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Multiple Data Abstraction in a Single Plane Using Different Transformation Techniques

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*Abstract— **In this paper we suggest embedding and extraction algorithms through which we can abstract multiple data in a single color plane by using different transformation techniques such as wavelet transformation, cosine transformation and single value decomposition.***

*keywords— **Wavelet Transformation, Cosine Transformation, Singular Value Decomposition.***

I. INTRODUCTION

Due to digitization of information in today's era it is difficult to project data from different illegal attacks (e.g. Cropping attack).Now-a-days information can easily be transmitted, copied and shared. To defend the windshield of multimedia message, data hiding has been introduced to disguise data into multimedia information. The objective of data hiding is to produce the digital information which is perceptually invisible, robust, recoverable and reversible. The basis of data hiding is to enclose important information in digital data and hide it in multimedia format in such a way that it can't be extracted from the content. In this paper we recommend a method to hide multiple data in one plane using different transformation techniques. We combine two types of transformations: wavelet transformation and cosine transformation following with singular value decomposition (SVD).When these transformation techniques are combined they give good robustness[1].

II. WAVELET TRANSFORMATION

Wavelet transformation is a multi-resolution process in which image is expanded on the basis of wavelet function. In this transformation technique an input image is decomposed into low frequency, middle frequency and high frequency bands and the image is produced in a new time and frequency scale. It does not change the information content of the signal. DWT allows multiple stage transformation. During its first stage an image is divided into four sub-bands these are LL1 (approximation coefficient), HL1 (horizontal details), LH1 (vertical details) and HH1 (diagonal details). Among four of them HH1 and LH1 represent the finest scale wavelet coefficient, where LL1 stands for the coarse level coefficients.[2]

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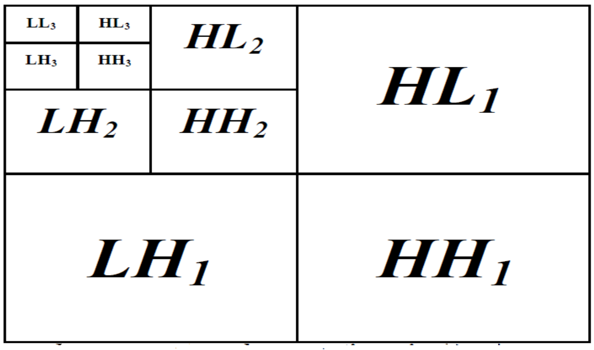

Fig.1. Three phase decomposition using DWT [3]

The simple possible wavelet is the Haar wavelet[4] but it is not continuous and therefore not differentiable. Thus it is useful in study of signals in sudden transmission.

III. COSINE TRANSFORMATION

Signals or images transform from time to frequency domain using DCT. It involves decorrelation of data. Further transform coefficient can be encoded separately. It is a linear transformation technique and can also be used in MPEG and JPEG image compression format.[5]
The general equation of DCT[2]:

$$C(u,v) = \alpha(u)(v)\sum_{x=0}^{N-1}\sum_{x=0}^{N-1} f(x,y) \cos[2x+1]u\pi/2N) * \cos[2y+1]u\pi/2N]$$

$$F(x,y)=\sum_{u=0}^{N-1}\sum_{v=0}^{N-1} \alpha(u)\,\alpha(v)\, c(u,v)\cos[2x+1)u\pi/2N]*\cos[2y+1]v\pi/2N]$$

IV. SINGULAR VALUE DECOMPOSITION

SVD [6,7] is related to theory of diagonalizing a symmetric matrix. If A is matrix of size p*q, there are orthogonal matrixes U and V and a diagonal matrix ($\sum$). Such that A=U$\sum$V. Here, size of U is p*p, V is q*q so that $\sum$ is rectangular with same size as A. The diagonal entries of $\sum$ i.e. $\sum_{ii}$ is expressed as σ_i positive values of σ_i are called singular value of A. Also, column of U and V are left and right singular vectors respectively of A. SVD can pack large amount of data into few information. Multiple data can be hidden in one plane using SVD.

V. PROPOSED ALGORITHM

Properties of DWT, DCT and SVD techniques are combined and an algorithm is introduced.

A. Data Abstraction Embedding Process

Digital data abstraction embedding process include following steps:

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Step 1: Input the Original image be G of size p*q and data masking W of size r*s.
Step 2: Decompose G into three color planes (R , G and B) .
Step 3: Obtain G’ by applying K- scale DWT on any one plane of G where K is no. of scale.
Step 4: Apply DCT to HH sub- band of that plane and get coefficient matrix A.
Step 5: Perform SVD to matrix A , $A= U\sum V$ and obtain U , $\sum$ and V.
Step 6: Apply DCT to HH sub- band of W and get coefficient matrix B.
Step 7: Apply SVD to matrix B , $B= U_w\sum_w V_w^T$ and obtain $U_{w,}$ $\sum_w, V_w$.
Step 8: Obtain $\sum_2$, such that $\sum_2= \sum+\alpha*\sum_1$.
Step 9: Now, $A’=U\sum_2 V^T$.
Step 10: Obtain HH’ by applying inverse discrete cosine transformation (IDCT) on A’.
Step 11: Apply IDWT (inverse discrete wavelet transformation) to LL, HL, LH and HH’ and get GW (data masking).

B. Data Abstraction Retrieval Process

This process consists of following steps:
Step 1: Input screened data GW and decompose into three color plane (R, G and B).
Step 2: Apply DWT on one plane of GW where LL, LH, HL, HH’ sub-bands are obtained.
Step 3: Perform DCT on HH’ and obtain matrix C.
Step 4: Perform SVD to C, $C=U_{GW}\sum_{GW}V_{GW}^T$ and get the value of U_{GW}, $\sum_{GW}$, $V_{GW.}$
Step 5: Find $\sum_r$ as $\sum_r = (\sum-\sum_{GW})/\alpha$
Step 6: Find W_r as $W_r = U_w\sum_r V_w^T$.
Step 7: Perform IDCT on W_r and get W.
Step 8: Perform IDWT to LL, LH, HL and W to get extracted screened data EW.

VI. RESULT AND DISCUSSION

We test the algorithm on MATLAB R2008a.1.jpg is taken as cover image. Here we hide three data forms as graphs, logo and personal memo. Size of data is equal to that of cover image. To abstract text we first convert it into binary form. 0 and 1 can be arranged accordingly for each letter. Here we Abstract Personal detail of student. Each data is hidden in G plane of cover image.

Fig.2. Cover Image

Fig.3. Cover image in G plane

Fig.4. Image with enclosed data

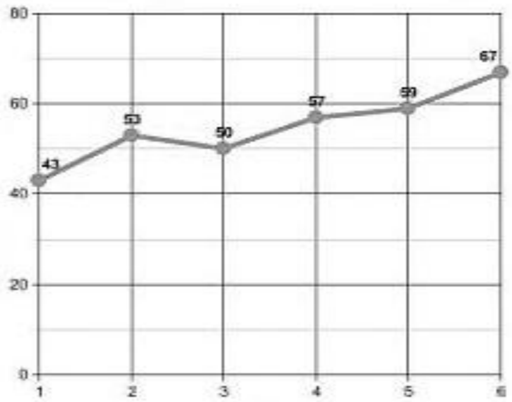

Fig.5. Data recovered 1

Fig.6. Recovered data 2

Fig.7. Data recovered 3

A. *Correlation*

To find the similarity between original image and image embedded with data we calculate correlation coefficient [8].Correlation coefficient is calculated by equation:

$$\rho = cor[X,Y] = cov[X,Y] / \sqrt{var[X]\ var[Y]}$$

Where, cov[X,Y] calculates the covariance between X and Y. Here we used three data to be enclosed in image hence Coefficient of correlation calculated for each are as follows:

Data	Correlation
Graph	0.9925
Logo	0.9963
Personal Details	0.9431

Table 1. Correlation table

VII. CONCLUSION

In this paper we have done multiple data abstraction in one plane by using wavelet and cosine transformation. We also used single value decomposition technique. We implement these transformations within two types of algorithm i.e. data embedding process and retrieving process .This transformation techniques gives very less value of coefficient of correlation which conclude that original image is quite similar to image enclosed with data.

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