Changeable Surface Fusion in Steganography

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***Abstract*— Reversible texture synthesis process is proposed for steganograpy. Resampling a smaller texture image synthesis a new texture image. The texture synthesis process is merged into steganography so as to hide secret messages. When compared with the earlier works, this algorithm works on hiding the source texture image and the secret messages are implanted with the help of texture synthesis. The required secret messages are extracted and as well as source texture is also isolated from a stego synthetic texture. This algorithm has two advantages.**

1. The implanting capacity is proportional to the size of the stego texture image.

2. Recovery of source texture is possible due to the reversible texture synthesis.

It is clearly understood that from the experimental results the proposed algorithm offers various implanting capacities, obtains visually credible texture images and recovers the source texture.

***Keywords*— Steganography, texture synthesis process,**

I. INTRODUCTION

Many earlier works have been done in the steganography and in turn it also has shown much progress towards working on various techniques. From the good olden days, it is found usual in hiding the information and transmitting the same. This is named as Steganography [1]. A medium is required in order to hide the messages so that no eavesdropper must get the information[2]. The success of steganography technique depends on the attacker. If the attacker is unable to detect the message, then it is understood that the communication between the two parties is working well [3]. Medium usedfor steganography might be text,audio,video,digital image,etc[4].Many investigations have been done on steganographic algorithms[5,6]. It is tacit that many image steganographic algorithms implement an existing image as a cover medium. Due to the implantation of secret images into the cover image, slight image distortion might happen. Hence it leads to two pitfalls.

1. Distortion depends on the size of the secret messages since the size of the cover image is fixed.
2. Image quality and the implanting capacity are interrelated since the capacity of embedding is limited in the cover image.

In this paper, an algorithm is proposed which focuses on texture synthesis process. Texture synthesis process is analyzed. The other section provides the algorithm for implanting and extracting the information.

II. RELATED WORKS

In texture synthesis process, source texture image is resampled with the help of pixel-based or patch-based algorithms. Synthesised form of image with similar local appearance and random size is obtained. The synthesised images are generated in terms of pixel by pixel using pixel based algorithms. Spatial neighbourhood comparisons are done in order to select the most similar pixel in a sample texture image as the output pixel. Each output pixel is decided based on the pixels that were synthesized already. In case of any misinterpretation of synthesized pixel might create an impact on the result that causes the propagation of errors. Instead of pixels, patches are pasted from a source texture in order to synthesize textures in patch-based algorithms. Cohen et al and Xu et al proposed the improved version of patch based algorithm in which the image quality has been increased due to the presence of texture structures inside the patches. Synthetic process needs much attention since during this process, there might be a chance of overlapping regions due to the pasting of patches. A new approach "image quilting" has been proposed by Efros and Freeman [7]. This approach identifies the source texture and selects one candidate patch. This candidate patch must be able to satisfy the pre-defined error tolerance with regard to neighbours beside the overlapped region. The minimum error path is revealed all the way through the overlapped region by means of dynamic programming. From this approach, it is clearly understood that an optimal boundary exists between the selected candidate patch and the synthesized patch, which in turn is capable of generate visually reasonable patch stitching. The cover image has to be recovered from the stego image without any distortion after the hidden data is extracted. This is done with the help of image reversible data hiding algorithm proposed by Ni et al [8]. To perform the reversible data hiding, histogram shifting is used. In this approach, the implanting capacity is considered based on the number of pixels in peak point. Some of the benefits are

- Constant PSNR ratio
- High capacity
- Low distortion

Disadvantages

- Time consumption is more while searching the image number of times.

There will be no loss of information in reversible watermarking. Histogram shifting technique is proposed by Diljith M. Thodi[9]. This technique replaces the embedding

the location map. In this approach, the performance of distortion is increased and it has low embedding capacities .In addition, the capacity control problem is also diminished. Ali Shariq Imran et al developed a new and enhanced data hiding technique based on the neighbourhood pixles information. The solution developed by the author is considered as robust,effective and detects the existence of any secret data that is been hidden inside the host image. This is achieved by utilizing those bits that are either on edges or green component of color image which is least perspective to human eye. The data hiding capacity of the host image is increased by using all the pixels.

III. PROPOSED ALGORITHM

Some notations used in the proposed algorithm

1. Patch – basic unit represented for steganographic texture synthesis.
2. Pw and Ph is used to denote Patch Width and Patch Height respectively.
3. Kw * Kh denotes the size of the central part of the patch.
4. Pd represents the part surrounding the kernel region and it is known as boundary region.
5. Sw * Sh denotes the size of source texture. This is subdivided into a number of non-overlapped kernel block and it is denoted as Kw * Kh.
6. KB represents the number of elements in this set.

Indexing is done for each source patch KB= $\sum_{1=0}^{n} Kbi$

Message embedding process consists of three steps. They are

1. Index table generation.
2. Patch composition process.
3. Message oriented Texture Synthesis Process.

1 .*Index table generation process.*

In this process, an index table is produced as an output. It is used to denote the location of the source patch set SP in the synthetic structure. Using this table, the source texture is retrieved completely. The dimensions of the index table are denoted as $(T_{pw} \times T_{ph})$. T_w and T_h, denotes the width and the height of the synthetic texture. TP_n denotes the number of patches in the stego synthetic texture.

2. *Patch Composition process.*

A composition image is generated when the source patches are pasted into the workbench. A blank image is used as the workbench in which the size of the workbench is equal to the synthetic texture. The source patches are then pasted into the workbench by referring to the source patch IDs. Due to this pasting process, overlapping might occur. If overlapping is encountered, then it is understood that the source patches are pasted directly into the workbench. Image quilting technique is utilized if there is no overlapping.

3, *Message-Oriented Texture Synthesis Process:*

In this process, the secret message is embedded in order to produce the final stego synthetic texture. The proposed algorithm has three important features and thus it shows the way how it is distinguished from the existing works.

1. The shape of the overlapped area in this algorithm plays the role since the source patches are pasted into the workbench.
2. Candidate selection is the attribute used for texture synthesis. The appropriate patches that are used for hiding the messages are selected based on this attribute. Earlier works have shown that the patches are selected based on the threshold rank.
3. The large synthetic texture is used for hiding the secret message. From the previous works, it is understood that the output generated out of this process is a pure synthetic texture.

IV. CAPACITY DETERMINATION

The data embedding capacity is analyzed from the equations mentioned below. A mapping is done between the embedding capacity, number of embeddable patches in the stego synthetic texture (EP_n) and the capacity in bits per patch (BPP) that are utilized for hiding the messages at each patch. The lower bound of BPP will be 1 and the upper bound will be BPP_{max}. The number of embeddable patches is computed by taking the difference between the number of patches in the synthetic texture and the number of source patches.

V. SOURCE TEXTURE RECOVERY, MESSAGE EXTRACTION, AND MESSAGE AUTHENTICATION PROCEDURE

From the receiver side, the message extracting procedure includes the following steps:

1. Generation of index table.
2. Retrieval of source texture.
3. Texture Synthesis is performed.
4. Extract and authenticate the secret message that is inside the stego synthetic texture.

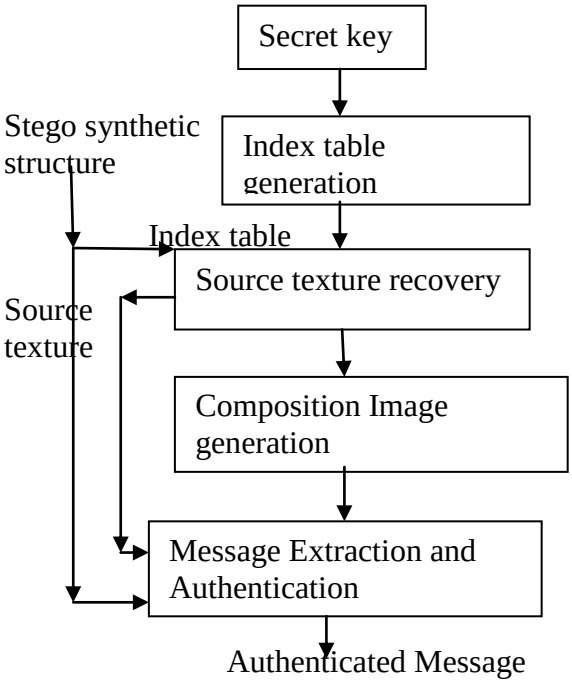
The secret key,the index table are in the receiver side. In the source texture recovery, the source texture is obtained by taking the kernel region as its input. The composition image generation generates the image which is similar to the image that is produced in the embedding procedure. The total embedding capacity TC is computed as given in the below equation

$$TC = BPP * EPn$$

VI. SECURITY ISSUES

The index table might be perceived by an eavesdropper. Intruding the index table depends on the length of the seed. for the four possible squared sizes of the source texture (Sw×Sh), the probability of breaking down is Pbi=0.25. The probability of breaking down five possible squared sizes of the patch.

The process flow is shown in the below figure 2.



(Pw×Ph) is Pbp=0.2. Finally, the probability of breaking down ten possible BPPs from 2-bit to 12-bit is Pbc =0.1. The total probability that the eavesdropper can break down the security of level one is Pb৭ ৩৯=Pbi × Pbp × Pbc=5 ৬৬ে 10ি৪.

VII. CONCLUSION

A reversible steganographic algorithm using texture synthesis is proposed. A large stego synthetic texture that hides the message is produced. Here , in this approach, the original source texture is retrieved from the stego synthetic.

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