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Comparitive Analysis of Watermarking in Digital Images Using 3-Level DWT & LBP

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Abstract: ***Digital watermarking has rise as a new research area for preventing illicit copying and duplication. In this paper two methods 3-level DWT & Local Binary Pattern (LBP) algorithm for watermarking in digital images are discussed. In order to compare the robustness of both algorithms noise attack is used.***
Keywords: Digital watermarking, 3-level Discrete wavelet transformation (DWT), local binary operator(LBP), PSNR(peak signal noise ratio), MSE(mean square error)

1. Introduction

The success of Internet and digital consumer devices such as mobile, laptop, tablet etc. which are used by individuals profoundly changes our daily lives and society by making the transmission, capture and storage of digital data easily and conveniently. However, this raises a big issue is how to protect these data and avert from unauthorized use. These concerns have become issues in many regions such as video and music industry etc. So as a solution digital watermarking is mainly used. Hence digital watermarking becomes very stunning research topic. Digital watermarking technology that detect and create invisible markings, which can be used to track down the origin, accuracy, and authorized usage of digital data. In future the major development of digital watermarking is like as: pirate tracking, image authentication, copying protection, copyright protection, and hide communication. [1][3]

The meaning of robustness is in which watermark is capable to resist some changes in the watermark embedded signal. So a good algorithm should be robust.

In terms of embedding field digital watermarking are classified into two category spatial domain and frequency domain watermarking. In spatial domain method watermark is embed by modifying the pixel values of novel image and transform domain process which embed the data by modulating the transform area coefficients. Semi fragile spatial domain technique is more robust than frequency domain technique.

In frequency domain technique, DWT(Discrete wavelet transform) are used in different fields such as, blood pressure, heart rate and ECG analysis, speech recognition, fingerprint verification, DNA analysis and protein analysis etc.[4]

In spatial domain local binary operator are used in texture analysis, face recognition and gas, liquid two segment pattern analysis [5].

2. 3-Level DWT Alpha Blending Techniques

2.1. *Concept*

3-level Dwt is a mathematical tool in which it hierarchically decompose an image. It gain extensive getting in signal processing, image watermarking & compression. It divides a signal into a set of fundamental functions, which are called wavelets. Wavelets are formed by translation and expansion of a fixed function called mother wavelet.

Wavelet transforms carries both frequency and spatial depiction of an image. 3-level DWT is very appropriate to identify the areas in original image where secret image can be embedded meritoriously. This property allows the exploitation of HVS such that if a DWT co-efficient is modified, it modifies only the area corresponding to that co-efficient. The embedding watermark in the lower frequency sub-bands may worsen the image as generally most of the image energy is stored in these sub-bands [6].

The DWT ruptures the signal into high frequency and low frequency bands. The low frequency domain contains rough information of signal while high frequency domain contains information about the edge element. The high frequency elements are frequently used for watermarking since the creature eye is less receptive to change in edges [7].

In the 2d-applications, for each stage of decomposition, firstly we implement the DWT in the vertical direction which is follow by the DWT in the horizontal direction. After the first stage of decomposition, there are four sub-bands: LL1, LH1, HL1 and HH1. For each sequential level of decomposition, the LL sub band of the previous level is used as the input. To perform DWT on 3-level decomposition we applied DWT on LL2 & finally we get 4-sub band of 3-level that are LL3, LH3, HH3, HL3. Which are shown in **[Figure-1].**

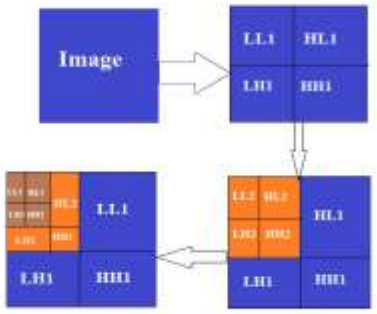

Figure: 1. shows 3-level dwt decomposition.

2.1. 1. Watermark Embedding

For watermark embedding alpha blending technique is used in alpha blending technique two images are blend together using a alpha factor these two images are original image and watermark image and it was blend using alpha factor and produced final image. Just like a rainbow over a rainfall which is naturally occurring alpha blending technique.

2.1.2. Watermark Extraction

For extraction of watermark firstly applied 3-level dwt to watermarked image and original image which divide it into sub bands and After dividing into sub bands we apply the alpha blending technique on low frequency components [8] and subtract low frequency component of original image from watermarked final image by using scaling factor and produced extracted watermark.

3. LBP (Local Binary Operator)

3.1. **Local Binary Pattern (LBP)**

Local Binary Pattern (LBP) is a feature which is used for classification in digital images. LBP was first elaborated in 1994. Since then it is used as a powerful feature for texture classification. Earlier LBP operator is widely used in texture classification and face recognition to measure the local contrast between pixels. Now a days it is also used to ensure the authenticity of digital image as it provide a comparatively robust watermark embedding technique for digital images. The main concept of LBP can be explained as:

3.1.1 ***Concept***

In LBP technique, LBP operator is defined as, a local neighborhood surrounding a center pixel which is used as the threshold to define the local contrast of the surrounding pixels with respect to the center pixel. The surrounding pixels are labeled as 1 when the value of that pixel is greater than the center, or labeled as 0 when the value is smaller than the center. To obtain LBP code of the center pixel threshold values of neighboring pixels are multiplied with their corresponding weights and summing up them.

3.1.2. Watermark Embedding

In this method, three vectors are created namely g_p , m_p and s_p. the first vector g_p is used to hold the grey level values of pixels, second vector m_p is used to hold the values of difference between each surrounding pixel and the center pixel, third vector s_p is used to hold the binary information about each pixel based on the obtained difference between center pixel and the each surrounding pixel as 1 or 0 by comparing it with the value of center pixel.

In order to embed watermark, the XOR function is used to calculate the XOR value of the whole s_p vector because has associative and commutative properties that is any circular shift of bits does not change the value of the function.

One bit of the watermark is embedded in a local region. In order to embed the watermark bit in the local region, the watermark bit and the XOR value of the region is compared if they are not same then only that bit is embedded in that local region. In this method author uses a 3*3 window to define local region. After successfully selecting the local region, the pixel whose value in the m_p vector is minimum is choose to embed

the watermark bit. If all the values of a local region are 0 or 1 then the value of the center pixel is modified in order to embed the watermark bit.

3.1.3. Watermark Extraction

To extract the watermark from the image simply the XOR value of each local region is judged if the value is 0 the corresponding watermark bit is 0 or if the value is 1 the corresponding watermark bit is 1.

So the watermark embedding and the extraction phases are very simple but are robust against the post processing attacks like noise addition.

4. PERFORMANCE EVALUATION

This part explains the simulation and experiments of 3-level DWT& LBP and results obtained. For quantitative evaluation, Peak signal noise to ratio (PSNR) which measure the image quality.

When PSNR is 40db or greater than it, It means images which are reconstructed are virtually impossible to differentiate by human observer.

4.1. Imperceptibility: It means the image quality of original image should not be vague in presence of watermark. For evaluation purpose PSNR (peak signal noise to ratio) are used which measure the image quality in decibel.

Noise	Correlation for 3-level DWT	Correlation for LBP
10%	0.91	0.72
20%	0.82	0.70
30%	0.77	0.65
40%	0.64	0.60
50%	0.62	0.54
60%	0.54	0.49
70%	0.52	0.46
80%	0.43	0.39
90%	0.37	0.32

4.2. Robustness: Robustness is a measure of immunity of watermark against attempt to remove or mortify it intentionally or unintentionally, by different types of attacks. In this chapter we will present robustness result which is based on noise attack. For evaluation purpose correlation is used.

5. EXPERIMENTAL RESULTS

For simulation purpose we used three images Lena, baboon & flower images of size 128 X 128 original images & 32 X 32 logo image. Results are shown for imperceptibility in **[Table-5.1]** and graph are shown in [**Figure-5.1]**

Original image	Logo image	PSNR in 3-level DWT	PSNR in LBP
lena	Logo.jpg	58.95	68.53
baboon	Logo.jpg	57.75	64.26
flower	Logo.jpg	56.12	62.12

Table 5.1

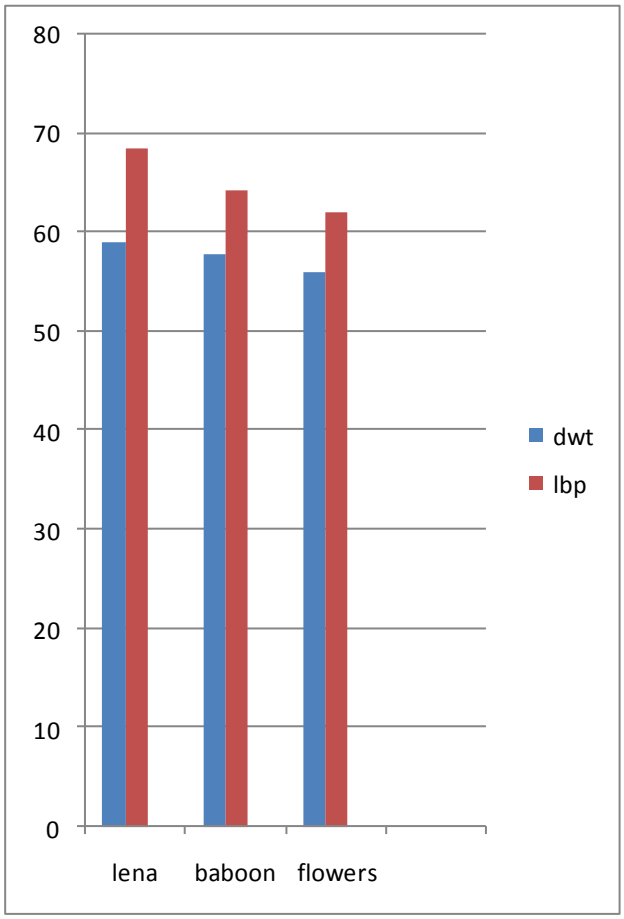

Figure: 5.2. Embedding watermark image psnr (peak signal noise ratio)

Results are shown for noise attack vs correlation for lena image:

Table 5.2

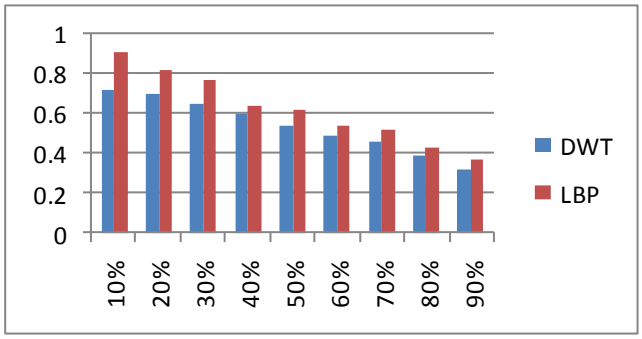

Figure: 5.3. Robustness check for extracted watermark against noise attack(correlation vs. noise)

6. CONCLUSION

In this review paper watermarking techniques is describe as a new development in the digital image watermarking in which the watermarking techniques is indistinguishable for human observer. After analysis of these algorithm LBP(local binary operate) is better than the 3-level DWT alpha blending techniques from imperceptibility views and it is concluded from the graphs LBP is more robust than 3-level DWT alpha blending technique against noise attack.

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