content owner can be embedded as a watermark data into the original data to prove the ownership. This application requires high level of security.

Copy Control

One of the techniques of copy prevention is to have a copy and consumer control mechanism to prevent illegal copying or recording of the content by inserting a never- copy watermark or limiting the number of times of copying. Authentication /Content

Verification: In authentication the goal is to be able to detect any change or modification of the data so that the information required to authenticate the content should be watermarked. This can be possible through the fragile watermark that has low toughness to any adjustment. Transactional Watermarks/Fingerprinting: The main challenge in fingerprinting is to trace the source of illegal copies so that the owner can embed of a different watermark key into each copy that distributed to a different customer.

Broadcast Monitoring

Advertisers use this kind of application to ensure that the commercials are aired by the broadcasters at the time and location that they want according to the contracts. Watermarks can be set in any sort of data to broadcast on the network by computerized systems that are competent to monitor distribution channels to track the content in the time and the place that they appear.

III. Proposed Methodology

In this project a Robust watermarking algorithm is proposed which, the input image is decomposed into four levels by a DWT, an I1 approximation subband including the low frequency components and 12 detail subbands including the high frequency components.

Every subband occupies a specific spatial frequency interval that corresponds to an average contrast sensitivity factor which is the weight of the watermark strength. The proposed algorithm detects edges in each subband using Canny edge detector and forms two groups of coefficients according to their magnitude. Also, a morphological dilation operation around each edge coefficient captures the coefficients near the edges and forms another group.

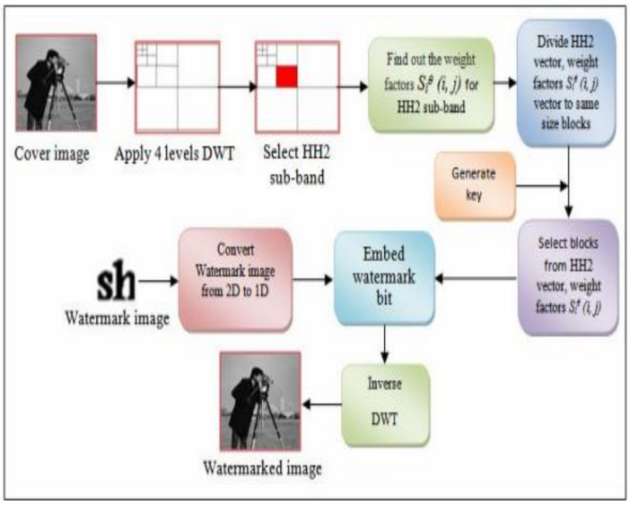


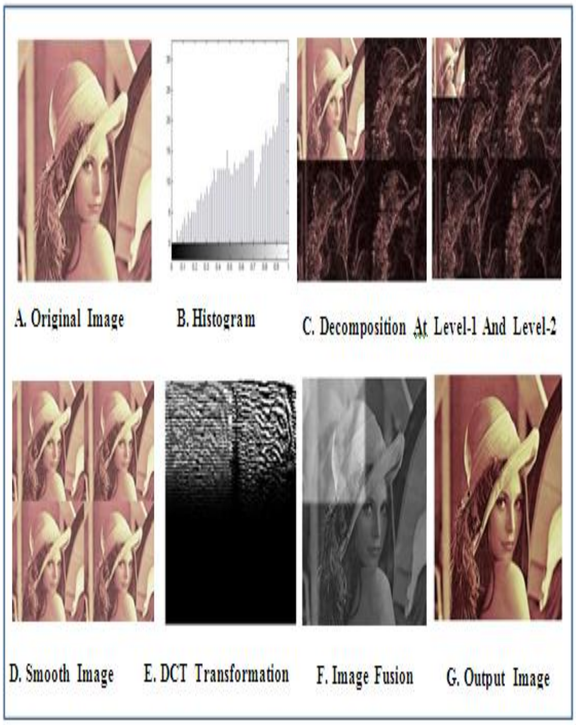
Fig. 2.1 Block diagram of proposed method

IV. RESULT ANALYSIS USING DIFFERENT PARAMETERS

In this section we attached the various image results in order to show the outputs of the proposed work. As we discussed about the environment of implementing these outputs are generated by the MATLAB.

A HMPBDIP architecture having DWT, DCT and image fusion results are taken as a scenario for implementation of proposed work whole procedure is done over MATLAB 7.5.0.342(R2007b). The proposed methodology has been used for preserving brightness and enhanced contrast of three images like Lena, koala and satellite image.

First of all, the performance the proposed algorithm is carried out in the three images sample. Thereafter, the preserving brightness of proposed method is done with following method-(1) DWT (2) DCT (3) Image fusion (4) Inverse dwt. Here, Lena images shown, as in Figure 5.1 in (A, B, C, D, E, F, G).



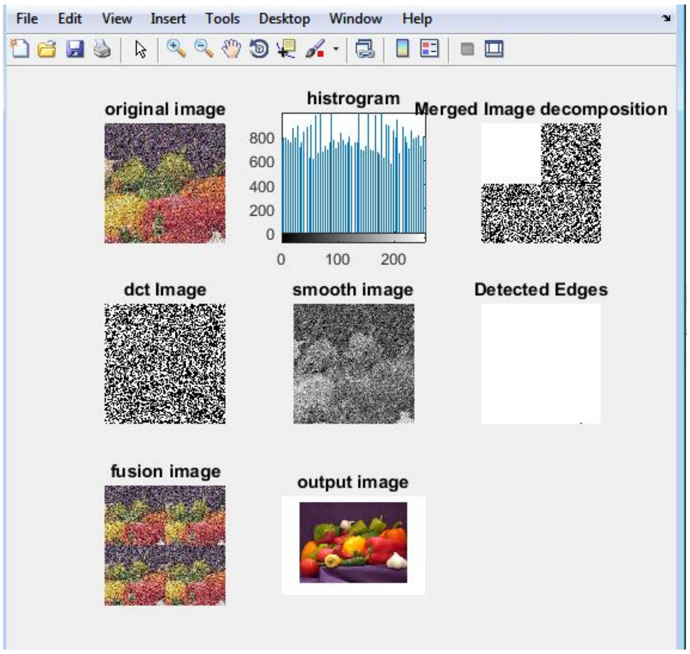


Figure: Resultant vegetables Image Using Hybrid Transformation Model

Figure 1 is vegetables image as input, process of hybrid model apply on this image. Figure 2 is histogram of vegetables image; Figure 3, show decomposition level of koala image at level-1 and level-2 by DWT. After decomposition output image have tilled or smooth image as shown in figure 4. When output of DWT process is passed through DCT transformation output of kola image is converting in to wave form as shown in figure 5, combine output of DCT and DWT by image fusion output as shown in figure 6. Figure 7 is the output of vegetables image after IDWT.

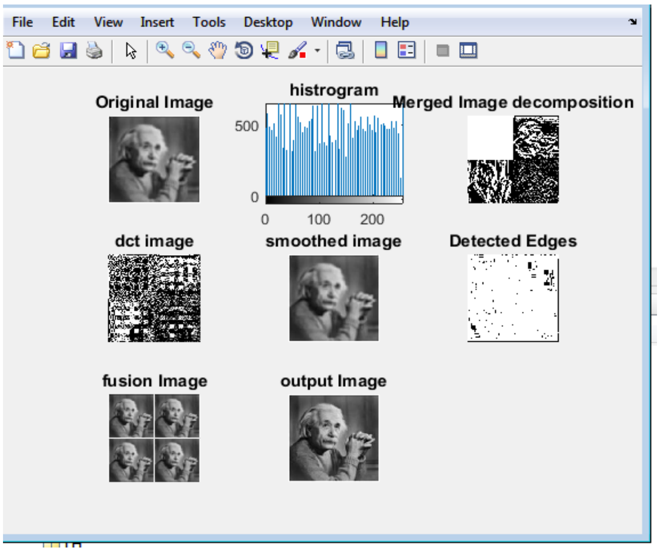
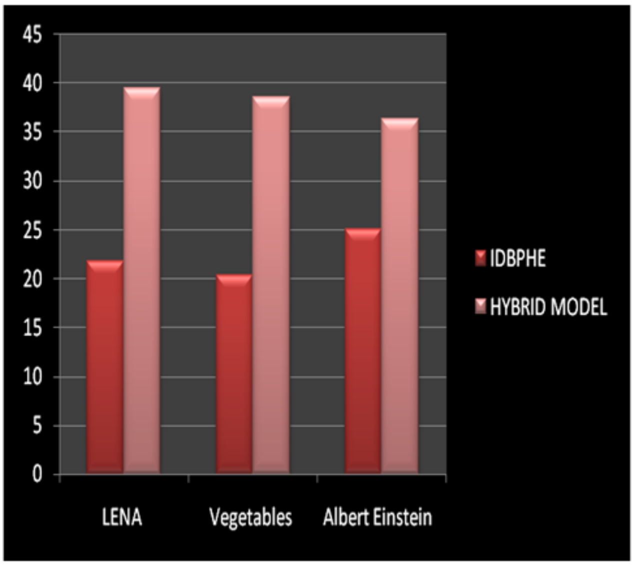


Figure: Resultant Albert Einstein Image Using Hybrid Transformation Model

IMAGES	IDBPHE	HYBRID MODEL
LENA	21.7135	39.5138
Vegetables	20.4	38.5148
Albert Einstein	24.991	36.3743



The table uses three images i.e. Lena, koala and satellite, PSNR values. Overall, it can be seen that the quality of image in the IDBPHEs (image-dependent brightness preserving histogram equalization and hybrid model techniques). To begin, in the hybrid model, Lena image, this had the highest PSNR value i.e. 39.5138. The other two images values were significantly lower as compare to Lena. In IDBPHE method, The PSNR value of images is lowest i.e.20.4, as compared to hybrid model. PSNR of hybrid model is better than previous method. The greater PSNR is better the output image quality

V. CONCLUSION & FUTURE WORK

We had focus on the fundamental concepts of image processing. we have restrict ourselves to two-dimensional (2D) image processing although most of the concepts and techniques that are to be described can be extended easily to three or more dimensions

Various classical edge detectors are implemented and compared in the current work. Edge detectors are intended to detect and localize the boundaries of objects. In practice, it is clear that edge detection is an ill-posed problem. It is impossible to design an edge detector that will find all the true (i.e. object boundary) edges in an image and not respond to other image features. Examining with real images, it is clear that edge detectors only give ambiguous local information about the presence of object boundaries Here in this work we have presented the comparative results of the Roberst, Prewitt, and Sobal edge detectors for different types of noises. And in the second stage of work the results of wavelet based edge detectors are presented and the comparative results are presented. It is found that wavelet based results with multi resolution are better than the conventional method it is also performing better for noisy conditions.

For the future work we can use the different edge masks for implementing the wavelet based watermarking. Rapid evolution of multimedia systems and the wide distribution of digital data over the World Wide Web address the copyright protection of digital information. The aim is to embed copyright information, which is called watermark, on digital data

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