A Survey on Steganography Based Reversible Texture Synthesis

Aruna M P, Maya Mathew

Abstract— **Steganography is a method for communicating secret data using appropriate multimedia carrier such as image, audio, and video files. Several stenographic methods are present. The objective of steganography is to hide information in such a way that existence of communication is unknown by an attacker. This paper introduces steganography in texture images.Texture synthesis process synthesizing a large texture image from a smaller texture image, which has same local appearance. We combine texture synthesis and steganography to conceal secret messages. This paper provides a review and analysis of the different existing steganography methods in texture images and also explains common standards and information drawn from the literature.**

***Index Terms*—texture image, texture synthesis**

I. Introduction

The main purpose of steganography is to hide information in a way that prevents the detection of hidden messages. The meaning of Steganography is "covered writing". The application of steganography includes conversion of communication between two parties whose existence is unknown to an attacker and their success depends on detecting the existence of this communication [1].

In a stenographic system, the information-hiding process is started by identifying a cover medium's redundant bits (Bits can be alter without destroying that medium's integrity).The embedding process replaces these redundant bits with data from the hidden message to form a stego medium.[2] The goal of steganography is to keep the secret message undetectably. Most stenographic methods take over an existing image as a cover medium. When embedding secret messages into this cover image, distortion of image may occurs. Because of this reason two drawbacks occur .First, the size of the cover image is fixed, so more secret messages are embedded allow for more image distortion. Therefore to maintain image quality it will provide limited embedding capacity to any specific cover image. Second,that image steganalysis approach is used to detect hidden messages in the stego image. This approach can defeat the image steganography and reveals that a hidden message is being carried in a stego image.

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This paper proposes a combination of steganography and texture synthesis process .The process of re-samples a small texture image drawn by an artist or captured in a photograph in order to synthesize a new texture image, which have a similar local appearance and arbitrary size is called texture synthesis. This paper combines the texture synthesis process into steganography to conceal secret messages as well as the source texture. The secret messages and the source texture can be extracted from a stego synthetic texture.

II. LITERATURE SURVEY

J. Fridrich, M. Goljan, and R. Du [3] proposed a scheme for detecting least significant bit (LSB) non sequential embedding in digital images. The length of secret message is derived by examine the lossless capacity in the LSB and shifted LSB plane.

The method analyzing lossless data embedding capacity in the LSBs. Randomizing the LSBs in the decreasing order of lossless capacity in the LSB Plane. Thus, the lossless capacity used to measure the degree of randomization of the LSB plane. Note that, the LSB plane of most images is random and it does not have any easily recognizable structure. To capture the degree of randomization using classical statistical quantities constrained to the LSB plane is unreliable. The lossless capacity revolves the fact that the LSB plane is related nonetheless to the other bit planes. Even if this relationship is nonlinear, the lossless capacity seems to measure this relationship equitably well. So, this method is used for steganography detection. In this technique, can be reliably detect the presence of secret messages in the images.

M. F. Cohen[4] have used to implement an interactive application for texture design and synthesis. Texture is an image which has locality and stochastic property. Locality means small part of the image is look alike and they never look exactly the same (Stochastic). To overcome the memory consumption problems of large images , generates a technique for tiling small images to fill a large area. We often needs large texture images. So, we need to create large image from small samples .just tiling the samples is not a good method. Wang tile method is used for tile the plane with appropriate samples based on matching colors of adjacent edges.

If the set of tiles is rich enough and there is no periodicity, we can fill inside the tiles anything we want such as texture, geometric primitives etc. Using this method the user can fill Wang tiles on her own. The system interactively displays the

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result of the tiling. Using Wang Tiles method, once the tiles are filled, can be creates large expanses of non-periodic texture as needed very efficiently at runtime. Wang Tiles are squares shaped and each edge is has a color. A valid tiling requires matching colors to all shared edges between tiles.

Another advantage is that, using a small set of tiles created from sample patches of a source image a highly compact representation for texture is achieved. If the two source images contain distributions of differing densities allows the creation of less uniform textures using two source images. An efficient real-time rendering of complex scenes can be done with modern graphics hardware by combining Wang Tiles with Layered Depth Images.

L. Liang, C. Liu[5] presented an algorithm for synthesizing textures from an input sample. This patch-based sampling algorithm is very fast and it creates high-quality texture image. This algorithm works well for a wide variety textures likes regular to stochastic textures. Can be sampling patches using a nonparametric estimation of the local conditional MRF density function .Also avoid mismatching features across patch boundaries of an image.

The building blocks of the patch-based sampling algorithm are patches of the input sample texture to construct the synthesized texture. We can carefully select these patches of the input sample texture and paste it into the synthesized texture to avoid mismatching features across patch boundaries. Patch-based sampling algorithm combines the nonparametric sampling and patch pasting strengths .The texture patches in the sampling scheme provide implicit constraints to avoid garbage found in some textures.

A. A. Efros and W. T. Freeman [6] proposed a method for generates a new image by stitching together small patches of existing images. This process is known as image quilting. It is very fast and simple texture synthesis algorithm. By extend this algorithm to perform texture transfer operation.

In patch-based texture synthesis procedure, define the square block of user-specified size from the set of all such overlapping blocks in the input texture image. To synthesize a new texture image, let us simply tile the blocks taken randomly from the input texture image. Next step is to introduce some overlap in the placement of blocks onto the new image. Now, search source texture for such a block that agrees some measure with its neighbors along the region of overlap .At last, let the blocks have ragged edges which will allow them to better approximate the features in the texture. Before placing the block into the texture can be calculates error in the overlap region between it and the other blocks. Then find a minimum cost path through that error surface and find boundary of the new block.

Z. Ni, Y.-Q. Shi [7] presented a reversible data hiding algorithm for recover the original image without any distortion from the marked image after the hidden data have been extracted. The zero or the minimum points of the histogram of an image is utilized by this algorithm and slightly modifies the pixel grayscale values for embedding the data into the image. By comparing the existing reversible data hiding algorithms ,It can embed more data. The algorithm applicable to a wide range of images such as commonly used images, medical images, texture images, aerial images and all of the 1096 images in CorelDraw database.

This method can embedded a large amount of data at the same time keeping a very high visual quality for all natural images, specifically, the PSNR of the marked image versus the original image is guaranteed to be higher than 48 dB. This techniques is applicable to all types of images. This proposed lossless data hiding technique is applied to still images and videos. Videos consist of a sequence of images. In the proposed algorithm, embedding and extracting of data are presented in terms of pseudo code.

X. Li, B. Li, B. Yang, and T. Zeng[8], have used a Histogram shifting (HS) technique for reversible data hiding (RDH). Using HS-based RDH method, high capacity and low distortion can be achieved. This paper presents a general framework to construct HS-based RDH technique. Using this proposed framework, can be get a RDH algorithm by simply designing shifting and embedding functions.

In this method, first divides the host image into nonoverlapping blocks such that each block contains *n* pixels. Then, generates an *n*-dimensional histogram by counting the frequency of the pixel-value-array sized *n* of each divided block. At last, modifies the resulting *n*-dimensional histogram for implementing the data embedding scheme.

H. Otori and S. Kuriyama [9] have presented a data hiding techniques tools for protecting copyright or sending secret messages. This paper proposed a method for embedding arbitrary data by synthesizing texture images using the smart techniques of generating repetitive texture patterns through feature learning of a sample image.By extending this technique, a synthesized image can effectively conceal the embedded pattern, and the pattern can be robustly detected from a photographed image.

This method introduces a random coating and re-coating to improve the quality of the texture image synthesized from the initial painting of LBP. The algorithm focuses on the textures that are iteratively generated by learning a pattern of an exemplar. This is infeasible for a procedurally and randomly
generated pattern. Computes the shape of a histogram of the LBPs for every pixel inside a divided image block and embedded the data onto it. The implementation requires border lines for extracting the square region of a data-embedded area in the texture image. This is done by developing a technique of automatically determining the square region.

This paper uses texture images for embedding data because texture patterns are widely utilized artificial images. Texture images can be automatically generated by computing the feature of the iterative patterns of real objects. So that we

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can embed data by affixing a seal of a synthesized image on a real object in unnoticeable manner, with quality of the object's appearance is guaranteed. We directly paint the data by converting its numerical value into a dotted colored pattern rather than changing the color component of images .Then automatically coat a texture image onto the painted pattern from a sample image (or exemplar) so as to conceal its existence with a natural texture pattern.

Y. Guo, G. Zhao[10] proposes a video texture synthesis method.Two key factors, such as frame representation and blending artifacts, that affect the synthesis performance. To improve the synthesis performance from two features. First, effective frame representation is used to capture both the longitudinal information in temporal domain and the image appearance information in spatial domain. Second, Artifacts that reduce the synthesis quality are significantly suppressed on the basis of a diffeomorphic growth model.

The proposed video texture synthesis approach has mainly two stages such as video stitching stage and transition smoothing stage. In the video stitching stage, a video texture synthesis model is proposed to generate an infinite video flow. This paper presents a new spatial–temporal descriptor to gives an effective representation for different types of dynamic textures. In the second stage of video synthesis, a smoothing method is presented to improve synthesis quality. It aims to set up a diffeomorphic growth model to emulate local dynamics around stitched frames.

First, a Multi-frame LBPTOP frame signature is proposed to capture both the spatial and temporal information. Based on this frame signature, it identifies the most appropriate matching pairs of frames. Second, a diffeomorphic growth model is applied to identify matching frames. For smoother transition, this growth model can emulate temporal motion around matching frames and estimate virtual frames. This synthesis method has some advantages .First, combines the spatial and temporal description in each feature, which enhances the ability of capturing the relationships among neighboring frames. Second, considers abundant temporal discriminative information, which makes it flexibly adaptive to dynamic textures with different properties. Third, gets more natural visual effects by using the diffeomorphic growth model.

A. A. Efros [11] presented a non-parametric method for texture synthesis. The texture synthesis process emerges a new image outward from an initial seed, consider one pixel at a time. The objective of this method is to preserve local structure and produces good results for a wide variety of synthetic and real-world textures.
The algorithm considers texture, pixel by pixel, outwards from an initial seed. First, chose a single pixel so that the model captures high frequency information as possible. Using probability tables for the distribution of single pixel can be synthesis the process by using all possible contexts. An approximation can be getting by using various clustering techniques.

This method generates texture as a Markov Random Field (MRF). It assumes the probability distribution of brightness values for a pixel given the brightness values of its spatial neighborhood and the rest of the image are independent. The neighborhood of a pixel is design as a square window around that pixel.

R. Rejani[12] have proposed a pixel pattern based steganography. This method involved hiding the message within in an image by using the existing RGB values whenever possible at pixel level or with minimum changes. A key is present along with the image, which can be used to decrypt the message stored at pixel levels.

This method presents an improved steganography technique for embedding secret message bit in image metadata fields based on the RGB values and the position of the pixels. The pixels in the image changed only for characters and the algorithm cannot find a pixel which can represent it. Because only the metadata is modified, the stego image looks exactly the same as original image. In this method, only the size of the stego image will increased.

Most of the existing image steganographic algorithms have many drawbacks. First, the size of the cover image is fixed, so embedding more secret messages will leads to image distortion. So it needs a compromise between the embedding capacity and the image quality, which results in the limited capacity provided in any specific cover image. Second, that image steganalytic algorithm can be used to detect secret messages hidden in the stego image .To overcome this limitations,Kuo-Chen Wu and Chung-Ming Wang [13] have proposed an approach for steganography using a reversible texture synthesis. A texture synthesis process synthesizes a new texture image from a smaller texture image which has a similar local appearance and an arbitrary size. This method combines the texture synthesis process with steganography to conceal secret messages. This scheme offers many advantages. First, the embedding capacity is proportional to the size of the stego texture image. Second, steganalytic algorithms not defeat this steganographic approach. Third, this allows recovery of the source texture.

III. STEGANOGRAPHY BASED REVERSIBLE TEXTURE SYNTHESIS

An approach steganography using reversible texture synthesis is used for hiding the secret messages. A texture synthesis process synthesizes a new texture image from a small texture image with a similar local appearance and arbitrary size. This method combines the texture synthesis process and steganography for concealing secret messages as well as the source texture. It has two procedures such as

- Message embedding procedure
- Message extracting procedure

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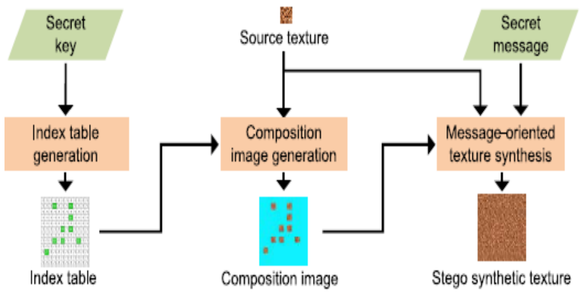

Fig.1 The flowchart of the message embedding procedure.

In message embedding procedure, first divides the source texture image into image block, called patches. To produce an index table for recording the location of the corresponding source patch. Establish a blank image as workbench where it's size is equal to the synthetic texture .Then paste the source patches into workbench by referring the source patch IDs stored in the index table to produce a composition image. Then find Mean square error of overlapped region between the synthesized area and the patch which want to place .Ranking these patches based on increasing order of Mean Square Error .Then select patches from list where its rank equals the decimal value of an n-bit secret message.

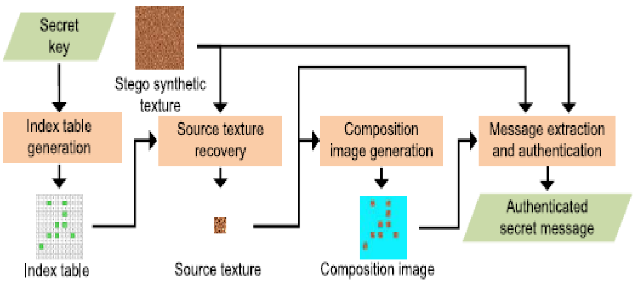

Fig.2 The flowchart of the message extracting procedure.

In message extracting procedure, the index table can be generated by using secret key in the receiver side. The size of the source texture can be retrieved by referring each patch region and its corresponding order in the index table. Arrange blocks based on their order. To paste the source patches into a workbench to produce a composition image.

In the match-authentication step, consider the current working location on the workbench and also refer the corresponding stego synthetic texture at the same working location to determine the stego block region. Then, based on this region, to search candidate list to determine if there is a patch in the candidate list where its kernel region is the same as this region. If this matched patch is available, and then can be locate the rank of that matched patch, and this rank represents the decimal value of the secret bit in the stego patch when operating the texture synthesis in the message embedding procedure.

IV. Conclusion

In this paper various data hiding techniques were analysed and among them Kuo-Chen Wu's[13] method performs well for produce a large stego synthetic texture for concealing secret messages.This method provides reversibility to retrieve the original source texture from the stego synthetic textures and it can be used for second round of texture synthesis if needed. Studies show that the previous methods have many drawbacks; this can be solved using the new Steganography method using Reversible texture synthesis. This method can achieve reversibility,separate data extraction and image recovery.

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