Analytical Study of Hybrid Techniques for Image Compression and Decompression

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Abstract- Due to its ability to facilitate cloud-based medical and diagnostic data interchange, telemedicine has grown in importance among healthcare facilities, hospitals, and research organizations. Transmitting medical data over channels with constrained bandwidth might be laborious due to the volume of data generated by IoT. Thus, before being transmitted, information needs to be compressed. Currently available techniques compress data greatly, however the resulting restored data quality is very poor. It is crucial to achieve the appropriate quality because images and data are crucial for clinical and diagnostic purposes. In order to preserve both the efficiency of the compression and the desired quality of the returned information, this work aims to provide a hybrid medical information compression technique. This work attempts to demonstrate the value of the hybrid medical image compression method for raising the standard of the medical image while simultaneously offering effective compression ratios. Both the increased security of asymmetric algorithms and the speed and simplicity of symmetric algorithms are incorporated into the hybrid approach.

Keywords: Hybrid Compression, Medical Image, Lossy Compression, Lossless Compression

1.INTRODUCTION

Medical image compression is unavoidable due to large amount of storage space or high bandwidth for communication in its original form. The technique of image compression involves lowering the digital image's file size while maintaining the highest level of visual quality. This is necessary for the effective processing, transmission, and storage of images [8]. Researches are becoming more aware of the need for compression strategies that can lower the number of model parameters and their resource consumption. Three types of information can be found in an image: valuable, redundant, and relevant. Reduced data redundancy is achieved by using the compression approach. In digital image compression, there are three types of data redundancy: psychovisual redundancy, interpixel redundancy, or spatial redundancy, and coding redundancy. Based on the information content of the reconstructed image, image compression technique can be classified into lossy compression, which has a high compression ratio but results in significant data loss, and lossless compression, which preserves the original image exactly but has a very low compression ratio. For small-size data, lossless picture compression algorithms are particularly effective [11]. The benefit of employing compression to speed up website or application loading times and conserve storage space. Because of the reduced bandwidth usage, online activities run more smoothly [12]. In this paper we are focusing on the hybrid algorithms that is the combination of two or more algorithms. With this method, by combining lossy and lossless compression methods, you can achieve a high compression ratio without sacrificing the quality of the reconstructed image.

2. PROCESS OF IMAGE COMPRESSION

Encoder and decoder are the two main components of a common image compression model. Both the encoder and the decoder carry out compression and decompression, respectively. Encoding and decoding are tasks performed by coders. The encoder receives the input image and converts it into a compressed form. A reconstructed image is produced when the compressed representation is fed through to its matching decoder. The mapper eliminates interpixel redundancy by transforming the input image into a Predetermined format. The information in the rebuilt image is identical to that of the original due to the reversible nature of this technique. The quantizer reduces redundancy in psycho-visual data. The quantization procedure is applied to the stage prior results using this technique. Because of its irreversible nature, certain information in the rebuilt image differs from that in the original. The function of the symbol encoder is to map quantizer outputs into codes and to construct codes that represent those outputs. As a result, the output is reversible and able to eliminate unnecessary data. The figure 1 shows that the working model of the image compression technique.

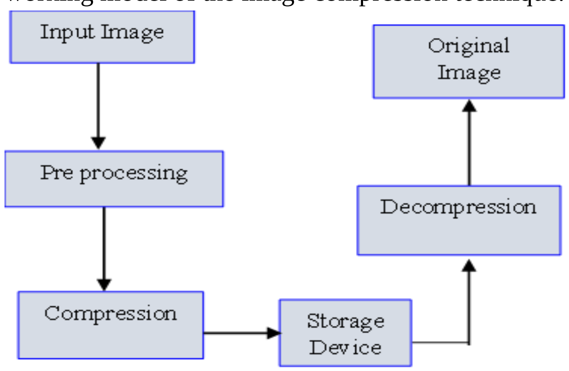

Figure 1: Stages of Image Compression

3. PROCESS OF HYBRID IMAGE COMPRESSION

A hybrid compression approach is a method of combining one or more compression techniques to optimize the image compression and decompression process, increase the speed and get the greatest possible compression ratio and improve image quality. The goal of this combination is to maximize the benefits of each compression technique. The different stages of hybrid compression technique as illustrated in Figure 2.

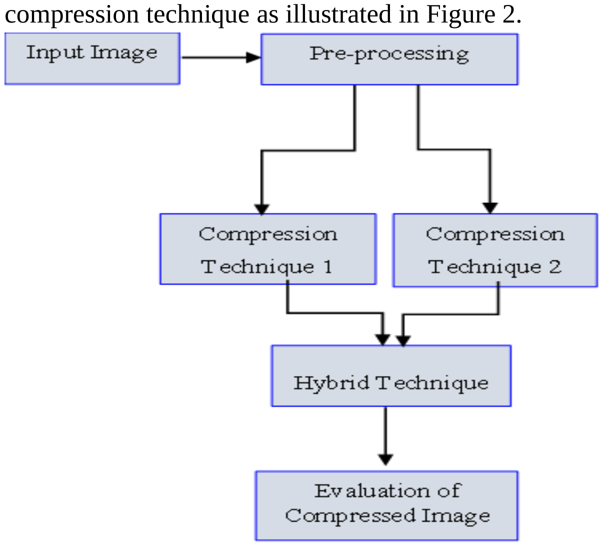

Figure 2: Stages of Hybrid Compression Technique

4. LITERATURE REVIEW

The article [1] focuses on conservation Patient data through improved security and optimized storage of big data images and also provides greater data protection without compromise Image quality. To improve the quality of the reconstructed image, Discrete Wavelet Transform (DWT), a hybrid compression technique based on Discrete Cosine Transform (DCT), is applied. To provide even more compression, entropy encoding methods like Huffman coding are used after these techniques. Because Huffman coding can be implemented more quickly, simply, and easily than other codes, it is the best prefix code [2] [14]. In paper [3], a novel image compression technique utilizing wavelet VQ and a recurrent neural network is presented, known as the GenPSOWVQ approach and the experimental results indicated that the proposed method achieves Higher PSNR SSIMM values than existing methods. The patient's fingerprint is utilized as a watermark to improve verification, identify the original medical image, and protect the patient's privacy. This approach amplifies the watermarking algorithm by using lifting wavelet transform (LWT) and discrete wavelet transform (DWT). To improve fingerprint watermarking and medical picture imperceptibility, respectively, the scaling and embedding factors are adaptively generated using the host medical image's Local Binary Pattern values [4]. One of the most significant and helpful methods for studying illnesses is multimodal medical image fusion, which gathers complimentary information from many multimodality medical images. To achieve better outcomes, hybrid picture fusion is suggested. Medical image fusion is typically accomplished using DTCWT and NSCT in [5]. The paper [6] introduced the L2-LBG method, a VQ codebook creation technique that makes use of the Lempel Ziv Markov chain Algorithm (LZMA) and the Lion optimization algorithm (LOA). After LOA created the codebook, LZMA was used to further improve LOA's compression performance by compressing the index table. To eliminate irrelevant data in a medical image, the author [8] proposed hybrid DCT-DWT based ROI medical image compression for telemedicine application. A novel lossless image compression algorithm is proposed, which uses both wavelet and fractional transforms for image compression. An image is split into low- and high-frequency sub-bands by using Daubechies wavelet filter [9]. Analyzing various image compression algorithms and their improvements by using various techniques [10[11]. [12] introduced a hybrid SVD-DCT approach that shows how to use this algorithm for the color images compression without additional cost in computation, space and time. A hybrid approach of image compression using Singular value decomposition (SVD) and Set Partition in Hierarchical Trees (SPIHT) is proposed in [13] and also SPIHT delivers better image quality with more compression than SVD, which offers worse image quality with higher compression rates. A paradigm for image compression backdoor attack with several triggers is presented in [15].

5. ANALYSIS OF RELATED WORK

This section provides a detailed discussion of the current hybrid algorithms that use different lossy and lossless image compression techniques. We have defined such general and algorithm-specific recommendations to enable a comparative analysis of all the various approaches that have been further integrated. As Table 1 illustrates, the development of the hybrid compression technique is categorized according to the analytical evaluation of the journals.

Ref. No	Hybrid Method	Advantages	Disadvantages
[1]	DWT+ Knight Tour	Improve compress ratio	Memory Requirement is higher
[2]	DCT + DWT	Color image is applied	Improve the image quality
[3]	Gen PSO + Wavelet VQ	Achieves high performance	Dynamic sample is not explained
[4]	LWT + DWT + LBP	Achieved excellent results in terms of robustness and variety recognition	Need security process for medical image attacks.
[5]	NSCT + DTCWT	better visual image and lower compression ratio	Storage Optimization is not considered
[6]	LOA + LZMA	Achieved excellent compression efficiency with high reconstructed image quality	Real time implementation is not presented
[7]	AES + JPEGLS	enables picture tracing and reliability control for image integrity and authenticity	Reducing the algorithm complexity
[8]	DCT + DWT + ROI	Multi resolution and superior data compaction properties are used	Segmentation can be automatically performed to identify ROI part.
[9]	DWT + DFrFT	solved the problem of computation and high protection.	Speed is Low
[12]	DCTBT + DCTVQ	Performance is evaluated with correlation coefficient	Not suitable for multiple images
[13]	SVD + DCT	Better quality output with high compress rate	Required more space
[14]	DCT + DWT	Moving image can be compress	Need high band width
[15]	DCT + Adaptive Frequency Trigger	A backdoor attack can be protected	Extend for audio and video files

Table 1: Classifications of hybrid compression technique

6. CONCLUSION

Creating an efficient compression technique for medical images was the main goal of this work. Based on the study, it can be inferred that the hybrid strategy yielded superior outcomes in terms of enhanced PSNR, CR, Time, and MSE, as well as reduced memory requirements for medical systems. Medical images that have been compressed require less memory, which saves storage space and allows for speedier transfer between centers with lower bandwidth. Finally, post-processing methods can be used to further improve the perceived quality of medical images.

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