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Blind Image Steganalysis using Feature Extraction Through the Combinational Transforms

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Abstract: The art of Steganalysis is to be discover the presence of hidden message through the cover media. The main issue in Blind image Steganalysis is the non-availability of knowledge about the Steganography technique applied to thestego image. In the SVD technique the detection of hidden message is very difficult. So, in order to detect the hidden Message data in digital images using combinational transforms like Discrete Cosine Transform(DCT) and Discrete Wavelet Transform(DWT) techniques is used.The procedure is applied for different images like stego image and clean image. After feature extraction, SVM is chosen for classification due to its efficiency and flexibility.

Keywords: Steganalysis, DCT, DWT, SVD, Stego Image, Clean Image.

I. INTRODUCTION

Steganography is an art of hiding some secret message in another message without letting anyone know about presence of secret message except the intended receiver. The message used to hide secret message is called host message or cover message. Once the contents of the host message or cover message are modified, the resultant message is known as stego message. In other words, stego message is combination of host message and secret message. Steganography is often mixed-up with cryptography. in early days 19th century steganography is one of the more popular technique, by the purpose of hiding information. Steganalysis may be classified into two types: Algorithm specific and blind schemes. In the algorithm specific, it is assumed that the stenographic method is known for attackers, while another one method the embedding method is considered to be unknown. It should be noted that in most of the cases designing a blind specific method is a problem of great interest. in generally the JPEG Steganalysis schemes are always encrypt the messages by manipulating the quantized DCT cofficients. As a results in DCT domain may be more sensitive to classify cover and stego images .In recently many Steganalysis methods in which the feaures are calculated in DCT domain.

II. OVERVIEW OF SVD TECHNIQUE

SVD technique is a matrix decomposition method. which is used in signal processing applications. It has been successfully utilized in the quality assessment approaches, multimedia de-noising, compression and Steganalysis. Using singular value decomposition, any given (m,n) matrix A can be broken into three matrices; W, U and V; where U and V are orthogonal matrices and W is a diagonal one. The column of U and V are left and right singular vectors and the elements of diagonal matrices (W) are called singular values of the input matrix.

$$\mathbf{A} = \mathbf{U}\,\mathbf{W}\,\mathbf{V}^{T}$$

In MATLAB
[U W V]=svd(A)
Where
U is m×n and orthonormal
W is n×n and diagonal
V is n×n and orthonormal

In this singular value decomposition method detecting the secret message or image is very difficult task.so that we are detecting message is very easy through combinational transforms like Discrete Wavelet transform and Discrete Cosine transforms.

III. PROPOSED SYSTEM

In this proposed algorithm combination of Discrete Wavelet Transform and Discrete Cosine transform are used to detect the hidden image. in previously used the SVD technique only three features are applied to detect the hidden image is very difficult task. But our proposed method used in more number of features and finally get the hidden image is very simple task. There are two types of images are used in this work, clean images and stego images. Stego image made by embedding the image to another image

A. Discrete Cosine Transform

Discrete Cosine Transform is closely related to DFT. It is transforms a time domain signal into its frequency components. The DCT however only uses the real parts of the DFT coefficients. In terms of property, the DCT has a strong energy compaction property and most of the signal information tends to be concentrated in a few low-frequency components of the DCT. The JPEG compression technique utilizes this property to separate and remove insignificant high frequency components in images.

B. Algorithm for DCT

1. An input image is divided into 8*8 non- overlapping blocks.
2. Applied DCT for each block.
3. Featuers are calculated based on DCT blocks.
   - Histogram of Global AC coefficients.
   - Histograms of AC coefficients in specific locations.
   - Histogram of AC coefficients with specific values.

The proposed method JPEG image size with M*N. let dct(i,j) denotes DCT coefficient at location(i,j).here dct(1,1) is called DC coefficient, it cantains a significant fraction of an image energy. so we are concentrate on the remaining 63 AC coefficients in the DCT block. As show in fig 1(a),1(b).

Histogram of Global AC coefficients: Suppose the JPEG image is represented with a DCT block matrix $dct_{r,c}(i,j)$ where (r,c) denotes the index of the DCT block.

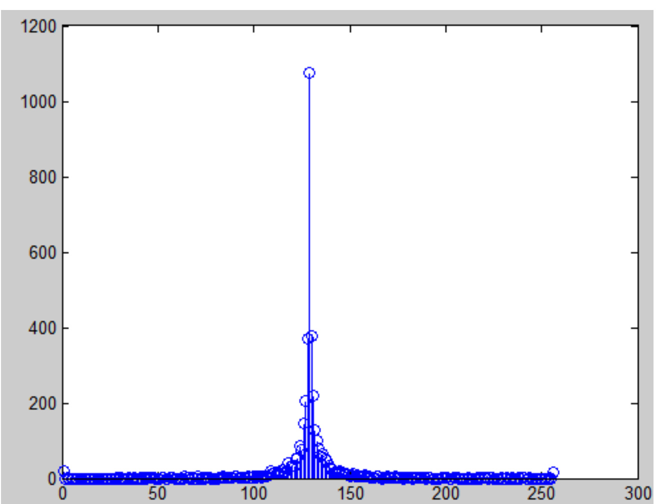
$$H_1(d)=\sum_{r=1}^{M/8}\sum_{c=1}^{N/8}\left(\sum_{i=1}^{8}\sum_{j=1}^{8}Q(d,dctr,c(i,j))\right)$$

where

$$\text{Q is defined as } Q(x,y)=\begin{cases}1, & \text{if } x==y\\ 0, & \text{elsewise}\end{cases}$$

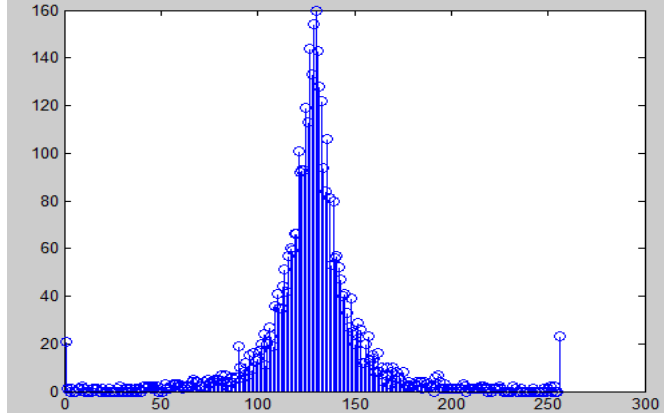
dct(i,j) denotes DCT coefficient at location (i,j) d€ [L,R], L=min(dct(i,j)), R=max(dct(i,j)),(i,j)≠(1,1)

Histograms of AC coefficients in specific locations: In this steganography schemes may preserve the global histogram. So we are add the individual histograms for low frequency Ac coefficients. As shown in fig 2(a),2(b).



Intensity level

Fig 1(a). Clear image.



Intensity level

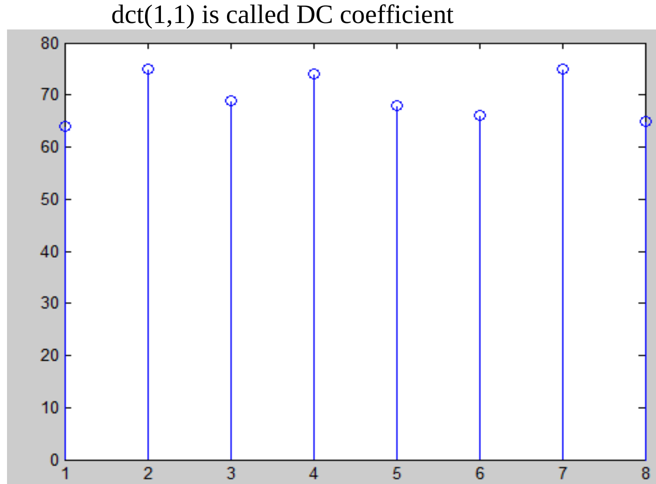
Fig1(b). Stego image.

$$H_2(d)=\sum_{r=1}^{M/8}\sum_{c=1}^{N/8}Q(d,dct(i,j))$$

Where ij € [12 13 21 22 23 31 32 33]

dct(i,j) denotes DCT coefficient at location (i,j)

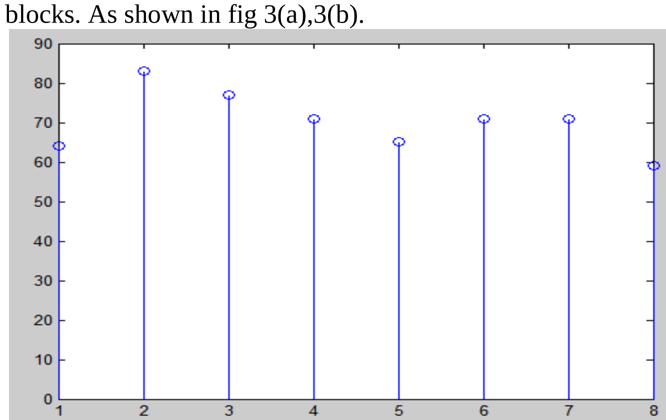
dct(1,1) is called DC coefficient



Intensity levels

Fig2(a). Clear image.

Histogram of AC coefficients with specific values: A fixed coefficient value d, calculate the distribution of all AC coefficients in the 63 locations separately all DCT blocks. As shown in fig 3(a),3(b).



Intensity levels

Fig2(b). Stego image.

$$H_3(d)= \sum_{r=1}^{M/8} \sum_{c=1}^{N/8} Q(d, dct(i, j))$$

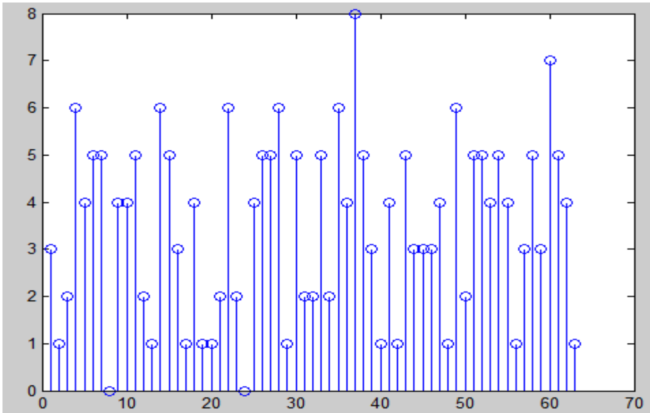


Fig 3(a). Clear image.

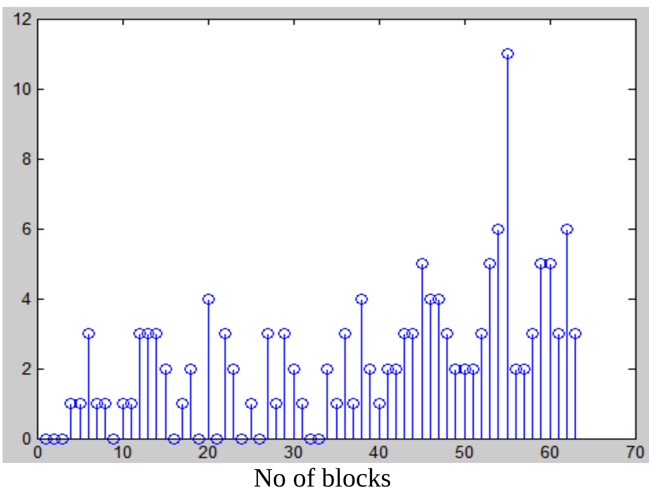


Fig3(b). Stego image.

After getting the DCT Domain statistics, histogram characteristic function(HCF) and center of mass(COM) are used to estimate the embedding changes in the frequency domain of statistical models.HCF is a representation of a histogram in frequency domain and COM can be introduced as a measure of energy distribution in the HCF.

$$COM(HCF[k])= \sum_{k=1}^{N/2} k.|HCF[k]|/\sum_{k=1}^{N/2} |HCF[k]|$$

Where N is length of DFT sequence.

For each histogram take its1-D DFT as its HCF. then COM can be calculated. After feature extraction, SVM is chosen for classification due to its efficiency and flexibility.

B. Discrete Wavelet Transform

Wavelet Transform is a modern technique frequently used in digital image processing, compression, watermarking etc. The transforms are based on small waves, called wavelet, of varying frequency and limited duration. A wavelet series is a representation of a square-integrable function by a certain ortho-normal series generated by a wavelet. Furthermore, the properties of wavelet could decompose original signal into wavelet transform coefficients which contains the position information. The original signal can be completely reconstructed by performing Inverse Wavelet Transformation on these coefficients. Watermarking in the wavelet transform domain is generally a problem of embedding watermark in the sub bands of the cover image.

Algorithm for DWT:

An input image is divided into 8*8 non- overlapping blocks.

1. Applied DWT for each block.
2. Featuers are calculated based on DWT blocks.
   - finding DWT on level1 variance
   - Finding DWT on level2 variance

In DWT technique the message should be stored in the wavelet coefficients of an image.

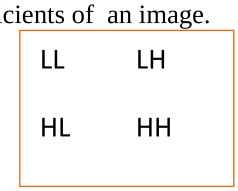


Fig4. First Level DWT

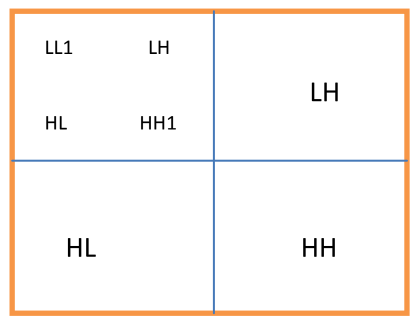


Fig5. Second level DWT.

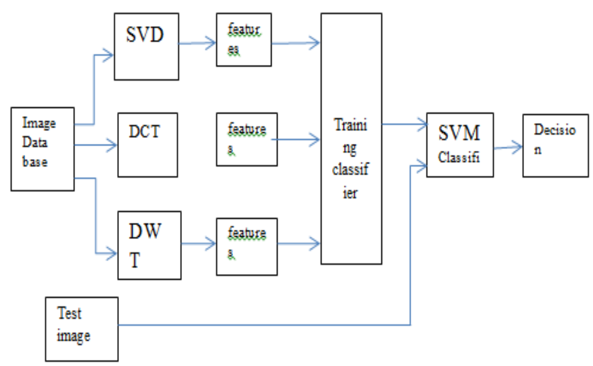


Fig 6. Proposed block diagram.

The SVD technique used in spatial domain but in our proposed method frequency domain features are included for the classification. Both the spatial and frequency domain are combined and trained through the SVM classifier and finally decision of detected image issaid to be either original or stego image.

IV.EXPERIMENTAL RESULTS

In order to evaluate the proposed scheme, the extracted feature vector should be tested by a variety of steganographic algorithms. For frequency domain, the experiments are conducted using Uncompressed Color Image Database (UCID).which contains uncompressed natural images. These images are grouped together with some selected images. All the selected clean images are embedded with relative payloads of 0.17, 0.09 and 0.04 bpp (bit per pixel). for each payload in each approaches clean and stego images are produced.

Table1. Detection percentage comparison

Methods	Bits per pixels		
	0.17	**0.9**	**0.4**
SVD	0.7	0.6	0.6
DCT	0.8	0.71	0.7
Proposed	0.9	0.8	0.7

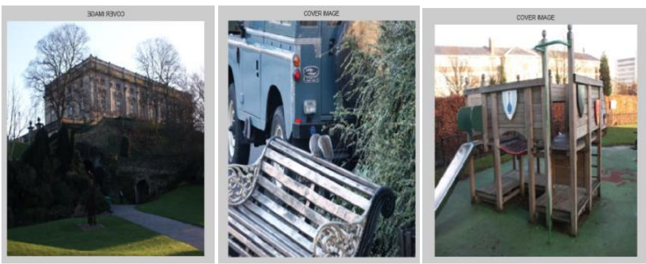


Fig 7. Different cover images.

Fig 8. Different host images.

V. CONCLUSOIN

In this project, an universal steganalysis method is proposed. The proposed work finds detect the presence of hidden message. All the selected clean images are embedded with relative payloads of 0.17, 0.09 and 0.04 bpp (bit per pixel). Then classifier detection of hidden image .if payloads are increasing detection percentage automatically increasing respectively. Comparing spatial domain like, SVD with combination of frequency and spatial domain the detection percentage increases by considering suitable image database.

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