New Image Steganography by Secret Fragment Visible Mosaic Image for Secret Image Hiding

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Abstract— A new type of image similarity method is proposed, which created automatically by composing small fragments of given secret image in mosaic form in the target image .The mosaic image is yielded by dividing the secret image into fragments and transforming the colour characteristics of secret image to that of target image. Skilful techniques are used in the colour transformation process so that secret image may be recovered nearly lossless.
Keywords: Computer art, information hiding, secret fragment-visible mosaic image.

I. INTRODUCTION

Steganography is the science of hiding secret data into cover media so that no one can realize the existence of secret data. Steganography techniques may be image, video, text types. In image steganography, secret image embedded to cover image resulting a stego-image looking like the original cover image.
Recently, Lai and Tsai proposed a new type of computer art image, called secret fragment visible mosaic image, which is the result of random rearrangement of the fragments of secret image in the target image. By using this method difficulty of hiding huge amount of data behind cover image is solved automatically. More specifically, as illustrated by Fig.1, a given secret image is first divided into tiny rectangular fragments, and target image with similar colour distribution is selected from a database. Then the small fragments of secret image are arranged in a random fashion controlled by a key to fit into the blocks of target image. But a large image database is required here in order to select a similar colour target image for each of the input secret image. Resulting mosaic image will be same as that of target image. Using this method user cannot able to select freely his/her favourite image for use as the target image.

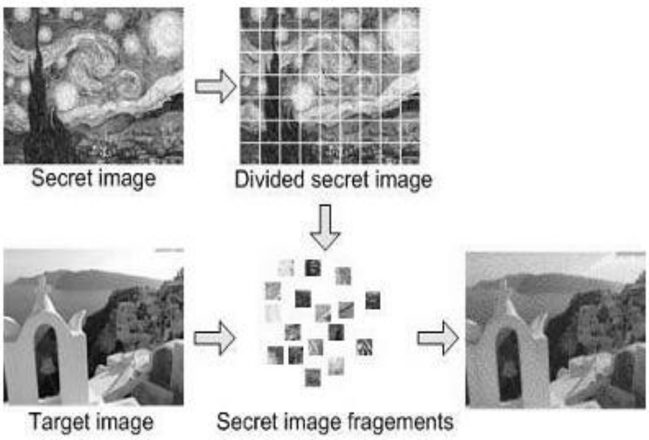

Fig. 1: Illustration of creation of secret -fragment mosaic image

Accordingly, a new method is proposed that creates secret fragment visible mosaic image with no need of databases, so any image may be selected as the target image for hiding the secret image. After the target image is selected arbitrarily, the given secret image is first divided in to rectangular fragments, which then fit to similar blocks in the target image according to a similarity criterion based on colour variations. After that colour characteristics of each tile image in secret image is transformed to that of the blocks of target image

II. BASIC IDEA OF PROPOSED METHOD

The proposed method includes two main phases: mosaic image creation and secret image recovery.
The first phase includes four stages:(1)stage 1.1- fitting tile images of secret image into target blocks of target image;(2)stage 1.2- transforming the color characteristics of each tile image in the secret image to match with the blocks of target image;(3)stage 1.3-rotating each tile image into a direction with the minimum RMSE value with respect to its corresponding target block; and (4)stage1.4- embedding relevant information into mosaic image for later recovery. The second phase includes two stages(1)stage 2.1-extracting the embedded information for secret image recovery from the mosaic image;(2)stage2.2-recovering the secret image.

III. PROPOSED SOLUTIONS FOR MOSAIC IMAGE CREATION

A. *Color Transformations Between Blocks*

The first phase of the proposed method is to fit tile image T in a given secret image is to be fit into a target block B in a preselected target image. In order to make a similarity between secret image and target image color transformation is carried out.
Let T and B described by two pixel sets $\{p_1, p_2... p_n\}$ and $\{p_1', p2... p_n'\}$ respectively. Both blocks are same dimension with size n. Let the color of pixel pi in the RGB color space is denoted by denoted by (r_i, g_{it} bi) and that of pi by (r/, g/, b/).First compute mean and standard deviation of T and B respectively.

$$\mu_C = \frac{1}{n}\sum_{i=1}^{n} c_i \quad , \quad \mu_C{}' = \frac{1}{n}\sum_{i=1}^{n} c_i{}' \qquad (1)$$

$$\sigma_c = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(c_i - \mu_c)^2}, \sigma_c' = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(c_i' - \mu_c')^2} \quad (2)$$

Where c_i and c/ denote the C-channel values of pixels pj and p/, respectively. Next compute new color values (ri', gi', bi') for each pi in Tby

$$c_i{}'' = (\sigma_c{}'/\sigma_c)(c_i - \mu_c)^2 + \mu_c{}' \text{ with } c = r, g, b. \qquad (3)$$

These results anew tile image *T* with a new color characteristic that is similar to that of target block *B*. To compute original color values (r_i, *g*, b_i) of p_i from the new ones *(ri' , gi', bi')* following formula is used.

$$c_i'' = (\sigma_c \ / \sigma_c')(c_i'' - \mu_c')^2 + \mu_c \text{ with } c = r, g, b. \quad (4)$$

B. Choosing Appropriate Target Blocks And Rotating Blocks To Fit Better

In transforming color characteristics of a tile image *T* to be that of target block *B* as described above, first we have to choose a an appropriate *B* for *T*. For this we use standard deviation of blocks colors to find most similar *T* for *B*. First compute the standard deviation of every tile image and target block for each color channel, then sort the tile image to form a sequence S_{tile}, and all the target blocks to form another, S_{target}, according to the *mean* of the standard deviation values of the three colors. Finally, fit the first tile image in S_{tile} to the first target block in S_{target}; fit the second in S_{target} to the second in S_{target}, etc.

After the target block selection for fitting the tile image and after the color transformation of *T* to match with *B,a* further improvement on the color similarity between the transformed *T* and *B* is conducted by rotating *T* into one of the four directions 0^o, 90^o, 180^o and 270^o, which yields a rotated version *T'* of *T* with the minimum RMSE value with respect to *B* among the four directions for final use to fit *T* into *B*.

C. Handling Overflows and Underflows In Color Transformation

After the color transformation process between a tile image *T* and a target block *B*, some pixel values in the transformed block *T* might have underflows or overflows. We convert all the transformed pixel values in in *T* not smaller than 255 to be 255, and all of those not larger than 0 to
be 0. Next, we compute the differences between the original pixel values and the converted ones, 255 or 0. By using the following two formulas we compute first the smallest possible color value cS (with c = r, g, and b*)* in tile image T that becomes larger than 255 as well as the largest possible value cl in T that becomes smaller than 0, after the color transformation process has been conducted, as:

$$C_S = \left[\left({}^{1}/_{q_c}\right)\left(255 - C_\mu'\right) + C_\mu \ \right] \quad (4)$$

$$C_L = \left[\left({}^{1}/_{q_c}\right)\left(0 - C_\mu'\right) + C_\mu\right] \quad (5)$$

Respectively, where $q_c = \mathbf{o_c}'/ o_c$..

D. Embedding Secret Image Recovery Information

Information of tile image fitting is embedded into some blocks of mosaic image, which are selected randomly by a secret key. By embedding the information of tile-image fitting, the original secret image can be reconstructed from the created mosaic image. Each fitting of a tile image s into a target block d forms a mapping from s to d. The way for dealing with the issue is to record these mappings a sequence Lr, called the secret recovery sequence, and embed LR into randomly-selected blocks in the created mosaic image using a technique of lossless least-significant-bit (LSB) replacement. Concatenate the data of the width Ws and height Hs of S as well as the size Zt, transform the concatenation result into a binary string, and embed it into the first 24 pixels of image by the lossless LSB replacement scheme. Accordingly, an observer possessing the key can reconstruct the secret image by retrieving the embedded information, while the hacker without the key cannot.

IV. RESULTS

Secret image is hided in the target image resulting a mosaic image same as that of target image.

Fig. 2: Selected Target image

Fig. 3: Selected secret image

Created mosaic image after placing the tile of secret image to that of target image is shown below:

Fig. 4: created mosaic image with rotation

Fig. 5: Created mosaic image without rotation

Retrieved secret image from the mosaic image without rotation is shown below

Fig. 6: Retrieved secret image without rotation

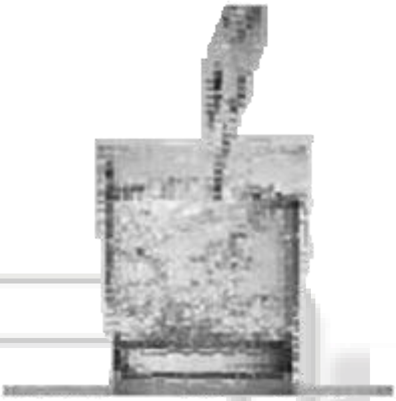

Fig. 7: Retrieved secret image with rotation

V. CONCLUSION

In this paper, a new type of digital art, called secret-fragment-visible mosaic image is proposed. By the use of proper pixel color transformation as well as skillful handling of overflows/underflows in the converted pixel's colors, mpsaic images of high similarities to arbitrarily selected target images created without no need of target image database, and the original secret images can be recovered nearly listlessly from the created mosaic image.

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REFERENCES

[1] Lai,I.J.,Tsai,W.H:en-Bang Feng, Iuon- Chang Lin, Chwei-Shyong Tsai, and Yen- Ping Chu, "Secret Fragment Visible Mosaic Image-A New Computer Art And Its Application To Information Hiding "IEEE Transactions on information forensics and security, Vol.6, No.3,September 2011

[2] Peticolas, F.A.P., Anderson," Information Hiding-A Survey" ,Proceedings of IEEE,Vol.87,No.7,1996

[3] Reinhard, Ashikhmin, Gooch, "Color transfer between images ", IEEE Computer Graphics And Applications, Vol.21, No.5, 2001.