

# A REVIEW: ASSESSMENT OF THE PERFORMANCE OF VARIOUS IMAGE COMPRESSORS FOR RADIOGRAPHIC IMAGES

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**Abstract**—Modern Digital world is mainly concerned with storage space and bandwidth utilization. Digital images requires huge amount of storage space in uncompressed form and require large bandwidth for transmission over the network. As a result of growing demand for effective utilization of storage space and bandwidth many efficient image compression techniques were developed. The Internal details of an opaque body can be obtained by using electromagnetic radiations like X-rays other than visible light and images obtained by this way are called Radiographic images. In this paper a comprehensive survey of performance of various image compression software are presented and performance is evaluated based on Compression Ratio (CR), Relative Data redundancy and Compression Ratio per byte and Entropy. Based on the experimental results, PAQ8pxd method has a good performance when compared with other image compression software.

**Keyword**:-Compression Ratio, Entropy, PAQ8pxd, WinZip, WinRAR, Context Tree Weighting (CTW), Relative Data redundancy.

## I. INTRODUCTION

Compression is a process of reducing the storage space, processing time and transmission time required for information by subjecting it to some modification. Image compression is reducing storage space of image by removing irrelevant and redundant data. Image compression should be performed with the capability of providing image reconstruction. The content of the image data is one factor that determines the amount of compression. A photographic image can be compressed to 80% without any degradation in quality.

Image compression [17] techniques are divided into two kinds, lossless and lossy compression techniques. Original information can be retrieved from the compressed data without any loss by using Lossless image compression techniques. It is very useful in the cases when original data and decompressed data should look similar. Arithmetic coding, Run length encoding, Huffman coding, LZW coding are some of the lossless compression techniques. Whereas in a Lossy compression the original information of the data is lost to some extent, so an approximation of original image can only be reconstructed. Lossy compression [18] is useful for applications which are not very concerned about some loss of data. Compression ratio of lossy compression is more when compared with lossless compression. Some of the lossy compression techniques are Discrete Wavelet Transform (DWT), Discrete Cosine Transform (DCT) and Discrete Fourier Transform (DFT).

## II. LITERATURE SURVEY

Chen et al [3] proposed a Game playing approach to analyze the Password Based Key Generation algorithm, which is the core for the security of the WinRAR mechanism. The paper explains the security of the WinRAR encrypted file using a theoretical derivation. Using GPU-Based exhaustive password search attacks, the paper concludes that if the password length is greater than 6 characters, then better security can be achieved.

WinZip is compression software, which also has encryption feature, belonging to computers with Microsoft Windows. Kohno et al [4] proposed a paper which exhibits several attacks against the WinZip security. It also discusses security alternatives. It is mainly concerned with the subtleties in designing a secure cryptographic algorithm.

Neill et al [7] using context tree weighting method proposed Adaptive Context Tree Weighting (ACTW) algorithm which is its extended version. In this algorithm more weights are given to recent observations unlike giving equal weights to all observations in order to improve performance. Experimental results obtained using merged files reveal that Adaptive context tree weighting algorithm has better performance over normal Context Tree weighting algorithm. When WinRAR software is used, it creates a temporary folder which associates with specific users. Geoffrey Fellows et al [1] proposed that these temporary folders help forensic analysts to provide evidence for the files that have been viewed from the WinRAR archive. Such evidence will be very useful when user denies that the files were not accessed by him.

WinRAR software furnishes encryption along with compression. Yeo et al [2] presented a paper which highlights on several attacks on encryption facility provided by WinRAR. These attacks mainly focused on that the flaws in the development of a secure algorithm based on the integration of various cryptographic primitives. The paper finally concluded that WinRAR is more reliable compared to WinZip, in terms of the number of security features.

Nicklas et al [5] proposed a method for lossless image compression for medical gray scale images using context tree weighting (CTW) [19] algorithm. This algorithm in its normal form can be applied to image compression and by making small modifications to algorithm it can be applied to image data. Magnetic flux leakage (MFL) technique is an effective method for the evaluation of pipelines. Cheng et al [6] proposed a lossless compression algorithm for compressing large size MFL data using Context tree weighting method in order to regain MFL data without any distortion.

Wang et al [8] proposed a method in which related weights of confined features are added in both spatial and descriptor domain and this method is useful to retrieve images from database which contains large number of images. With very small computational overhead power of individual local features can be improved. Experimental results from benchmark tests show this method has greater performance with less computation and retrieval accuracy.

Stephen et al [9] made a comparative study of lossless and lossy radiography image compression and presented the challenges of using lossy methods for medical records by explaining fundamental concepts of radiologic imaging and then made a detailed study of current compression technique in the field of medical imaging and discussed regulatory policies and legal questions facing the use of compression in this field.

Khafaji et al [10] proposed an image compression scheme based on locally changing image characteristic. Derived from this information an image is divided into blocks and then using polynomial approximation the image is decomposed into less compressed data. Finally performance rate is improved by Huffman encoding.

Ferragina et al [11] investigated on where to use compression for web pages and found two appropriate situations. In the first situation fast scanning of compressed images stored on disk is to be supported. Second situation is concerned with access to stand alone pages of compressed data which are scattered among random access memory of many computers. Experimental results reveal that web pages have crossed the expectation level of compression.

Kohno et al [12] did detail study on the strength of WinZip by subjecting WinZip new encryption method dubbed Advanced Encryption, Version two, to several attacks and then various alternatives are discussed. At a higher level WinZip encryption method is secure.

Nowadays image compression has been one of the important factors in the field of communication. As a result a number of image compression techniques have evolved. Chew et al [13] presented a review on popular image compression techniques. With the experimental results it was found that compression ratio was very high for Set-partitioning in Hierarchical Tree wavelet based image compression.

Transmission of medical images is very difficult because of their large sizes particularly in the field of teleradiology and communication systems. In order to make the transmission easier compression is essential. Usually region of importance is only needed in medical images. Hence Oyeleke et al [14] proposed a hybrid data compression on diagnostic accuracy. In this Region of Importance from the original image is extracted and it is compressed using lossless Wavelet Based Compression and the remaining parts of the image are compressed using Discrete cosine transform. A compression ratio of 7:1 was achieved and it has 100% acceptance compressed region of importance for healthy diagnosis.

Wood et al [15] published an article in which sequence memorizer is used for general purpose lossless compression. Sequence memorizer provides a high level description of a general probabilistic model for discrete sequence data. The result shows significant improvement over commonly used general purpose compressors.

In this age of technology need for compression has gained gravity. So a number of image compression techniques and more number of hybrid image compression techniques have unfolded in the recent years. Rehna et al [16] published a paper which discusses various hybrid approaches to image compression. Hybrid techniques refer to combining two or more traditional approaches to increase the quality of individual methods and to achieve good results. A Neuro-wavelet approach for enhancing coding efficiency is highlighted.

### III. EXPERIMENTAL RESULTS

In this paper comparative analysis of some of the significant image compression software PAQ8pxd\_v5, WinRAR, WinZip, and CTW is done. Research is done on some standard Radiographic images [20] in order to evaluate the performance of different software.

WinZip and WinRAR are the two most popular file compression software for windows based operating systems. These software's are not only compresses the information but also provide a high level of security to confidential information. Owing to the fact that these software are efficient and popular they are most widely

used for compression. Due to the encryption techniques incorporated into them users tend to use these instead of using two separate software's for encryption and compression.

The different compression algorithms are compared on certain performance measures. In this paper algorithms are compared on compression ratio (CR), Relative Data Redundancy (RDR), Entropy. The standard ratio of number of bits required to represent original image ( $n_1$ ) to compressed image ( $n_2$ ) is called Compression ratio.

$$CR = \frac{n_1}{n_2} \quad (1)$$

Entropy is the statistical measure of uncertainty that can be used to illustrate the consistency of input image. RDR is the amount of wasted space used to transmit the data.

$$RDR = 1 - \frac{1}{CR} \quad (2)$$

Where CR represents compression ratio which can be calculated by using equation 1.

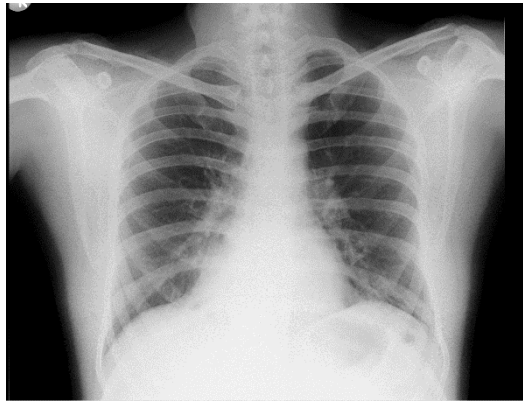


Fig 1. Example of sample radiographic image1



Fig. 2. Example of sample radiographic image2

TABLE 1. Uncompressed image size with different compressor performance

Images	Uncompressed(KB)	WinZip(KB)	PAQpxd_v5(KB)	WinRAR(KB)	CTW(KB)
1	219.14	48.59	28.51	47.20	32.97
2	314.65	187.78	136.69	176.05	140.91
3	673.64	211.55	132.48	199.04	140.28
4	1628.46	1541.61	1367.21	1528.07	1518.92
5	12782.93	783.09	376.86	857.07	593.23

TABLE 2. Uncompressed images entropy VS different software images entropy

Images	Entropy for initial image	Entropy for WinZip	Entropy for PAQpxd_v5	Entropy for WinRAR	Entropy for CTW
1	4.4968	1.77	1.04	1.72	1.2
2	6.1535	4.77	3.48	4.48	3.58
3	5.9141	2.51	1.57	2.36	1.67
4	2.9611	7.57	6.72	7.51	7.46
5	3.7085	0.49	0.24	0.54	0.37

TABLE 3. Performance comparison of different parameters for PAQ8pxd and WinZip

Images	PAQ8pxd			WinZip		
	CR	RDR (%)	CR per Byte	CR	RDR (%)	CR per Byte
1	7.69	86.99	1.04	4.51	77.83	1.77
2	2.30	56.56	3.47	1.68	40.32	4.77
3	5.08	80.33	1.57	3.18	68.60	2.51
4	1.19	16.04	6.72	1.06	5.33	7.57
5	33.92	97.05	0.24	16.32	93.87	0.49
6	33.79	97.04	0.24	16.88	94.07	0.47

#### IV. CONCLUSION

In this paper detailed survey on the most significant image compression software's is presented. Any image compressor software has its own merits and demerits; it is observed from the results that PAQ8pxd shows a better performance when compared to the other software's like WinZip, WinRAR, and CTW. The performance measure is accomplished by performance criteria i.e., Compression Ratio, Relative Data Redundancy, Entropy. PAQ8pxd has a high compression ratio.

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