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MATHEMATICAL CONEPTS AND COMPUTATIONS IN REVERSIBLE EMBEDDING MECHANISMS: A THEORETICAL STUDY

G. CHARLYN PUSHPA LATHA[1], S. SAIRA BANU, T. KARTHIKEYAN, AND N. YUVARAJ

ABSTRACT. In the health, military, and legal sectors, the reversible watermark becomes more common. The following are considered as important factors for the study: reversible watermarking methods for different applications, including error-resistance, embedding power, and coding efficiency. The main purpose of the article is to provide a comprehensive description of advanced reversible watermarking methods for different image processing applications. This article reflects the latest developments in watermarking reversible in research and addresses key questions for future work enhancement. Finally, in the newer areas of image processing, improvements in reversible watermarking systems are utilized.

1. INTRODUCTION

The growing need in multimedia applications over the years has been for the transmission of high definition (HD) videos with low-bitrate MPEG-4 or H.264/AVC video encoding standards. The H.264/AVC Standard of Video Coding, designed by the joint venture team ITU-T and ISO/IEC. The video coding standard allows just half the width of the frame to transmit as opposed to the MPEG-2 standard. This norm also has high error tolerance, high coding, and

[1]*corresponding author*

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high adaptivity [1]. Because major online users depend primarily on the applications of multimedia, the key interest or issue is to safeguard them when transmitting video. To secretly insert data from registered users during transmission over these multimedia devices. Reverse data integration covers the hidden data reversibly over the authentic data, i.e., the payload is entered into an image, video, or audio. The reversible technique mostly helps retrieve both the information secretly or embedded and the original. The key parameters for calculation of the reversible data embedding scheme include quality redutcion and power embedding [4]. Therefore, the tradeoff between the two parameters is made, i.e., the data power of the original data is lower than the distortion degree. As stated, its unique material quality, deterioration, and efficiency after embedding with a secret file are the primary factors affecting the reversible embedding scheme. There are many embedding methods available, but a minimal degradation is seems to be safer than a higher distortion operation. The risk of interference is higher; the chances are greater for the intruders intercepting the initial transmission. The embedding function, apart from the degree of efficiency and degradation, is another significant factor. Low payload approaches are also preferred because the degree of security during transmission is high. In order to do this, it is necessary to increase the ability to hide information so that it can not be prominent before the eyes of man [5]. When embedded in the original image, reversible data embedding may cause predictable distortions. Owing to a few shortcomings in the integration scheme's reversibility choices, the deformities in the integration scheme are irreversible [6]. Reversible data incorporation comprises of three main approcahes: spatial domain: this enables secret code and reverse code to be implemented. Frequency Domain: Uses a discrete transform cosine (DCT), or a discrete fourier transform (DFT) or a discrete transform wavelet (DWT) to pre-process the original material. This is made to transform spatial domain information to frequency domain information prior the embedding process. Frequency domain helps to combine secret data with frequency coefficients during the embedding process, along with the reverse performance from the frequency domain. Compression domain: this compresses the image via the cover image as compression codes. This supports to minimize the size of the data content considerably to transfer the data quickly. It is the most basic and efficient technology widely utilized for safe data transmission, e.g., Quantization codes for vector compression [1–10]. This article addresses the conventional approaches in the reversible data embedding approach surveyed in common. The techniques were evaluated according to the accuracy of the embedding scheme and the standard literature techniques. The article focuses primarily on technologies and measures of quality discussed in previous research. This is mainly aimed at enhancing the future analysis of reversible data integration schemes in various specialized areas, including image, video, etc. Section 2 contains the review of diverse literature on accuracy in embedding, traditionally reversible data inclusion schemes-part of this article-sections 3 deals with conclusion and findings of various research.

2. WATERMARK TECHNIQUES

This section deals with the various techniques used over the last decades over reversible embedding systems. This involves vector quantification, high-capacities encoding, SOC coding method, differential extension, histogram processing, wavelet technique, stenography, watermarks, sliding door proofing, differential values, rice code, spatial and frequency domain, block encoding, Wavelet domain, as well as soft computing techniques.

2.1. **Encoding frameworks for vector quantization.** A Vector Quantization technique for reversible data embedding. The remaining Chinese theorem is used to reverse the coded image to the original details. The ability to mask or watermark relies totally on parameter (P1 and P2). The data are transformed into vector-quantized indices by applying Principle Component Analysis and primarily segment an image into blocks. The predefined parameters are considered safer within transmission. Grayscale images compressed from the VQ which could incorporate one hidden bit into a single compressed index of the VQ. A robust data hiding approach has the flexibility in utilizing the model for vector quantization. The indexing table, with a lower bit rate of 0.552, was used. This method was applied for maximizing the bit rate, and this uses two hash functions to take advantage of Vector Quantization functionality. It combines the data with great protection to restore and recreate the real indices from the cover data to achieve the compressed VQ image. Wang and Lu suggested the VQ Joint Neighbouring Coding Scheme cover losslessly. The codebook is sorted based on the codeword numbers, including index table generation and M-sequence generation for the initial level. M-sequence output relies on the primary key and the chosen path, where the paths are described in two ways. It specifically specifies the embedding capability over an index. Two separate hiding rules were created depending on the route selected: one embeds two and three bits. A VQ index table reversible embedding approach. This approach works on natural images of identical neighbourhood blocks compared to pallet images. The algorithm is designed to give a certain order. It specifies the index value that is equal or unequal. The similar set of indexed values are compatible with their neighbours, and the block was secretly concatenated. This was seen as a new index, and analysis with natural images with greatest hidden potential have proven successful. The hiding ability is considered to be appropriate, as it varies from 1 to 3 bits/index, which can be correctly recovered after hidden recovery.

2.2. **Encoding systems with high efficiency.** Compressing overlay bits and bitstring around the data block and then adding it. The camera cover over an embedded image and extracted the picture to obtain the original details. The distribution of the human visual system and statistical data assessments. Hadamard transform provides benefits including relatively less loss, reliability of detection, and hiding performance with high compression.

2.3. **Schemes for SOC code.** Rahmani et al. suggested an acceptable SOC encoding code outputs SOC codes. This hides the secret knowledge and indexes presence, and data were loaded with possible index. Nevertheless, the representation of the index is transformed in this approach, and the SOC decision codes the index tables with the VQ decoder when unauthorized users decode the data. It increases productivity and speed of degradation [2].

2.4. **Several operating frameworks.** A reversible scheme for palette pictures using forecasting techniques and techniques. Here the utility of the natural image was overlooked, provided that the smoother region was most similar to the pixels of neighbourhoods. The predicted Pixels create the codeword (the same and different colours). The process of recovery is carefully handled with the same restored and original picture consistency. The embedded method, therefore, consists of two instances: the first involves encoding with a single secret bit rule and the second includes two secret bits. The use of location maps here has been absolutely eliminated, and this technique cannot present better MPEG-4 coding. Yokoo proposed a file size dame coding scheme. However, over cover data, more data is collected. This asymptotic integration is evaluated on the basis of the data string. Such string derive from ergodic and stationary root H. This approach increases the integration potential as data volume. In addition, an ideal compression approach transforms data into compressed data and improves integration performance. The research methodology is tested using the new data functionality approach for both embedding and compression in different groups. A reversible embedding strategy with a virtual codeword generation from universal bitstream parser. The Golomb-Rice codes are statistically translated by merging two Golomb-Rice codes that differ in one bit of LSB payload. This method is suitable for both payload and host physical communication and reversible. Extracts payload without the initial message being restored. This method was successful in incorporating more information and maintaining the file size. A reversible embedding approach for JPEG images. The sign message is then pre-selected with external data in sub-bands of DCT coefficients. The message is not used to insert data because there would be further unwanted visual distortion. It is the first approach to the use of a signed message as the visual quality of scrambling pictures is a minor concern. For recovering the original JPEG file, DCT sign prediction is used, and the standard test result has been efficient.

2.5. **Difference expansion schemes.** A differential expansion method that seeks more power by defining the excess material in the images. The incorporation of hidden bits into a gray picture is accomplished. Differential Expansion technology Embedding reversible data into digital picture cover images. The embedded functionality and image visual qualities are, therefore, better considered in relation to low compute complexity [7]. A system with this differential method of expansion where the embedding efficiency of this method was higher. A grayscale image used to encode data and every combination of colour attributes should be coded or decorated separately. After decorating the colour components, the dependency is based on their blocks of pictures. Components are then embedded using a reversible data-based algorithm to keep their efficiency high. The DE technique cancels compression of images and provides additional storage space. Linear prediction and entropy coding could achieve maximum embedded potential with enhanced complexity [3]. A strategy for removing visual loss in the differential expansion system. This approach was successful with a 6-dB improvement in visual quality compared to the actual and extricated image. This form of reduced creation was accomplished by the integration of multi-layer data. An error-tolerant algorithms to provide reversible information in cover data. This approach used intraframe differential expansion (DE). The error-resilient algorithm focuses mostly on the H.264 intraframe compression in a picture culture, compared to B and P frames. This approach offers a better coding/compression ratio. The introduction of more intraframe H.264 techniques would increase reliance on neighbourhood blocks. When there is an error in a dependent row, it may spread greatly. Current approaches, such as error-resistant encoding and disguising, often degrade the image quality, but these techniques are considerably degraded if no error occurs. Yet the error-resistant algorithm of Shinfeng was best illustrated by its losslessness [8]. Shinfeng et al. suggested that Differential Expansion (DE) be applied to intraframes of the image. Nonetheless, an H.264 encoder stores reversible content and recovers H.264 encoders and decoders. It is known that the use of embedded (Ee) and embedding (Ea) is in four variants. Significant pixels are (ee) and (ea), DCT is (ee), pixels are (ee), DCT is (ea). Such four combinations will minimize sign bit, bit size difference, variable length coding, and higher complexity. Both pixel values and DCT coefficients were handled based on the macroblocks, integrated within a separate block with the differential expansion technology. The method obtained best comparative outputs than traditional and non-incorporated approaches [9].

3. CONCLUSIONS

The above approaches lead to an analysis about preserving the balance among visual quality and payload efficiency. Most of the methods proposed by now were based mainly on successful coding methods, but error tolerance failed. There is also a balance among these two conditions. The approaches mentioned are much less numerical and differential; there is no use of algorithms regulated by consistency. This method is previously suggested to concentrate primarily on the quality-controlled techniques, and the use of these control systems could increase the efficiency and capacity of production. This article offers insight into the full reversible data integration schemes and DCT schemes in general. Upon looking at the varying range of historical literature, we have expounded the connections between the various approaches and the reversible data embedded framework. We have also identified essential methods for enhancing reversible data-integrated schemes as supplementary schemes. In the previous study, we have found some differences in reversible watermarking schemes. We also addressed coding issues, error tolerance, and payload efficiency. The recommendation relating to specifications, non-use of techniques, and inadequate solutions to the experimental approach to reversible data integrated schemes is over-specified. This article would also promote work to enhance the efficiency of work in reversible data integration schemes in relation to its efficiency and payload power.

REFERENCES

[1] S. MAITI, M.P. SINGH: *A noble reversible data embedding method for source authentication and tamper detection of H. 264/AVC video*, International Conference on Emerging Trends in Networks and Computer Communications (ETNCC), Udaipur, 2011, 459-462. doi: 10.1109/ETNCC.2011.6255881

[2] P. RAHMANI, G. DASTGHAIBYFARD, E. RAHMANI: *A reversible data embedding scheme based on search order coding for VQ index tables*,8th International ISC Conference on Information Security and Cryptology, Mashhad, 2011, 79-82. doi: 10.1109/ISCISC.2011.6062332

[3] J. TIAN: *High capacity reversible data embedding and content authentication*, IEEE International Conference on Acoustics, Speech, and Signal Processing, 2003. Proceedings. (ICASSP '03)., Hong Kong, 2003, pp. III-517. doi: 10.1109/ICASSP.2003.1199525

[4] H.J. KIM, V. SACHNEV, Y.Q. SHI, J. NAM, H.-G. CHOO: *A novel difference expansion transform for reversible data embedding*, IEEE Transactions on Information Forensics and Security, **3**(3) (2008), 456-465. doi: 10.1109/TIFS.2008.924600

[5] U.T. TILAKARATNE, U.A.J. PINIDIYAARACHCHI: *Image steganography scheme based on reversible data embedding strategy*, 8th International Conference on Computer Science & Education, Colombo, 2013, 503-507. doi: 10.1109/ICCSE.2013.6553962

[6] Z.-H. WANG, C.-C. CHANG, Y.-H. CHEN, M.-C. LI: *High Payload Reversible Data Embedding Scheme Suitable for VQ Compressed Smooth Images Using Index Lookup*, 2nd International Conference on Computer Science and its Applications, Jeju, Korea (South), 2009, 1-4. doi: 10.1109/CSA.2009.5404237

[7] J. TIAN: *Reversible data embedding using a difference expansion*, IEEE Transactions on Circuits and Systems for Video Technology, **13**(8) (2003), 890-896. Aug. 2003, doi: 10.1109/TCSVT.2003.815962

[8] S.D. LIN, H.-C. MENG, Y.-L. SU: *A novel error resilience using reversible data embedding in H. 264/AVC*, 6th International Conference on Information, Communications & Signal Processing, Singapore, 2007, 1-5. doi: 10.1109/ICICS.2007.4449605

[9] S.D. LIN, H.-C. MENG, J.-Y. HUANG: *An error resilient technique using reversible data embedding in H.264/AVC*, 3rd International Conference on Innovative Computing Information and Control, Dalian, Liaoning, 2008, 26-26. doi: 10.1109/ICICIC.2008.137

[10] M.S. ABDUL KARIM, K. WONG: *Defining redundancy in Histogram of any signal for reversible data embedding*, International Symposium on Intelligent Signal Processing and Communication Systems (ISPACS), Kuching, 2014, 265-270. doi: 10.1109/ISPACS.2014.7024465

DEPARTMENT OF INFORMATION TECHNOLOGY
SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES (DEEMED TO BE UNIVERSITY)
CHENNAI, TAMIL NADU, INDIA.
E-mail address: charlyn.latha@gmail.com

DEPARTMENT OF ELECTRONICS AND COMMUNICATION SYSTEMS
KARPAGAM ACADEMY OF HIGHER EDUCATION (DEEMED TO BE UNIVERSITY)
COIMBATORE, TAMILNADU, INDIA.
E-mail address: sairabanu.ecs@gmail.com

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES (AUTONOMOUS)
RAJAMPET, ANDHRA PRADESH, INDIA.
E-mail address: vtkarthi18@gmail.com

RESEARCH AND DEVELOPMENT
ICT ACADEMY
INDIA.
E-mail address: YRAJ1989@gmail.com