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A Brief Review on Data Hiding Techniques in Stereo Images

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Abstract: ***The paper mainly deals with different data hiding techniques in stereo images. Stereo image, one of the main representation of 3D images can provide pragmatic experience by taking into account the depth perception. Sometimes the 3D content of the stereo image can be misused, copied or intruded by the illegal users. The Data hiding technology in which some valuable information is hided inside the stereo image can be effectively used to ensure the security of the stereo images. Using this method copyright protection and authentication can be easily achieved. In most of the cases after embedding the secret data the stereo images will be changed but for the applications like medical, military, forensic etc any minor change will not be acceptable due to the requirement of higher precision. Reversible data hiding is an effective method that can perfectly recover the original stereo image after removing the secret hided data***

Keywords: Stereo image, Data hiding, reversible data hiding, embedding capacity, image distortion, image recovery

I. INTRODUCTION

Today digital communication has become an extremely important area of concern and most applications are internet based. When we transfer a message through internet its our responsibility to ensure the integrity, confidentiality etc. For the security of the transmission of data many methods are implemented. There were several uncertified users who tries to attack the data transmission. The main aim of those attackers is to take away some crucial data from the communication. The main objective is to secure the private data and confidential data's from the attackers. There were several methods which ensures the security of monocular images but few methods are reported for stereo images till now.

Stereo images are one of the main representations of the 3D images. By simultaneously using a pair of CCD cameras we can capture the stereo image. Stereo images have more information per frame which allows to create the 3D presentation of an image. The image detected by the 2D camera contains no depth information. However in many system we need depth information for eg: in automated map making, robotic vision, target tracking etc. There are a range of schemes to extract the depth information. [1]

1) *Active Measurement*: Range of pulse echo techniques to measure distance to a point. Some of them are Radar, Ultrasound, Laser pulse or laser line scan. The most common of these schemes is the laser line scan where a 3D,solid object in rotated while been scanned by a laser beam. This obtains external shape of the object and thus a 3D shape. These are not really imaging in the normal sense. [1]
2) *Stereo Imaging*: It uses two or more spatially separated cameras to form images from different directions. The depth information is then extracted from the differences. In the simplest case the optical axis of the 2 cameras are parallel being separated by a distance S as shown in Fig 1

Fig. 1: Basic layout for parallel stereo imaging

From the 2 camera we get a different view of the same object as shown in Fig 2 .ie, we get shifts in the vertical lines only, from which we can extract depth information. This system is equivalent to the human visual system where we have 2 eyes separated between 60-70mm.So when we view a 3D object we see two slightly different views. [1]

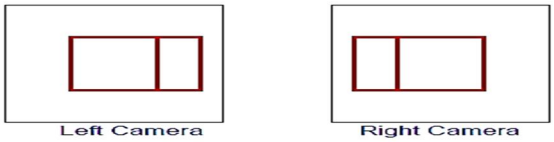

Fig. 2: Two stereo images of a cube

3) *Holography:* Active optical system that records full 3D object information. Very difficult to extract the information and its not really useful as a depth analysis scheme. [1] Sometimes the 3D content of the stereo images can be misused, copied or intruded

by the illegal users. The Data hiding technology in which some valuable information is hided inside the stereo image can be effectively used to ensure the security of the stereo images.

The data hiding techniques can be categorized into two types which is described below:

a) *Reversible Data Hiding:* In reversible data hiding technique it is possible to recover the host image exactly. Since this method is lossless it can be used for forensic, medical and military purposes. Most common methods reversible data hiding techniques are interpolation technique, difference expansion, histogram modification, prediction and sorting. The important advantage of reversible data hiding is that it can restore the original image without occurring any error.

b) *Non-Reversible Data Hiding:* In non-reversible data hiding method, once the data is embedded the original image is lost which means that in the extraction process the original image cannot be recovered perfectly. The simplest method of irreversible data hiding in irreversible category is using LSB (Least Significant Bit) insertion. Simplicity and invisibility by the naked eye are the main advantage of this technique.

II. LITERATURE SURVEY

Ting Luo,Gangyi Jiang, Mei Yu, Feng Shao, Zongju Peng proposed a disparity based stereo image reversible data hiding based on the histogram shifting technique. In the data hiding technique a good predictor always plays an important role. For monocular image, pixels are often predicted by their neighbor pixels. Relationships of neighbor pixels are used to judge whether the predicted value is close to original value. It is called as intra-correlation based predictor (ICP). While, for stereo images, besides intra-correlations, intercorrelations between two views can be also utilized to predict pixels well. Here disparity based predictor (DP) is used. Since pixels of left columns in the left view will not match any pixels in the right view, data will not be embedded into those pixels. The same number of right columns in the right view does not embed data either. DP is used to predict pixels of stereo image. In order to obtain the reversibility of data hiding, when computing disparity, pixels of the searching view must be same in the processes of hiding and extraction. Thus, for data extraction, one view must be firstly recovered, and then the disparity is computed to recover the other view. Only pixels in one view are predicted by using DP, and pixels of the other view are predicted by using intra-correlations predictors. Data extraction is the reverse of data hiding. Overflow/underflow may occur during data hiding. One bit is used to record whether overflow or underflow happens, and it will be side information. If it happens, two location maps are used to keep overflow/underflow of the left and right views, respectively. Moreover, two location maps will be compressed further by using arithmetic coding. In order to demonstrate the effectiveness of the proposed method here four 8-bit gray stereo images with the size of 640×480 are used as test images. Moderate embedding capacity can be achieved and the PSNR is 49.98dB. [2]

Ting Luo, Gangyi Jiang, Xiaodong Wang, Mei Yu, Feng Shao, Zongju Peng proposed Stereo image watermarking scheme for authentication with self-recovery capability using inter-view reference sharing. Stereo image blocks are divided into matched and unmatched types based on block matching. The mechanism of inter-view reference sharing is employed for reference generation of each pair of matched blocks. Watermark bits including authentication bits and reference bits are embedded into predefined embedding position, and watermarked stereo images are achieved. Each view of a stereo image to be watermarked is divided into non-overlapping blocks of 4×4 pixels, and two LSBs of each pixel within all blocks are set to zero first. After that, each block is transformed by using one level of DWT. Then, all blocks in left and right views can be classified into matched or unmatched type using the block matching method. Before watermark embedding, block mappings are established to determine embedding positions, and authentication and recovery reference bits of blocks are both embedded into their mapping blocks for tamper detection and recovery, respectively. Block mapping is established among blocks with the same type. Different from matched block, each unmatched block has two mapping blocks locating in two respective views. Two sequences indicate positions of mapping blocks in left and right views for unmatched blocks in left view, respectively, and the other two sequences represent positions of mapping blocks in left and right views for unmatched blocks in right view. Thus, one unmatched block is the same mapping block for two unmatched blocks in left and right views, respectively. Since authentication and reference bits are generated and embedded in different ways for matched and unmatched blocks, they are described respectively as follows. For a matched block, two LSBs of each pixel, that is, 32 bits of each block are allocated for watermark embedding, where reference and authentication bits are fixed as 28 and 4 bits, respectively. In order to demonstrate the effectiveness of the proposed method here six stereo images with the size of 480×640 is used. The PSNR achieved here is 31.99dB. [3]

Wen-Chao Yangand, Ling-Hwei Chen proposed Reversible DCT-based data hiding in stereo images. The proposed method is based on a fact that a pair of stereo images looks very similar and have many similar block pairs. This is an important property of stereo images. Based on this property, they proposed a reversible method to embed secret data through similar block pairs in the DCT domain. The proposed method contains two procedures: embedding and extraction. In the embedding procedure, each image is first divided into 8 × 8 blocks in the DCT domain, each block is divided into three areas with different DCT. One contains some lower-

frequency DCT-quantized coefficients called searching area, one contains some middle-frequency DCT-quantized coefficients called embedding area, and the other contains other non-used coefficients called non-used area. Next, similar block pairs between a pair of stereo images are found based on the searching area. Then, for each pair of similar blocks, a secret data is embedded in a certain middle-frequency DCT-quantized coefficient from one of the similar block pair. In order to keep security, for each secret data embedding, a stego key is used to randomly choose the embedding image. The embedding area is different from the searching area, this makes sure that the result of similar block search in the extraction procedure is the same as that in the embedding procedure. Here no overflow/underflow problems occur in the experiments. . In order to demonstrate the effectiveness of the proposed method here 21 pairs of stereo images from Middlebury stereo datasets are used. The PSNR achieved here is 30Db, which is comparatively lesser and low embedding capacity. [4]

Ting Luo, Gangyi Jiang, Mei Yu, Haiyong Xu, Feng Shao proposed Inter-view local texture analysis based stereo image reversible data hiding. To enhance security of three-dimensional images, an inter-view local texture analysis (ILTA) based stereo image reversible data hiding method is presented. Due to low accuracy of existing predictors, two novel predictors are proposed to improve the prediction precision. In the first predictor, a texture analysis model is built by using ILTA, in which the texture similarity between a pair of matched pixels in the stereo image is used to classify pixels into horizontal texture, vertical texture, smooth and complex types. Thus, the accurate prediction is adaptively computed by considering the pixel type. Moreover, an intra-view based predictor as the second predictor is also described to predict pixels by optimal weights finding (OWF). Since ILTA and OWF predictors are combined to predict pixels in the stereo image, sharp prediction error histograms of two views are both constructed, and then multi-level histogram shifting is used to embed secret data reversibly for obtaining low image distortion and high embedding capacity. ILTA and OWF predictors can obtain precise predicted values, and the proposed data hiding method outperforms some state-of-the-art data hiding methods in terms of embedding capacity and quality of stego stereo image. In order to demonstrate the effectiveness of the proposed method here six different stereo images with the size of 640 ×480 are tested. The PSNR achieved here is 40 dB and embedding capacity is 1bpp. [5]

Ting Luo, Gangyi Jiang , Mei Yu, Caiming Zhong, Haiyong Xu, Zhiyong Pan proposed convolutional neural network based stereo image reversible data hiding method. The stereo image, as the main representation of 3D images should be protected, and data hiding technology can authenticate stereo images and protect copyright of stereo images. In some special areas, such as military or medical applications, stereo images are not allowed to be modified, owing to the high-precision requirement. Therefore, reversible data hiding (RDH), which can reconstruct the original image completely by removing the embedded data, is required for stereo images. For stereo image RDH (SIRDH) methods, if monocular RDH methods are directly applied in the stereo image considering two independent views, the performance cannot be improved. Thus, the main challenge of the SIRDH methods is how to employ characteristics of the stereo image to increase EC with low image distortion of the stereo image. A good predictor always plays an important role in SIRDH method. CNN can be established and trained to predict pixels accurately. Here a novel CNN-based SIRDH method is presented. In order to improve the accuracy of the stereo image predictor, a CNN-based stereo image predictor (CNNSIP) is described by making full use of correlations of left and right views. In CNNSIP Rhombus prediction is used, and the pixels are divided into two types. For predicting one type of pixels in one view, the other type of pixels in the same view is considered as a low-resolution (LR) image. The prediction processes are regarded as recovering a high resolution (HR) image from the LR image. Since the difference view between two views includes texture and depth information, which represents strong inter-relationships of two views, the LR difference view is computed by subtracting the LR image from the other view. CNN is established to obtain a high-precision difference view and then the HR image is reconstructed for predicting pixels accurately. Finally, PEE technique is employed to embed data. At the receiver side the reverse process can be done to obtain the secret data and the stereo images. In order to demonstrate the effectiveness of the proposed method here eight pairs of standard stereo images with the size of 640 x 480 are used. Improved PSNR and embedding capacity can be achieved here. [6]

III. CONCLUSION

This paper presented a review on various existing data hiding techniques in stereo images. Data Hiding in Images is one of the topic receiving huge attention because of the need for high security requirement in many applications. There were several methods which ensures the security of monocular images but few methods are reported for stereo images till now. Data hiding mainly consists of various phases like prediction, data hiding and finally the data extraction/ image recovery. These techniques gives better security when compared to various existing methods for security.

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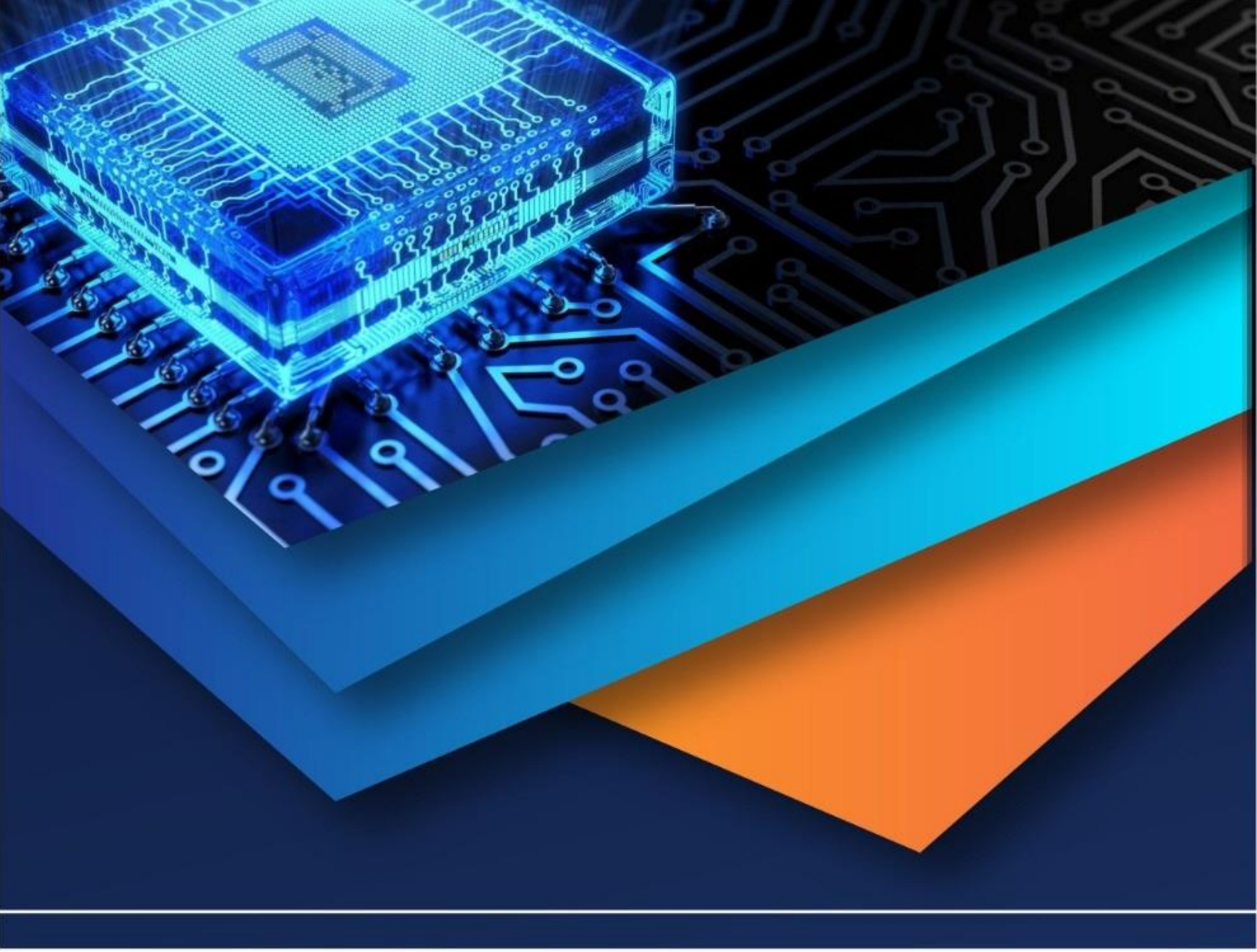

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