# An Analysis of Digital Watermarking Techniques In Image Enhancement

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***Abstract-*** *The improvement of the image is one of digital image processing's easiest and most desirable fields. An image processing is a fundamental concept of image enhancement to make the result more suitable for a specific application than the original image. Watermarking is an information secret that is used to mask proprietary information in digital media, such as images, digital music, digital video. The use of multi-media applications and internet is becoming popular. Watermarking is becoming more widespread. The watermarking image hides digital data in a host image or logo/audio/video/text cover image. DCT is an orthogonal transformation which has a set of basic functions for many nonanalytical applications such as picture processing and signal processing. DCT is used. Discrete wavelet transformation is a process to convert pixels into wavelets that are then used for compression and coding based on wavelets. We have also identified different kinds of applications such as technologies, features, benefits, drawbacks, etc. in this analysis concerning image enhancement, watermarking, digital watermarking, (discrete cosine transforms) DCT and (discrete Wavelet Transform) DWT.*

***Keywords***- Image Enhancement, Image Watermarking, Digital Watermarking, DCT, DWT.

## I. INTRODUCTION

Today, there is hardly any sector in which digital image processing is not affected in any way. It involves modifying digital data to improve computer-based image qualities. Working to improve images and extracting information are both essential digital image processing components. Enhancing imaging technology improves visibility in other areas or characteristics of any portion or feature of images that suppress information. The improvement of the picture is one of digital image processing's easiest and most appealing areas. The concept behind enhancement methods is basically to bring attention, or simply to highlight, to hidden information, those elements of interest in an image Over the past couple of years, computer vision and analysis have attracted the attention of many researchers. [1].

Watermarking is a method by which the use of any digital media can cover useful data. This is a method by which the owner of digital media may be verified. Watermarking with steganography is particularly defined. Both of them mask signals inside the digital signal. The basic differences between two are: Watermarking seeks to hide message marked by the true content of the digital flag. The watermark image is precious data that unapproved creator is to be avoided. For sender level and also appropriate level watermark image is useful. It should also be protected against unauthorized at sending and acceptance stages. A third image, watermarked image, is obtained after watermarking process. Through the use of a hidden key, the watermarked picture can be distinguished by an approved person. The mystery key is only identified to the approved sender and receiver if a private watermark should occur [2].

The DCT approach is currently being held as one of the most important debates on image enhancement. A DCT is another common, fast and efficient technique. The basic purpose of DCT is to convert signals from spatial representation into frequency representation. DCT algorithm for improvement of results with major variations in illumination. The method found that discharge of low-frequency DCT coefficients into algorithm domain could significantly reduce illumination variations. There are no modelled measures and bootstrap sets. This strategy has advantages. The method is fast and simple to implement in a real-time face recognition framework. But shadow problems and specularity are important to solve since they have the same frequency as certain facial features.

Discrete Wavelet Transform (DWT) in the processing of images, wavelet transform technology has recently been widely used. Wavelet transform is capable of analysing a multi-resolution image and of detecting small fluctuations on multi-levels. Both global and local knowledge should be viewed as a good increase in comparison. A growing literature was discussed using wavelet-related methods, particularly in face recognition applications, based on illumination normalisation algorithms. In 2009, a paper describing multi-scale Retinex (MSR) and DWT combination has been

published to improve colour images. MSR mainly aims at standardising shadow effect and automatically increasing image quality. Finally, DWT was used to integrate sub-images into a single composite image, more informative or visually perceptive. [3].

## II. IMAGE ENHANCEMENT

An image processing is a basic aspect of improving images to make a specific application more desirable than an original image. The same name is used for a range of purposes. We know that a hot research study has now produced many methods & technologies used to enhance image processing. There is no specific theory of image enhancement. [4].

The technique for improving images can be divided into two broad categories:

### 1. Spatial based domain image enhancement

The enhancement of spatial domain operates directly on pixels. It is simple and complex to implement and supports the real-time, key benefit of spatial domain technology. It's very complicated techniques. Once again spatial domain approaches can be divided into two large categories:

- **Point Processing operation:** The most basic spatial domain operations are performed in the neighbourhood through images. Particularly for varying purposes.
- **Spatial filter operations:** Filtering is used to adjust or boost the image. Spatial domain operation or filtering where processed value for current processed pixel value depends on itself and surrounding pixels. Filtering is, therefore, neighbourhood operation that determines the value of a given image pixel using some algorithms for pixel value in the neighbourhood of input pixel.

### 2. Frequency-based domain image enhancement

Improvement of frequency image domain is a term used for the study of frequency mathematical function and work on transformative image coefficients such as transforming Fourier picture and discrete cosine transform (DCT). The main principle to use this technique is to enhance the picture by manipulating transformation coefficients. Frequency domain approaches can be split into three categories again:

- Image Smoothing
- Image Sharpening
- Periodic Noise reduction by frequency domain filtering.

Table 1: Advantages and Disadvantages of Techniques for Development.

| Techniques | Advantages | Disadvantages |
|---|---|---|
| Spatial based domain image enhancement | The key benefit of Spatial domain technologies are easily understood conceptually, and are low in complexity, preferring real-time implementation. | In general, these techniques lack sufficient and robust requirements |
| Frequency-based domain image enhancement | The advantages of enhanced frequency images include low computational complexity, simple viewing and manipulation of the image's frequency composition and easy application of special domain properties transformed. | The basic limitations include that all image parts can not be improved at the same time, and the image enhancement process is also hard to automate. |

## A. VARIOUS ENHANCEMENT TECHNIQUE

### 1. Histogram Equalization (HE)

Improve an image with different operations to brightness-increasing, sharpening, blurring or noise. Equalization of Histogram (HE) is one of the more popular methods of increasing global contrast. The image histogram is an operation that displays each intensity value in the image. Equalization histogram is a technique that increases an image histogram dynamic range. To achieve equal distribution of intensities on the output image HE assigns pixel intensity values image. The goal of HE is to generate a clear histogram. It can be used in the whole image or on an image part only.

### 2. Bi-Histogram Equalization

A Bi-HE method to resolve the limitation of the HE method stated in the last paragraph was proposed to preserve brightness. BBHE is used to decompose original images into two sub-images, using grey average image level and add HE on each sub-image. aThe image histogram divides into two sub histograms based on the average histogram value of the original image and divides subhistograms through refined histogram quantization, generating flatter histogram.

### 3. Gray Level Grouping (GLG)

of the low-contrast image should be grouped into a sufficient number of bins, based on a selected criterion. Then these bins should be uniformly distributed by greyscale. GLG achieves results that are superior to conventional contrast enhancement techniques, but in most cases is also totally automatic and can be applied to a broad variety of images.

### 4. Histogram Specification/ Modification

We will like to convert the image here to histogram specific that can be arbitrarily defined. This mapping function can be found in three steps: equalise histogram of the input image; equalise the stated histogram, and relativize two equalised histograms.

### 5. Dynamic Histogram Equalization (DHE)

Based on their local maximum, DHE methods decompose an original image into several sub-images, then apply dynamic histogram equation to each sub-image and eventually merge sub-images.

### 6. Adaptive Histogram Equalization(AHE)

(AHE) Adaptive histogram equalisation is an image processing technique that improves the contrast of the image. The adaptive approach measures a set of histograms, each corresponding to various image portions, and uses them to redistribute image lightness values. It differs from a simple comparison of histograms. It is best used locally for greater comparison. [5].

## III. IMAGE WATERMARKING

The use of Multimedia apps and the Internet makes the image watermarking more common. The watermarking image covers digital data in the host image or logo/audio/video/text cover photo. Digital watermarking is a type of marker that is embedded in a noise-sensitive signal such as audio or image data and is the most significant digital watermarking technology. Digital watermarking is commonly used to assess that signal is released. The hiding of digital information in a carrier signal is watermarks process. The hidden data should be digital but do not have to be connected to the carrier's signal. The conventional watermarks could be used on visible media (such as images and videos) where the signals could be audio, video, text or 3D models, as in digital watermarking. [6].

digital watermarking are a code that is put into the image. They are very similar to steganography because there is little or no deterioration of covering item in all texts. Huge volumes of data are integrated by steganographic systems, resulting in the safe transmission of data without the deterioration of cover objects and a large quantity of data that can "be not collected or diversified without rendering cover item fully useless is embedded on watermarking systems. An impalpable signal, like inscription and copyright control, is inserted in information such as sound, video, and pictures to a varied number of purposes. It is used primarily for identifying copyright of an image.

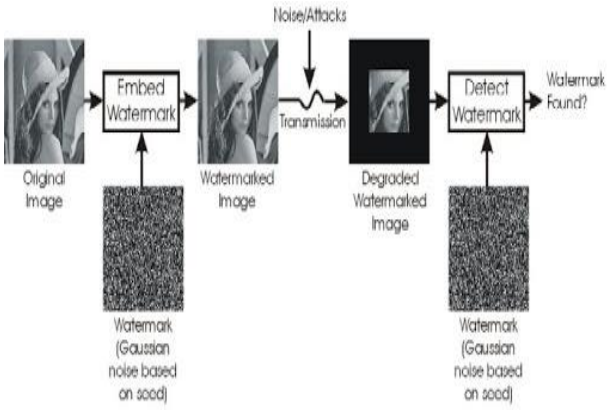


Figure 1: Digital watermarking

### A. APPLICATIONS OF THE IMAGE WATERMARKING

The image watermarking can be used for various purposes, some of which are seen below:-

- **Tamper detection:** Image watermarks are used to tamper detecting, Degradation or destruction of the watermark in the image.
- **Telecast monitoring:-** This method of monitoring is used specifically for advertisements to ensure that content is a contract between company and customer.
- **Software clipping:-** In this case, when purchasing software, the user displays some aspects of the programme such as saving or printing it before purchasing registration key to use watermark.
- **Copyright protection:** Watermarking image is used for copyright protection. The copyright data or information may be inserted into the image as a watermark and extracted if necessary to show ownership.
- **Validation of the Authentication and integrity:** They may use a watermark to detect whether the image has

been changed or not. The integrity of the image can be checked with delicate, durable watermark.

- **Medical applications: -** The watermarking image can also be used for purpose of preserving patients ' data in medical images. This can also not be used by unauthorised access. [7].

## B. WATERMARKING TECHNIQUES

Digital watermarking consisting of two data protection watermarking strategies.

### 1. Spatial domain watermarking

The pixel values of the carrier signal are added to this watermarking process by varying. the less significant bit in the spatial domain watermarking process is a technique. Last but not least: the watermark is inserted into image pixel. You access the pixel for the pictures and insert the details to be submitted into the pixel. This ensures protection for data to be transmitted.

### 2. Frequency Domain watermarking

In this watermarking technique, the information is translated into a carrier frequency coefficient. It is deeper and capable of concealing information. (FT) Fourier transform, (DCT) Discrete cosine transform, (DWT) Discrete Transform Wavelet, etc.

### 3. Discrete cosine transform (DCT)

The image is broken into the various high, medium and low-frequency ribbons in discrete cosine transform. It converts a signal to the frequency domain from the spatial domain. According to the option, the watermark is inserted in the band. DCT is used in many ways, such as data compression, pattern recognition and image processing in every region. DCT is a real transformation with increased calculation performance and greater efficiency in reducing the bit rate.

### 4. Discrete wavelet transform (DWT)

Divide images into subbands of varying resolution in discrete wavelet. On arrival of the image, a series of low and high pass filter will decompose image on different levels. DWT is used in optical watermarking because of its spatial location and multi-resolution technique. better location and visual image quality and are highly robust [7].

## C. PROPERTIES OF WATERMARKING

There are three main Properties of digital watermarking technique

*a)* **Translucency or Fidelity:** The digital watermark would not affect image quality after it has been reported. Visible alterations should not be made because watermarking degrade the commercial value of image if such distortions have been presented.

*b)* **Robustness**: Simple image processing operation like contract and brightness improvement, gamma correction etc. may purposely or accidentally remove watermarks. Therefore watermarks against such attacks should be robust.

*c)* **Capacity or Data Payload:** This property displays the amount of data to be integrated during extraction as a watermark. The watermark should be able to collect enough details to show image characteristics. There are different payload requirements for various applications. [8].

## IV. DCT & DWT DOMAIN WATERMARKING

**DCT Domain Watermarking**: DCT-based watermarking techniques are richer than simple watermarking techniques in the spatial domain. Algorithms such as low pass filtering, brightness and contrast setting, fluttering, etc. are durable for basic image processing operations. They are, however, difficult to execute and are more costly computationally. At the same time, geometric attacks such as rotating, scaling, cropping and so on are working. The global DCT watermarking and block DCT watermarking domain can be categorised. One of the first algorithms proposed by Cox et al. ( 1997) employed global DC testing methods to incorporate a robust watermark in the HVS. The integration into the image's perceptive significant portion has its advantages, as most compression schemes eliminate perceptively small part of the image. In the spatial domain, it represents the LSB but it represents the high-frequency components in the frequency field.

**DWT Domain Watermarking:** In recent years, the wavelet transform was widely studied in signal processing and image compression in general. In certain wavelet-based watermarking applications, DCT-oriented approaches are outperformed. Transform Wavelet is localised type of analysis in the time domain. DWT was designed on the premise that the original image should be divided into sub-image after the original image was carried by DWT, picture transformed into 4 varying wavelengths.

One such scheme is proposed here. Hence it makes it an important topic for research.

## 1. CHARACTERISTICS OF DWT

- Wavelet transforms an image into horizontal, vertical, diagonal spatial directions. Wavelets thus more properly represent HVS anisotropic characteristics.
- Wavelet Transform are computationally powerful and can be used with simple philtre difficulty
- DWT is larger at each decomposition level in lowest bands (LL) and smaller for other bands (HH, LH, HL).
- the higher coefficient of wavelet, greater it is.
- Lower watermark detection is computationally efficient since there are a small number of frequency bands involved in each successive declaration level.
- High-resolution subbands can be easy to find edge patterns, textures in an image.

### A. Advantages of DWT over DCT

- Wavelet transforms more reliably understand HVS than DCT.
- The multi-resolution image description is a wavelet-coded image. This allows an image to be viewed at various resolution levels and processed sequentially between low resolution and high resolution.
- The visual artefacts that wavelet coded images introduce are less apparent than DCT since wavelet transformation does not break up the picture into processing blocks. In DCI blocking devices are evident at high compression ratios; however, wave coded images are visible.
- DFT, DCI are the full-frame transform, thus any transformation changes affect the whole image even when the block-based approach is used to implement DCT. DWT, therefore, has locale of spatial frequency which will affect the image locally if the signal is embedded.
- Hence wavelet transform provides both frequency or spatial definition for the image.

### B. Disadvantages of DWTover DCT

- DWT is more consistent with DCT 'computational complexity. the according to Feig (1990), only 54 times sum needed to calculate DCT for a block of 8 x 8 depends, unlike measurement of wavelet, on the length of filtering used. [9].

## V. LITERATURE REVIEW

**D. Nuñez-Ramirez [2020]** A digital watermarking method is proposed in the present paper for efficient management of ultrasound images. We use invisible watermarking on the frequency field of the image to avoid differences between record and image. We use visually imperceptible watermark in the spatial domain of an image to authenticate the source of medical image. The experimental results indicate that the watermark signal embedded in a medical image is effective and unnoticeable. The output comparison is included with similar works published previously in the literature. [10].

**Q. Yang et al. [2019]** A model of reconstruction of watermarks based on super-resolution and deep learning is proposed in this paper. The model comprises two parts: extracting feature and reconstruction image. The feature extraction component is composed of seven convolution layers, with 3 * 3 kernels and skip contacts. The image reconstruction component consists of many 1 * 1 layers of convolution. The read rate for watermarks is determined by the reading number and average watermarks. Experimental results show improved performance of the algorithm for reconstruction of the watermarked image. [11].

**J. Liu et al. [2018]** In this paper, Wavelet Coefficients probability density purpose is based on generalised Gaussian distribution (GGD), and Neyman-Pearson (NP) criterion defines the threshold for judgment. The energy of image block in watermark embedding process is taken into account. For the integration of watermark data only those blocks whose energy exceeds a predetermined threshold. The improved strength is induced by integration into significant coefficients of wavelet centred on the energy system and its force factor regulation from coefficient variance. Experimental results show that efficiency of watermarking presented, effectiveness against common image processing, certain geometric attacks [12].

**S. Bharati et al. [2018]** This paper focuses mainly on the need for watermarking of medical images. In this paper, Discrete wavelet transformation BFO, Discrete cosine transform, Particle swarm optimization were applied to the purpose of watermarking medical images and analysed their performance. The comparative performance of algorithms used is based on measurement of (PSNR) Peak signal to noise ratio, (normalized cross-correlation) NCC and (IF) image fidelity. For successful message integration, the importance of PSNR and NCC must be high [13].

**P. Lefèvre et al. [2017]** This article provides a new colour watermarking algorithm which minimises colour differences perception. It recognises colour data as HVS does. Many

watermarking methods, including quantization-based schemes[1] or techniques of spectrum insertion, can be easily adapted. This algorithm is based on the human eye model studied by D.Alleysson [2]. The results showed strong improvements for invisibility and robustness of watermarks in image processing: we compared methods used to measure greyscale and colours to show consistency or improvement of the model. [14].

**M. S. Goli and A. Naghsh [2017]** Many schemes have been suggested in recent years to reduce the effect of attacks. The new method for confronting cropping attacks using two sudoku tables was proposed. This process disperses the watermark image into two sudoku table layouts and is labelled as watermark in the host image. This method allows the watermark image to be replicated 81 times in the host image, which allows for the reconstruction of an image of the watermark with other segments. Both sudokus in this paper are in classic form 9 *9, confrontation against crop attacks increases to 98.8 percent by this process [15].

**T. Tuncer et al. [2017]** The BB-RIW approach is proposed to define, produce stamping, embed the stamp, stamp and picture recovery pixels. The BB-RIW method involves Pixel bits are in three classes with BB-RIW method: most critical bits, central bits, and least significant bits. 2 MSB, 4 OB and 2 LSB are used for 8-bit images. The MBs perform logical operations to verify that they are identical to 2 LSBs. 2MSBs are integrated into 2LSBs of pixels when there is equality. In key are recorded the positions of corresponding pixels. Stamps are used for key and mode 4 operators. In picture recovery level, key and MBs are used to retrieve images. The BB-RIW method performance was assessed using capability and visual quality. Experimental findings indicate that in many areas, including medical and military applications, BB-RIW approach can be used. [16].

**R. Choudhary and G. Parmar [2016**] Digital data growth has increased requirements of robust and high-quality watermarking techniques over the Internet. The watermarking techniques typically incorporate binary or grey watermark in image cover or into multimedia images. Variable visibility factor is used in this technique to insert watermarks into the host image's low frequencies component. This paper suggests the use of 2-level DWT image watermarking and contrasts its parameters such as PSNR, NCC with 1 level DWT as well. In simulated outcome invisibility of watermarks created by the method is shown [17].

## VI. CONCLUSION

Image Enhancement is a method typically used for preprocessing of digital images. Image enhancement techniques increase the visibility of any component or image feature in other sections or features that suppress information. Improving image is to enhance the quality of image such that for a particular application or goal set resulting image is better than an original image. Image watermarking is an effective way to hide the image detail. It's a healthy route to communicate reliably. Digital watermarking is an embedded code in the image. A digital watermarking is a form of marker incorporated into an audio or image tolerant signal. The digital watermarking is generally used to assess if the signal is released. DCT is an efficient transition with improved device efficiency and enhances bit rate reduction performance digital watermarking, DWT is used. It increases the accuracy of visual image, location and is highly resilient technology. Eventually, the survey would be very useful for research.

## REFERENCES

[1] G.Ruth Rajitha Rani," A Survey on Image Enhancement Techniques", International Journal of Computational Engineering Research (IJCER), ISSN (e): 2250 – 3005, Volume, 09 , Issue, 3 ,March– 2019

[2] Neha Mahant," Study of security enhancement strategies in digital image processing",IJARSE,Vol.06, ISSN: 2319-8354,Dec-2017.

[3] https://iopscience.iop.org/article/10.1088/1757-899X/557/1/012027/pdf

[4] Rupneet Kaur Hanspal," A Survey of Image Enhancement Techniques", International Journal of Science and Research (IJSR), ISSN (Online): 2319-7064, Value (2015): 78.96 | Impact Factor (2015): 6.391

[5] Rashmi Choudhary, Sushopti Gawade," Survey on Image Contrast Enhancement Techniques", International Journal of Innovative Studies in Sciences and Engineering Technology (IJISSET), ISSN 2455-4863 (Online), Volume: 2 Issue: 3 | March 2016

[6] Ankita Singh," A Survey Of Digital Image Watermarking Techniques", IJARSE,Vol.06, ISSN: 2319-8354,feb-2017

[7] Dr.B.Hari Krishna," A survey on Digital Image Watermarking", International Refereed Journal of Engineering and Science (IRJES), ISSN (Online) 2319-183, Volume 1, Issue 4 (December 2014), PP.49-53.

[8] M.Hariharalakshmi," Survey of Digital Watermarking techniques for Data security", International Journal of Innovative Research in Computer and Communication Engineering, Vol. 5, Issue 3, March 2017

[9] Potdar, V. M., Han, S., & Chang, E. (n.d.). A survey of digital image watermarking techniques. INDIN '05. 2005

3rd IEEE International Conference on Industrial Informatics, 2005. doi:10.1109/indin.2005.1560462

[10] D. Nuñez-Ramirez, M. Cedillo-Hernandez, M. Nakano-Miyatake and H. Perez-Meana, "Efficient Management of Ultrasound Images using Digital Watermarking," in IEEE Latin America Transactions, vol. 18, no. 08, pp. 1398-1406, August 2020, doi: 10.1109/TLA.2020.9111675.

[11] Q. Yang, Y. Zhang, L. Wang and W. Zhao, "Watermark Image Reconstruction Based on Deep Learning," 2019 International Conference on Sensing, Diagnostics, Prognostics, and Control (SDPC), Beijing, China, 2019, pp. 739-743, doi: 10.1109/SDPC.2019.00140.

[12] J. Liu, "An Image Watermarking Algorithm Based on Energy Scheme in the Wavelet Transform Domain," 2018 IEEE 3rd International Conference on Image, Vision and Computing (ICIVC), Chongqing, 2018, pp. 668-672, doi: 10.1109/ICIVC.2018.8492868.

[13] S. Bharati, M. A. Rahman, S. Mandal and P. Podder, "Analysis of DWT, DCT, BFO & PBFO Algorithm for the Purpose of Medical Image Watermarking," 2018 International Conference on Innovation in Engineering and Technology (ICIET), Dhaka, Bangladesh, 2018, pp. 1-6, doi: 10.1109/CIET.2018.8660796.

[14] P. Lefèvre, P. Carré and P. Gaborit, "A new blind color image watermarking based on a psychovisual model and quantization approaches," 2017 IEEE International Conference on Image Processing (ICIP), Beijing, 2017, pp. 505-509, doi: 10.1109/ICIP.2017.8296332.

[15] M. S. Goli and A. Naghsh, "Introducing a new method robust against crop attack in digital image watermarking using two-step sudoku," 2017 3rd International Conference on Pattern Recognition and Image Analysis (IPRIA), Shahrekord, 2017, pp. 237-242, doi: 10.1109/PRIA.2017.7983054.

[16] T. Tuncer, F. Özyurt and E. Avcı, "A novel bit based reversible image watermarking method," 2017 International Conference on Computer Science and Engineering (UBMK), Antalya, 2017, pp. 206-210, doi: 10.1109/UBMK.2017.8093376.

[17] R. Choudhary and G. Parmar, "A robust image watermarking technique using 2-level discrete wavelet transform (DWT)," 2016 2nd International Conference on Communication Control and Intelligent Systems (CCIS), Mathura, 2016, pp. 120-124, doi: 10.1109/CCIntelS.2016.7878213.