ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 3, Special Issue 1, March 2016

COVERT COMMUNICATION OF SECRET IMAGES USING COLOR TRANSFORMATIONS AND 2D DWT

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ABSTRACT: **A covert communication technique that hides the secret image into a target image is proposed, the mosaic image is obtained by splitting the secret images and target images into tiles and the color characteristics are transformed to those of the target tile images and then fitted into appropriate blocks. A scheme of handling the overflows/underflows is also proposed. The information is embedded into the created mosaic image by lossless modified LSB substitution using a key, without the key the secret image cannot be recovered. Experimental results shows the feasibility of the proposed method. A system that uses DWT is also proposed.**

1. INTRODUCTION

1.1 METHODS OF IMAGE TRANSMISSION

Recently in many applications such as confidential document storage, transmitting legal documents, military and medical images, etc., communication of images needs to be secure. There are two common methods of image transmission. They are image encryption and data hiding.

In image encryption if the secret image is encrypted it becomes a meaningless and noisy so it is difficult to retrieve the original image. Also it cannot provide additional information before decryption. An alternative method to image encryption is the data hiding where the secret information is placed in the cover image and nobody can realize the existence of secret information. Existing data hiding methods are LSB substitution, histogram shifting, difference expansion, prediction-error expansion, recursive histogram modification, and discrete cosine/wavelet transformations. The main issue of data hiding is the difficulty to embed large information into a single image.

1.2 MOSAIC IMAGE

Mosaic image is a type of artwork created by composing small pieces of materials, such as stone, glass, tile, etc. Today mosaic images are used in many applications. Creation of *mosaic images* by computer is a new research direction in recent years.. A survey of the mosaic images can be found in Battiato*et al.* [1] where the four types of mosaic images were discussed, which includes crystallization mosaic, ancient mosaic, photo-mosaic, and puzzle image mosaic.

1.3 OBJECTIVE

In this paper, a new technique of communicating a secret image is proposed, which transforms a secret image into a meaningful mosaic image of the same size and that also looks like a preselected target image. Only if the secret key is right the secret image can be recovered .The proposed method is inspired by Lai and Tsai [4].The objective is to increase the similarities between the target image and the mosaic image and also between the recovered secret image and the original secret image.

2. EXISTING SYSTEM

2.1 INTRODUCTION

The image that is about to be transmitted is called as the secret image and the image upon which the secret image has to be placed is the target image (cover image). According to the size of the secret image, the target image is chosen from the database, this forms the disadvantage of this system as it requires a large database to store the target image. Moreover the data embedding capacity of the system is also less.

2.2 DIS-ADVANTAGES OF EXISTING SYSTEM

- Requirement of large target image database.
- User is unable to select his/her own arbitrary target image.
- Cannot embed large amount of information into the mosaic image.

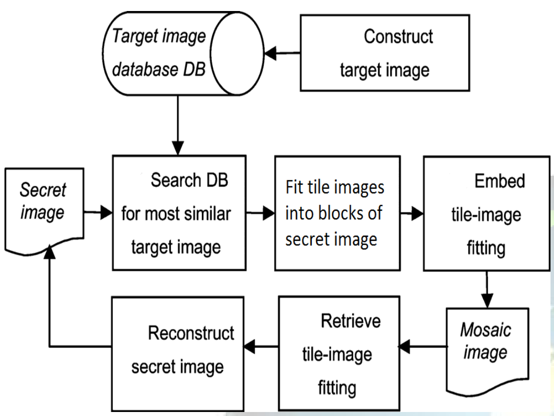

Fig 2.1 Block diagram of the existing system

3. PROPOSED SYSTEM: COLOR TRANSFORMATIONS

3.1 INTRODUCTION

The two phases of the proposed system is shown in the block diagram

1) Mosaic image creation

2) Secret image recovery

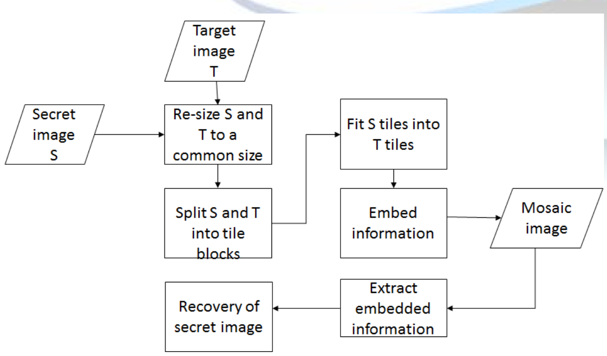

Fig 4.1 Block diagram of the proposed system using color transformations

The first phase includes four stages

1) Re-sizing the secret and the target images to a common size (256X256, 512X512)

2) Split the target and secret images into respective tiles of size (32X32, 16X16, 8X8) respectively.

3) Calculating the means and the standard deviation of the secret and the target tile images

4) Fitting the tile images of the secret image into the tile images of target blocks.

5) Embedding relevant information into the created mosaic image using LSB substitution.

The second phase includes recovery of the secret image from the mosaic image. The phase includes two stages:

1) Extracting the embedded information from the mosaic image, and

2) Recovery of the secret image using the extracted information.

3.2 MOSAIC IMAGE CREATION

3.2.1 COLOR TRANSFORMATIONS BETWEEN BLOCKS

In the first phase of the proposed method, the secret and the target images are resized to a common size (512X512, 256X256). Then the target and the secret images are divided into the tile images of various sizes such as 32X32, 16X16, 8X8 respectively. Then the means and standard deviations are calculated. The means and standard deviations will be different for both secret and target tile images.

Let the target image T and secret image B be described as two pixel sets $\{p_{1,}p_2 \dots p_n\}$ and $\{p'_1,p'_2,\dots p'_n\}$ respectively. Let the color of each pi be denoted by (r_i,g_i,b_i) and that of each $p'_i$by (r'_i,g'_i,b'_i). First we calculate the means and standard deviations of T and B, respectively, in each of R, G, and B color channels by the following formulas:

$$\mu_c = \frac{1}{n}\sum_{i=1}^{n} c_i \; \mu'_c = \frac{1}{n}\sum_{i=1}^{n} c'_i \qquad (1)$$

$$\sigma_c = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(c_i-\mu_c)^2}\; \sigma'_c = \sqrt{\sum_{i=0}^{n}(c'_i-\mu'_c)^2} \qquad (2)$$

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in which c_i and $c_i^{'}$ denotes the C-channel values of pixels p_i and $p_i^{'}$ respectively, with $c = r, g$, or b and C=R, G, or B. Next, we compute new color values (r_i, g_i, b_i) for each p_i in T by

$$c_i^{''} = \left(\frac{1}{q_c}\right)(c_i - \mu_c) + \mu_c^{'} \tag{3}$$

in which $q_c = \sigma_c^{'}/\sigma_c$ is the standard deviation quotient and $c = r, g$, or b. It can be confirmed easily that the new color mean and variance of the resulting tile image $T^{'}$ are equal to those of B, respectively. To calculate the original color values (r_i, g_i, b_i) of pi from the new ones $(r_i^{'}, g_i^{'}, b_i^{'})$, we use a formula which is the inverse of (3):

$$c_i = \left(\frac{1}{q_c}\right)(c_i^{''} - \mu_c^{'}) + \mu_c \tag{4}$$

We have to embed information into the mosaic image for use in the later stage of recovery of the original secret image. It is impractical to embed real numbers so we limit the numbers of bits used to represent relevant parameter values in (3) and (4). That is, each mean is rounded off to the closest value in the range of 0 to 255, and each q_c is changed to be the closest value in the range of 0.1-12.8. We do not allow q_c to be 0 (4) for the reason that $1/q_c$ in (4) is not defined when q_c=0.

3.2.2 CHOOSING SUITABLE TARGET BLOCKS

In order to transform the color characteristics of target tile image to that of the secret tile image, how to choose the appropriate tile target block for the secret tile block is an issue. We use standard deviation in order to select the most similar target tile for the secret tile image. To overcome this we sort all the tile images of the secret image to a sequence, S_{tile} and all the target blocks to form another, S_{target}, according to the average values of the standard deviations of the three color channels. Then, we fit the first in S_{tile} into the first in S_{target}, fit the second in *Stile* into the second in S_{target}, and so on.

3.2.3 HANDLING OVERFLOWS/UNDERFLOWS NN COLOR TRANSFORMATION

To deal with the problem of overflows and underflows, we convert the pixels to be non-overflow and non-underflow ones. It is assumed that when the pixel value goes above 255 then it will be normalized to 255 and if the pixel value goes below 0 then for such pixels it will be assumed as 0.We see to that the pixels value lies in the range of 0-255.

However, from (3), the ranges of possible residual values are unknown, and this causes a problem of deciding how many bits are to be used to record a residual. To solve this problem, we record the residual values in the untransformed color space. That is, by using the following two formulas, we compute first the smallest possible color value c_s (with $c = r, g$, or b) in T that becomes larger than 255, as well as the largest possible value c_L in T that becomes smaller than 0, respectively, after the color transformation process has been conducted:

$$c_s = \left\lceil \left(\frac{1}{q_c}\right)(255 - \mu_c^{'}) + \mu_c \right\rceil$$

$$c_L = \left\lfloor \left(\frac{1}{q_c}\right)(0 - \mu_c^{'}) + \mu_c \right\rfloor \tag{5}$$

Next, for an untransformed value *ci* which yields an overflow and underflow after the color transformation, we compute its residual as |*ci* - *cS*|and|*cL*- *ci*| respectively. Then, the likely values of the residuals of *ci* will all lie in the range of 0 - 255 as can be verified. As a result, we can simply record each of them with 8 bits.

3.2.4 EMBEDDING INFORMATION FOR RECOVERY OF SECRET IMAGE

In order to extract the secret image from the mosaic image, we have to embed relevant recovery information into the mosaic image. So we proposed by Chassery [2] and apply it to the LSB of the pixels in the so formed mosaic image for embedding data.

The method yields high data embedding capacities and also has the lowest complexity . Moreover, we have to embed as well some related information about the mosaic image generation process into the mosaic image for use in the secret image recovery process.

The bit stream will be embedded into the mosaic image.If the secret image is recovered then there will be surely some loss of data when compared to the original secret image, or in specific, in the color transformation process using (3), where each pixel's color value *ci* is multiplied by the standard deviation quotient *qc*, and the resulting real value *Ci*is truncated to be an integer in the range of 0-255. However, because each truncated part is smaller than the value of 1, the recovered value of *ci* using (4) is still precise enough to yield a color nearly identical to its original one. As far as the simulation results show that each

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
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recovered secret image has a very small RMSE value w.r.t the original secret image.

3.3 ALGORITHMS OF THE PROPOSED METHOD

The detailed algorithms for the creation of the mosaic image and the recovery of the secret image are discussed further.

3.3.1 ALGORITHM 1: MOSAIC IMAGE CREATION

INPUT: a secret image *S*, a target image *T*, and a secret key *K*

OUTPUT: a mosaic image *F*.

STAGE 1.FITTING THE TILE IMAGES INTO THE TARGET BLOCKS.

STEP 1. Resize the secret and target images to a common size divide the secret image S into n tile images $\{S_1, S_2, \ldots, S_n\}$ as well as the target image T into n target blocks $\{T_1, T_2, \ldots, T_n\}$ with each S_i or T_i being of size N_T .

STEP 2.The means and the standard deviations of each tile image Si and each target block Tj for the three color channels are computed according to (1) and (2); and compute accordingly the average standard deviations for S_i and T_j , respectively, for i = 1 through n and j = 1 through n.

STEP 3.According to the computed average standard deviation values of the blocks sort the tile images in the set Stile = $\{S_1, S_2, \ldots, S_n\}$ and the target blocks in the set $S_{target} = \{T_1, T_2, \ldots, T_n\}$; map in order the blocks in the sorted Stile to those in the sorted S_{target}in a one-to-one manner; and reorder the mappings according to the indices of the tile images, resulting in a mapping sequence L of the form:

$S_1 \rightarrow T_{j1}$, $S2 \rightarrow T_{j2}. . .S_n \rightarrow T_{jn}$.

STEP 4. Create a mosaic image F by fitting the tile images into the corresponding target blocks according to L.

STAGE 2 COLOR CONVERSIONS BETWEEN TILE IMAGES AND THE TARGET BLOCKS

STEP 5. For each mapping $S_i \rightarrow T_{ji}$ in sequence *L*, represent the means $\mu_c$andμ_c' of*Ti*and *Bji*, respectively, by eight bits; and represent the standard deviation quotient *qc*appearing in (3) by seven bits, where *c* = *r*, *g*, or *b*.

STEP 6. For each pixel *pi* in each tile image *Ti* of mosaic image *F* with color value *ci*\where *c* = *r*, *g*, or *b*, transform *ci* into a new value $c_i'$by (3); if $c_i'$is not smaller than 255 or if it is not larger than 0, then change $c_i'$to be 255 or 0, respectively

STAGE 3.EMBEDDING THE SECRET IMAGE RECOVERY INFORMATION.

STEP 7. The size of the key is generally limited to 8 bits. The size of the data to be embedded should be seen that it should not exceed the size of the image.

STEP 8. The encryption is done by using the LSB substitution where the key is inserted into the least significant bits of the so formed mosaic image

3.3.2 ALGORITHM 2: SECRET IMAGE RECOVERY

INPUT: a mosaic image *F* with *n* tile images $\{T_1, T_2. . .T_n\}$ and the secret key *A*.

OUTPUT: the secret image *S*.

STAGE 1: EXTRACTING THE SECRET IMAGE RECOVERY INFORMATION

STEP 1.The key for extraction of the secret image will be prompted. If the key is right then the secret image would be recovered. For a wrong key a random noise image would be generated and the process would terminate at this stage

STAGE 2: RECOVERY OF THE SECRET IMAGE.

STEP 3 Secret image is recovered by subtracting the target image from the mosaic image.

3.3.3 SIMILARITY MEASURE

The similarity is measured between (i) the mosaic image w.r.t target image and (ii) the recovered secret image to that of the original secret image. The simulation result shows the feasibility of the proposed method.

4. SIMULATION RESULTS OF THE PROPOSED SYSTEM USING COLOR TRANSFORMATIONS

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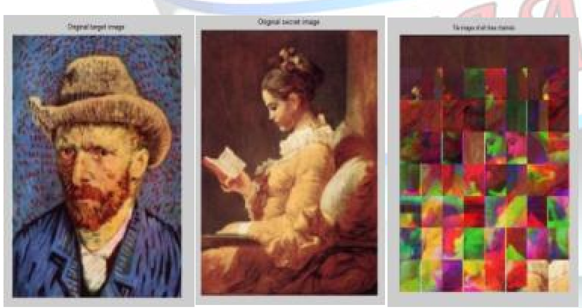
The secret image [151x198] Fig.5.1 (a) and target image [148x197] Fig.5.2 (b) is loaded and re-sized to a common size [256x256]. The secret and target images are divided into fragments so called the tile images of varying tile sizes. The Fig 5.1 (e) (f) has a tile size of about 32x32. The means and standard deviations for all the channels namely red, green, blue are calculated using the formulas as described earlier. The tiles are sorted according to the standard deviations and the mosaic images Fig. 5.1 (g), (h), (i) of red, green and blue channels are obtained. Then tiles of the target and the secret image are fitted according to the S_{tile}andS_{target} .Thus the mosaic image is formed. Then the secret information is embedded into the mosaic image using a lossless modified LSB substitution such that the information in the mosaic image is not affecting the appearance is shown Fig.5.1 (k). Then the secret image is recovered from the message encrypted mosaic image using the correct key as shown in Fig. 5.2 (a). The secret image will not be recovered if the key is wrong Fig 5.2 (b)

The plots Fig 5.3 (a) RMSE values of created mosaic images with respect to target images is shown.(b) RMSE values of the recovered secret image to that of the original secret images are shown.

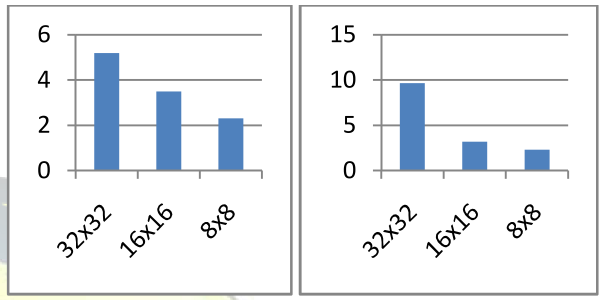
The experiments were simulated usingMatlab R2010a with the images of the format .jpg. The results obtained are shown further.



(a) (b) (c)

(d) (e) (f)

Fig 5.1 (a) Original secret image[151x198] **(b) Original Target image** [148x197]**(c) combined tile images of all the three channels**[256x256] **(d) color transformed encrypted mosaic image**[256x256] **(e) Recovered secret image using right key.(f) Image obtained for a wrong key.**



(a) (b)

PLOT : X-axis→ Tile sizes ; Y-axis→ RMSE

Fig 5.3 Plots of RMSE v/s Tile image sizes (a) RMSE=5.13 of Mosaic image with respect to target image; (b) RMSE=9.52 of recovered secret image with respect to original secret image.

The plots indicate that for a small RMSE value the similarity between the images will be high enough. If the RMSE value is high then the similarity between the images will be low.

5. PROPOSED SYSTEM: USING 2D-DWT

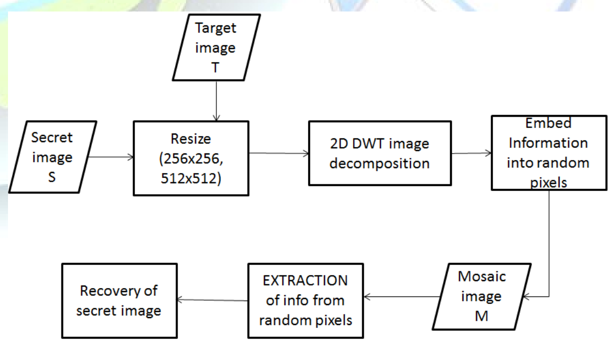


FIG. 5.1 Block Diagram of the Proposed System: Using 2D-DWT

The block diagram of the proposed system 2 is shown. The discrete wavelet transform is used as because it is advantageous when compared to Fourier transform i.e. it has the ability to generate temporal resolution and that it captures both frequency and location

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ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 3, Special Issue 1, March 2016

information. Christo Ananth et al. [5] proposed a system which uses intermediate features of maximum overlap wavelet transform (IMOWT) as a pre-processing step. The coefficients derived from IMOWT are subjected to 2D histogram Grouping. This method is simple, fast and unsupervised. 2D histograms are used to obtain Grouping of color image. This Grouping output gives three segmentation maps which are fused together to get the final segmented output. This method produces good segmentation results when compared to the direct application of 2D Histogram Grouping. IMOWT is the efficient transform in which a set of wavelet features of the same size of various levels of resolutions and different local window sizes for different levels are used. IMOWT is efficient because of its time effectiveness, flexibility and translation invariance which are useful for good segmentation results.

Fig 5.2 Three level decomposition of the secret image.

6. CONCLUSION AND FUTURE WORKS

A covert secret image transmission method has been proposed, which can create significant mosaic images but converts a secret image into a mosaic image for use as a camouflage of the secret image. There is no need for a target image database since the secret and the target images are resized to a common size. Also, the original secret images can be recovered losslessly from the created mosaic images. Experimental results show the feasibility of the proposed method. The data embedding capacity of the proposed method using 2D DWT is comparatively higher than the existing method.

Future studies can be directed to applying the proposed method to images of color models other than RGB and also to increase the similarities of the created mosaic image and target image and also the similarities of the recovered secret image and the original secret image.

REFERENCES

[1] S. Battiato, G. Di Blasi, G. M. Farinella, and G. Gallo, “Digital mosaic framework: An overview,” *Eurograph.—Comput. Graph. Forum*, vol. 26, no. 4, pp. 794–812, Dec. 2007.

[2] D. Coltuc and J.-M. Chassery, “Very fast watermarking by reversible contrast mapping,” *IEEE Signal Process. Lett.*, vol. 14, no. 4, pp. 255–258, Apr. 2007.

[3] C. K. Chan and L. M. Cheng, “Hiding data in images by simple LSB substitution,” *Pattern Recognit..*, vol. 37, pp. 469–474, Mar. 2004.

[4] I. J. Lai and W. H. Tsai, “Secret-fragment-visible mosaic image—A new computer art and its application to information hiding,” *IEEE Trans. Inf.Forens. Secur.*, vol. 6, no. 3, pp. 936–945, Sep. 2011.

[5] Christo Ananth, A.S.Senthilkani, S.Kamala Gomathy, J.Arockia Renilda, G.Blesslin Jebitha, Sankari @Saranya.S., “Color Image Segmentation using IMOWT with 2D Histogram Grouping”, International Journal of Computer Science and Mobile Computing (IJCSMC), Vol. 3, Issue. 5, May 2014, pp-1 – 7

[6] H. Narasimhan and S. Satheesh, “A randomized iterative improvement algorithm for photomosaic generation,” in *Proc. NaBIC*, Coimbatore, India, Dec. 2009, pp. 777–781.

[7] R. Silver and M. Hawley, *Photomosaics*. New York: Henry Holt, 1997.

8] T. S. Cho, S. Avidan, and W. T. Freeman, “A probabilistic image jigsaw puzzle solver,” in *Proc. IEEE CVPR*, 2010, pp. 183–190.

[9] E. Reinhard, M. Ashikhmin, B. Gooch, and P. Shirley, “Color transfer between images,” *IEEE Comput.Graph. Appl.*, vol. 21, no. 5, pp. 34–41, Sep.–Oct. 2001.