International Journal of Electronics Signals and Systems

Manuscript 1036

Digital Watermarking Technique used for Security of Digital Images during Broadcasting and Telecasting by Using DWT

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***Abstract*—Signals are any time varying quantity having lot of Information and have its own frequency. Signal can be classified into random signal, periodic signals, and non-periodic signals, discrete or digital signal. Signal may contain various data like audio, vedio, or in text format. Signal also has information like images. But question arises of security of signal. So; Signals can be making secure by using the different Security techniques such as encryption and decryption by using RSA algorithm, Stegnography, Digital watermarking techniques. In this paper we are going to discuss transmission of Signal and their modulation techniques and its security by using "Digital Watermarking Techniques" with help of "Discrete Wavelet Transform".**

***Keywords*-- Watermarking Techniques, Modulation Techniques, Transmission of Signals.**

I. INTRODUCTION

Signals are any time varying quantity having two parameter one is independent of other & having lot of information. There are different types of signals having various information like audio, video or in text format. Signal can be transmitted from source to its destination by using some medium i.e. called as "*Network*" .There are different types of networks such as Wired Network or Wireless Network. Again network can be categories on the basis of its different properties like bandwidth, such as LAN (Local Area Network), WAN (Wide Area Network), MAN (Metro Area Network), PAN (Personal Area Network),Backbone Network, ISDN(Integrated Switched Digital Network),BISDN(Broadband Integrated Switched Digital Network),etc.While transmitting any data we have to used analog data signal and convert it into digital data signal and at receiver side we have to convert digital data signal to into analog data signal. When any information carrying signal passing through channel or from any network, it may affect by interference of noise signal or intruders can attack to access the information [1, 2, 6, 8] .So we are utilizing two techniques to transmit the data over large Distance i.e. "*Modulation Techniques*" and second technique for security of digital information send by using different signals by using "*Digital Watermarking Technique*". In, this paper we are going to discuss transmission of signal and their "*Modulation Techniques*" and security of signal containing image by using "*Discrete Wavelet Transform Digital Watermarking*". Transmission of digital data by using electronic communication system is shown in figure [8].

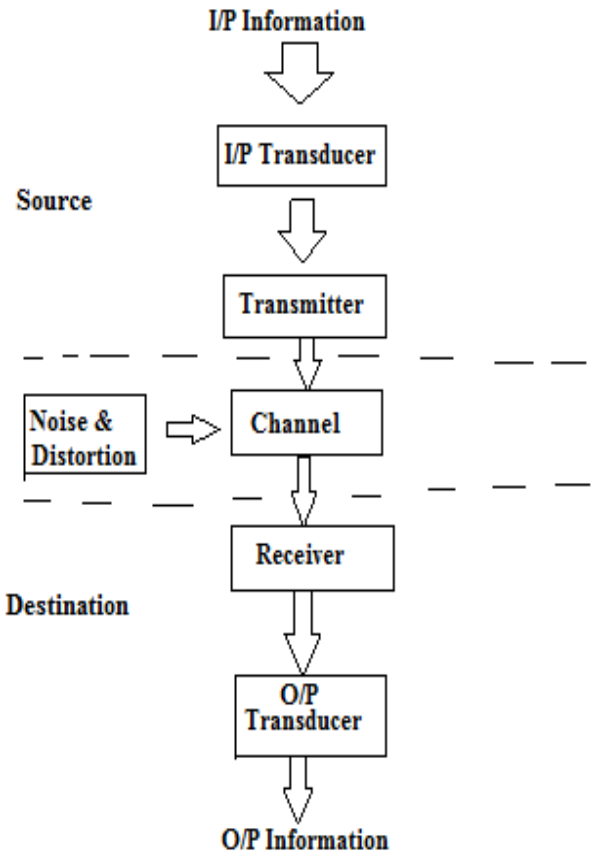

Fig 1: A Block Diagram Representation of Electronic Communication System.

II.TYPES OF SIGNALS

- Periodic Signal
- Non-Periodic Signal
- Random Signal
- Discrete Signal
- Digital Signal
- Noise Signal

Each signal has its own energy and power varying from minus infinity to plus infinity. So, we can say that each and every signal are energy signal and power signal.

III.TYPES OF SIGNAL MODULATION TECHNIQUES

A) Types of signal modulation techniques are as shown in figure are as follows[6]:-

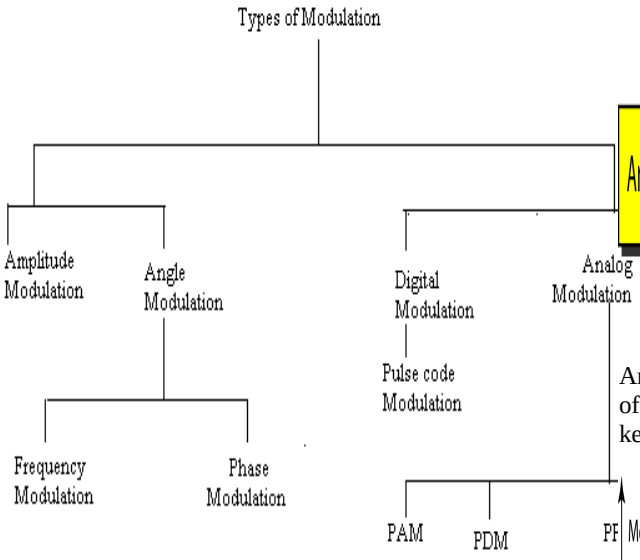

Fig 2: Types of modulation Techniques

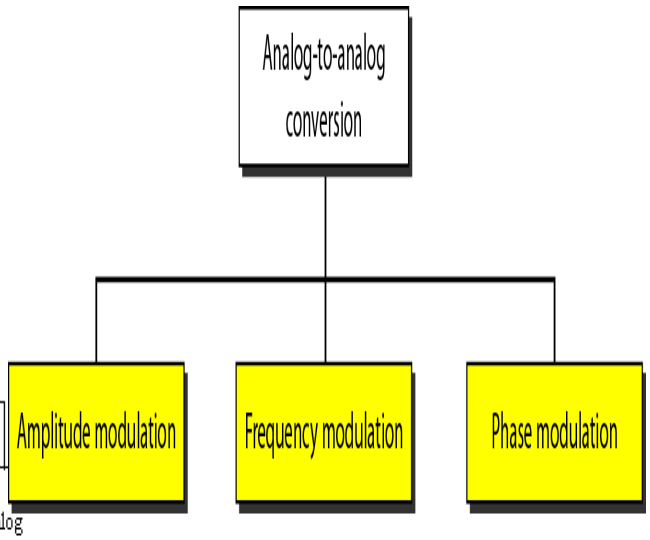

Fig: 3 Types of analog-to-analog modulation

- *A.M.(Amplitude Modulation)*

Amplitude Modulation is a technique in which amplitude of carrier is varied according to the base band signal keeping its frequency and phase constant [1].

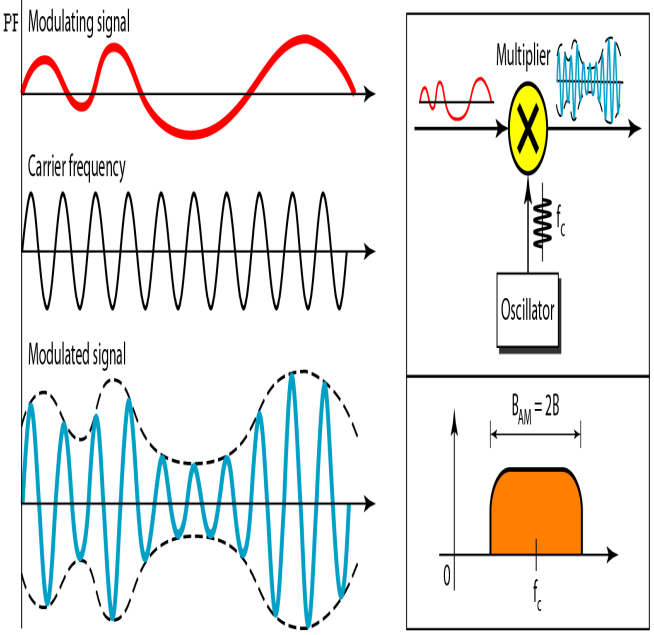

Fig: 4 Amplitude Modulation

- *F.M.(Frequency Modulation)*

Frequency Modulation in which the frequency of carrier is varied according to the base band signal [1].

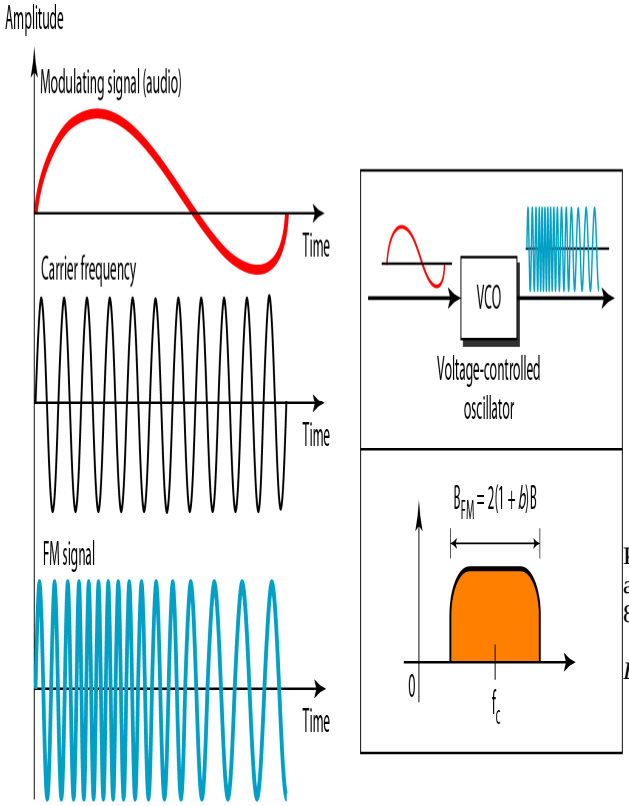

Fig: 5 Frequency Modulation

- *P.M.(Phase Modulation)*

Phase Modulation in which, the phase of the carrier is varied according to the baseband signal [1].

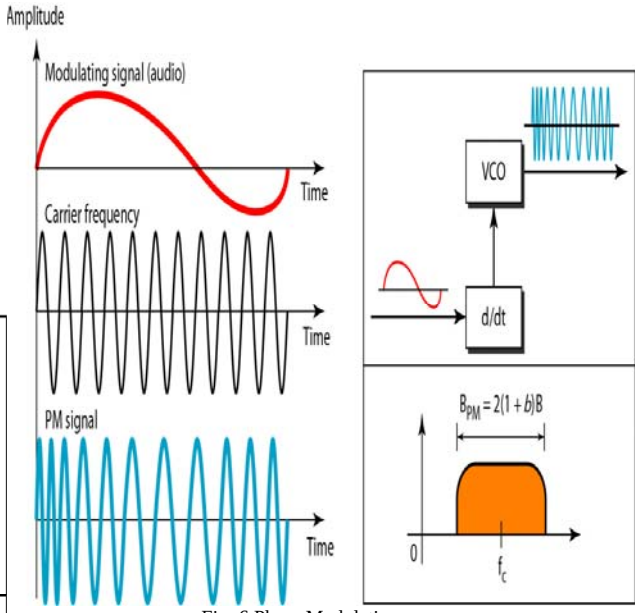

Fig: 6 Phase Modulation

- *P.A.M (Pulse Amplitude Modulation)*

Pulse amplitude modulation is technique in which amplitude of pulse is varied in accordance [1, 2, 5, 6, and 8].

B) Need for Modulation Technique

- To reduce the height of antenna.
- To allow Multiplexing of signals.
- To avoid mixing of signals.
- To increase the range of communication.
- To allow adjustments in bandwidth.
- To improve the quality of reception.

III.DIGTAL WATERMARKING TECHNIQUES FOR SECURITY OF SIGNAL CONTAINING IMAGE DATA BY USING DISCRETE WAVELET TRANSFORM.

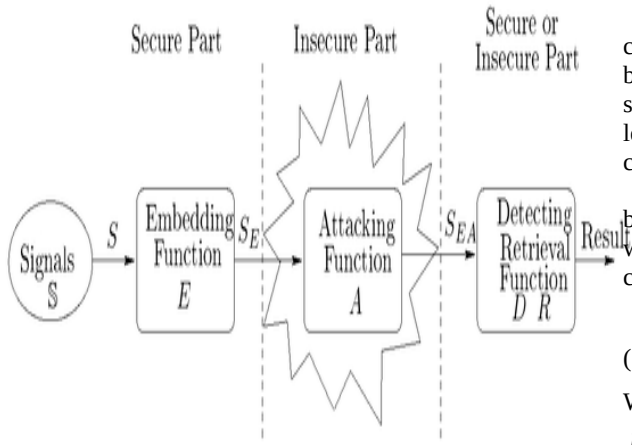

Fig: 7 Watermarking life-cycle phases

Above figure shows the simple working of digital watermarking life-cycle phase [18].

A) WHY DWT-BASED?

There are several reasons to adopt the DWT domain:

- The DWT domain is the kernel technique of JPEG-2000 [5, 7, 13, 16, and 17].
- The DWT is highly integral with JPEG-2000[5, 7, 13, 16, and 17].
- The goal to be robust against JPEG-2000 compression is achieved [5, 7, 13, 16, and 17].
- The DWT based approaches usually produce watermarked images with the best trade-off between transparency and robustness while the DFT and DCT domain approaches have blocking arti-facts [5, 7, 13, 16, and 17].

B) General overview of DWT method for watermarking:

First transform an image into a set of frequency domain coefficients and then modify the values of these transformed coefficients. The watermark is then embedded in the transformed coefficients of the image such that the watermark is less invisible and more robust to some image processing operations. Finally, the coefficients are inverse-transformed to form the watermarked image. The frequency sensitivity of the human visual system can be used to ensure that the watermark is invisible and more robust to any attacks [12, 13, 14, 15,].

C) DWT (Discrete Wavelet Transform) Digital Watermarking Algorithm:

A. Watermark Embedding Algorithm:

Step 1: First transform both host image and logo image from RGB to YCrCb color space.

Step 2: Decompose host image by L-levels and logo image by 1-level using wavelet transform.

Step 3: Find the weight factor *W* for each wavelet coefficient by considering the luminance, texture and sub band level and orientation. As the human eye is less sensitive to achromatic edges than to the chromatic edges, less weight age is given to texture activity in chromatic components.

Step 4: Weight factors of coefficients in each sub band are sorted out in descending order and threshold weight, which is used in finding significant coefficients, is calculated as given below:

$$T = S(p * G_S) \quad (1)$$

Where $S(\ )$ the sorted weight factors of the sub band are, p is percentage of wavelet coefficients in which watermark is embedded and G_S is the size of the sub band. The coefficients having weight factors more than threshold value T , are considered as significant coefficients and are used for watermarking.

Step 5: Watermark is added to significant coefficients as given in equation 2.

$$I'(i,j) = I(i,j) + \alpha\, W(i,j)\, X(m,n) \quad (2)$$

Where $I(i,j)$ and $I'(i,j)$ are original and watermarked wavelet coefficients, $W(i,j)$ is the weight factor, $X(m,n)$ is the watermark and α is a constant which gives the watermark strength. For embedding watermark in chromatic components, α is taken twice that used for luminance component.

Step 6: Watermark bits are repeatedly embedded so that watermark is embedded in all significant coefficients.

Step 7: Then after L-level inverse wavelet transform of each component is taken to get the watermarked image.

B. Watermark Extraction Algorithm

For watermark recovery from watermarked image, both original and watermark images are needed. Although assuming accessibility to original image may not be possible in some practical applications, we consider the applications where robustness is important and have access to the original image [12, 13, 14, 15].

Steps for watermark extraction are as given below:

Step 1: For extracting watermark from image in doubt, first both original and doubtful image are transformed into YCrCb color space and then are decomposed by L-levels using wavelets. Weight factors and significant coefficients are found by considering the original image.

Step 2: Each repetition of the watermark bit is extracted from watermark using

$$X^{r}(m,n) = \frac{I'(i,j) - I(i,j)}{W(i,j)} \quad (3)$$

Where $I(i,j)$ and $I'(i,j)$ are wavelet coefficients of origina1 and doubtful image, $W(i,j)$ is the weight factor of corresponding pixel and $X^{r}(m,n)$ is repetition of watermark bit.

Step 3: Corresponding extracted watermark bits are combined as given below

$$X'(m,n) = X'(m,n) + X^{r}(m,n)\left[\frac{W(i,j)*2^{l}}{\sqrt{D(i,j)}}\right]^{2} \quad (4)$$

Where l is the level of the sub band to which the wavelet coefficient belongs to and $D(i,j)$ is the distortion calculated in the neighboring $N_x \times N_y$ window as follows:-

$$D(i,j) = \frac{\sum_{x=i-\frac{N_x}{2}}^{i+\frac{N_x}{2}} \sum_{y=j-\frac{N_y}{2}}^{j+\frac{N_y}{2}} [I'(x,y) - I(x,y)]^2}{N_x \times N_y} \quad (5)$$

The factor 2^{l} is used to give equal weight age to extracted coefficients from all sub bands. This is required because $W(i,j)$ calculated for high frequency sub band coefficients is large and causes more weight age to extracted coefficients of these sub bands. The corresponding distortion weights are summed up as follows:

$$sum(m,n) = sum(m,n) + \left[\frac{W(i,j)*2^{l}}{\sqrt{D(i,j)}}\right]^{2} \quad (6)$$

Step 4: After extracting all watermark repetitions and combining using equation 4, they are normalized as given below:

$$X'(m,n) = \frac{X'(m,n)}{sum(m,n)} \quad (7)$$

Step 5: After extracting all components from doubtful image, each component is inverse wavelet transformed.

III. TRANSMITTING AND RECEIVING WATERMARK AUDIO AND VIDEO SIGNAL TECHNIQUE

a) A.M TRANSMITTER AND A.M. RECIEVER

A.M transmitter is used to transmit data in which contain different types of circuit such as Input transducer, transmitting circuit, R.F amplifier, modulator which is used to modulate signal such as shown below[1].

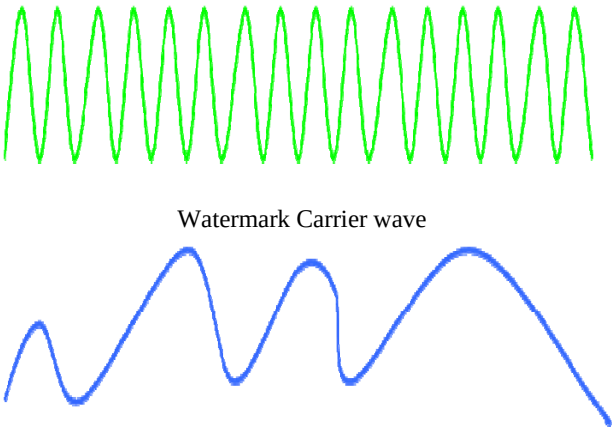

Fig: 8 Diagram Representation of A.M Wave.

A.M receiver is used to receive the modulated wave and demodulate the wave so that to get correct information. It contains circuit like mixer, demodulator, power amplifier etc.

b) F.M TRANSMITTER AND F.M. RECIEVER

F.M transmitter has circuit similar to A.M transmitter but it has voltage control oscillator (V.C.O) instead of multiplier.F.M receiver is used to receive the modulated frequency wave and that wave is demodulated by using circuit like demodulator ,mixer, limiter circuit, power amplifier,etc. The modulating technique of a signal is by using frequency modulation is shown in figure below [1].

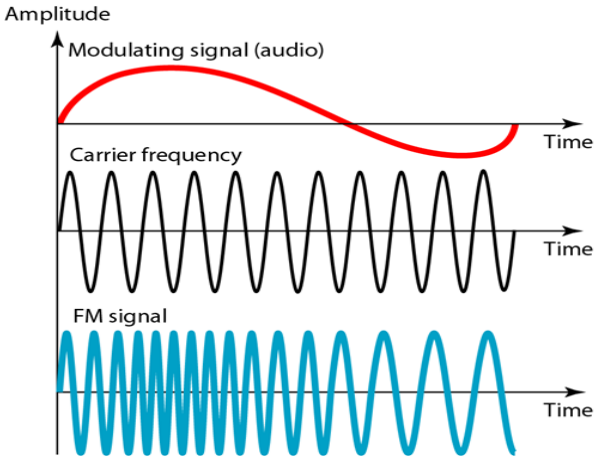

Fig 9: Diagram Representation of F.M Wave.

IV. TYPES OF ATTACK ON SIGNAL HAVING DIGITAL DATA

- Lossy Compression
- Geometric Distortions
- Common Signal Processing Operations

V. APPLICATION

Application of this technique is to transmit the digital data over large distance and security of data is done by discrete wavelet transform. Application like still digital color images which are being used by private company such as "TATA SKY" service provider, security of each and every channel logo such as "Star Plus", so that un-authorized user cannot able to see without authentication of service provider.

VI.CONCLUSION

In this paper, we discuss transmission of digital data that is still color images used for intectual property right information for the user and service provider of telecast and broadcast and its security by using discrete wavelet transform. Also discuss various methods of transmitting secure data that is still image logo of service provider by using various modulation techniques with the help of A.M and F.M transmitter.

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