Abstract— In this present work we proposed a resolving the copyright protection problem of digital images using an effective robust invisible watermarking scheme based on Dual Tree complex wavelet transform. Medical image security provides challenges and opportunities in watermarking. In this, Ultrasound image of patient is embedded into one level of the dual-tree complex wavelet transform of the chrominance channel of the original image to provide high quality watermarked image. After embedding, the resultant image is sent to the doctor. The doctor could analyze the image and diagnose the problem for the particular patient. This method is also robust to temporal frame averaging, multiple watermark embedding, camcording, downscaling in resolution, and other geometric attacks, such as upscaling, rotation, and cropping.

Index Terms—Watermarking, Ultrasound, Dual Tree Complex wavelet transform, Downscaling in resolution

1. INTRODUCTION

For the fast growth development of computer network technique and multimedia technology, digital media (for example, picture, video, sound or content) are transmitted and distributed through Internet without any loss in the nature of the substance. Thus, some method for assurance of copyrighted digital data is required. A digital watermarking strategy has been created to ensure licensed innovation from illegal duplication and manipulation[1]. Digital watermarking implies implanting data into computerized media in such way that it is imperceptible to a human observer but easily recognized by method for processing operations with a specific end goal to make assertions about the data. The watermark is needed to be hearty against purposeful evacuation by malevolent gatherings[1].

Watermarking schemes can be robust or fragile. Robust watermarks are designed to resist to pernicious or purposeful contortions; for example, general picture processing and geometric distortions; while a fragile watermark are required with the end goal of confirmation and check. We can also classify watermarking plans as indicated by operation area: the spatial space and frequency domain. Watermarking techniques can be classified into the Discrete Cosine Transform (DCT), Discrete Fourier Transform (DFT), Discrete Wavelet Transform (DWT), and others. The transform domain techniques have provided more advantages and preferable exhibitions over those of spatial ones in most of digital watermarking development and researches. The standard discrete wavelet change has been abused with great accomplishment over the extent of sign and picture preparing applications. For instance, the DWT has the accompanying points of interest, such as good energy packing, perfect reconstruction with short bolster channels, no excess and low calculation complexity. However, it lacks shift invariance and suffers from poor directional selectivity for askew elements, because the wavelet filters are separable and real. In order to conquer these issues, complex wavelets have been proposed. Kingsbury's dual-tree complex wavelet transform (DT-CWT) [2] is an outstanding example.

2. EXISTING METHOD

In this section Discrete Cosine Transform and Discrete Wavelet Transform Techniques are elaborated.

2.1 Spatial Domain Technique

In this method Watermarking is done based on the basis of pixel location. It is very simple and easy method, it is very frail and poorly strong to common attacks on Watermarked image [5][6].

2.2 Transform Domain Technique:

In Transform Domain Technique, Transform is applied on covered image. Watermark is used to embed into middle band coefficients of the Transformed image and then apply inverse transform to get watermarked image. There are various transforms used like DCT, DFT, SVD, DWT, Gabor Transforms.[11]

2.3 Discrete Cosine Transform (DCT):

DCT is a technique is similar to the fourier transform. DCT split the image into many sub parts or many sub bands. It is commonly used in image compression. DCTs are important to numerous applications [5]. Figure 1 shows the lower level components is FL and higher level components are FH and middle level components are FM. This technique is easy to understand the concept of the all bands like low level, high level, and middle level bands. Using this bands we can embed the watermark image into the low level band. Low level band only containing the information more about the watermarking image and we can extract the image easily.
2.4 Discrete Wavelet Transform (DWT)

Discrete Wavelet Transform is an wavelet transform for which the wavelets are sampled. Compared to the other wavelets its having an advantage i.e temporal resolution it captures both frequency and position information i.e location. Use of this property the filter is used to divide the watermark image in four non-overlapping sub bands like LL, LH, HL, and HH. LL sub-band is called as low pass band and other three sub-bands are high pass band: HL is the horizontal sub-band, LH is vertical sub-band and HH called as the diagonal subband [10].

<table>
<thead>
<tr>
<th>Sub-band</th>
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<tbody>
<tr>
<td>LL Band</td>
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<tr>
<td>HL Band</td>
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<tr>
<td>L3H Band</td>
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<tr>
<td>HH Band</td>
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Fig.2. DWT Sub-bands in General Watermarking Method

3. PROPOSED SYSTEM

3.1 Embedding Method:

Step 1: Original image is should be the colour image.

Step 2: Colour image planes are separated into luminance and chrominance channels.

Step 3: Dual Tree Complex Wavelet Transform is applied on the Original image.

Step 4: After applying DT-CWT, Secret Image is embedded into the Original image.

Step 5: After embedding process watermarked image is obtained.

Step 6: Figure 3 shows that embedding method for the secret image.

3.2 Extraction Procedure:

Step 1: Select Watermarked image.

Step 2: Inverse Dual Tree Complex wavelet Transform is applied into the Watermarked image.

Step 3: After that planes are separated from the Watermarked Image.

Step 4: Original image and secret image is separated from the watermarked image.

Step 5: Figure 4 shows the extracted method for the secret image.
3.3 Color Space Conversion

The proposed method of color image watermarking technique covers three stages: Firstly, a RGB color image, which serves as a host is changed over to YCbCr shading space. This is done because the latter is more robust and has higher indistinctness than the previous. Also, YCbCr comprises of three components namely, luminance (Y), blue chrominance (Cb) and red chrominance (Cr) [8]. Since the watermark is added to the chrominance, the RGB color space of the image should be converted to YCbCr color space [4].

\[
Y = 0.299 * R + 0.587 * G + 0.114 * B \\
Cb = 0.596 * R - 0.275 * G - 0.321 * B \\
Cr = 0.212 * R - 0.529 * G - 0.311 * B \\
\]

To convert YCbCr to RGB

\[
R = Y + 0.956 * Cb + 0.629 * Cr \\
G = Y - 0.272 * Cb - 0.647 * Cr \\
B = Y - 1.108 * Cb + 1.705 * Cr \\
\]

4. COMPLEX WAVELET TRANSFORM

A complex wavelet transform (CWT) solves four problems (directionality, shifting, oscillation also, associating) that are available in discrete wavelet change using complex valued basis functions [9]. This change is inspired by the Fourier change premise capacities. CWT is spoken to in the form of complex values scaling functions and complex valued wavelet functions as follows [3]:

\[\psi_{a}(s) = \psi_{a}(s) + j \psi_{b}(s)\]

where \(\psi_{a}(s)\) are real and \(j \psi_{b}(s)\) are imaginary. \(\psi_{a}(s)\) and \(\psi_{b}(s)\) shape a Hilbert change pair and \(\psi_{0}(s)\) is the analytic signal. The complex scaling function is characterized in comparable ways. The CWT is acquired by anticipating the signal into complex basis functions as follows:

\[d_{x}(s, t) = d_{a}(s, t) + j d_{b}(s, t)\]

where \(s\) is the scaling factor and \(t\) is the time shift. CWT is shift invariant and does exclude associating. For immaculate remaking reason, dual tree complex wavelet transform has been used[3].

4.1 DT-CWT Decomposition:

Images are converted from low frequency into high frequency by using DT-CWT (Dual Tree - Complex Wavelet Transform). In low frequency image it consists of overall information about images. So, the tumor areas are not viewed exactly. Here high frequency is used for detecting the tumor areas. An input noisy image will be decomposed into components like textural and auxiliary points of interest utilizing double tree complex wavelet transform. It is the shift and rotation invariant transform which denotes the textures and edges in various directions[3]. Because of the property of the DTCWT is directionally selective in two and higher dimensions. The high-frequency sub bands in six different directions give to the sharpness of the image details.[2] The real and complex band coefficients are utilized and low frequencies are kept same. The dual-tree complex wavelet change utilizes two genuine DWTs. These two changes together give an overall transform. The first DWT transform is the actual part and the second change shows the imaginary part. The two real wavelets incorporated with each of the two real wavelet transforms are represented as \(\psi_{a}(s)\) and \(\psi_{b}(s)\) [2]. After the filters are generated, the complex wavelet is approximately expected as follows:

\[\psi_{a}(s) = \psi_{i}(s) + j \psi_{j}(s)\]

In the 2D dual-tree complex wavelet transform, 2D wavelet function \(\psi_{a,b}\) is included with the row column of the wavelet transform where \(\psi_{a}\) is a complex wavelet represented by [2] [3].

\[\psi_{a,b} = [\psi_{i}(a) + j \psi_{j}(a)] \psi_{i}(b) + j \psi_{j}(b)\]

The real part of the complex wavelet is chosen, and then the sums of two separable wavelets are obtained:

Real part [2]

\[\psi_{a,b} = \psi_{i}(a) \psi_{i}(b) - \psi_{j}(a) \psi_{j}(b)\]

A directional filter of DTCWT [2] is applied on the watermarked image for decomposition purposes. The resultant pictures are the yield of the one directional filter from the low pass and high pass filters.

5. DIGITAL WATERMARKING

The watermark embedding operation is actually the image content information change, there are addition and multiplication of two main kinds of commonly used modification rule: [12].

Additive criteria:

\[I_{w}(x,y) = I(x,y) + k*W(x,y)\]

Multiplication rule:

\[I_{w}(x,y) = I(x,y)*(1+k*W(x,y))\]

Among them, \(I(x, y)\) on behalf of the carrier image, \(I(x, y)\) in the interest of the watermarked picture, the \(w(x, y)\) speaks to the watermark embedding strength factor, said \(k\)(12). Extraction of advanced picture watermarking, likewise require first to the transporter image, then under the control of the secret key, the watermark extraction algorithm to extract the watermark information of advanced picture watermarking, likewise require first to the transporter is embedded procedure from extraction from the region.

6. RESULTS AND DISCUSSION

In this section we have selected the Original image of size 256x256 and watermark image (ultrasound image) of size 128x128. Figure 5 is chosen as the original image and Figure 6 is chosen as the secret image. Secret image is the ultrasound image that is embedded into the input image that is called as “Watermarked Image"[Figure 8]. This image PSNR is 46, MSE value is 1.3289, Correlation Coefficient and the structure similarity index is approximately 0.99. These values are increased when compared to existing method. Figure 10 and figure 11 are the recovered output image and ultrasound image.
7. CONCLUSION

In this work, we proposed a blind digital image watermarking algorithm based on the DT-CWT. Firstly, we embed the watermark i.e ultrasound image into the input image to avoid the copyright problem. Distortion is less in the chrominance compared to the luminance channel. This method is robust when compared to the existing method. It is also robust to the camcording process.

REFERENCES


