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Subject Review : Various Techniques for Image Compression

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ABSTRACT

Due to the quick development of multimedia technology, now can see the increasing amount of multimedia data that is being generated or transmitted over the internet. digital image is one form of multimedia data, that can take different formats and different sizes. And here comes the main objective of image compression in transmitting or storing the data in an effective manner by decreasing the redundant or irrelevant information without significant loss of visual quality in image data. Compression of the images is utilized in various services, including TV broadcasts, satellite imagery, martial communications, webinars, medical imaging, weather reporting, etc. This paper provides a survey of the main techniques in image compression, covering both lossy & lossless approaches. The techniques that depend on lossy compression lose some of the image details during compression, while lossless compression techniques keep the image information without losing. Vector and scalar Quantization, transform coding, block truncation Coding, etc. are all examples of lossy approaches. Run length coding, entropy encoding, statistical coding, etc. are all examples of lossless techniques. This paper will assist the researchers in learning about these techniques and choosing appropriate techniques for their work.

Keywords: Image compression, redundancy, lossy, lossless, Soft computing, ANN, FL, GA.

I. INTRODUCTION

The image is a 2-dimensional signal that has been translated from its original analog into digital form for processing, storing, and transmission. A substantial portion of data is made up of various image kinds, which is essential in the domains of biomedicine and remote sensing, etc [1].

Media communication and Social networking sites have increased data sharing and transfer, requiring a lot of bandwidth and storage space. In contrast, media compression algorithms are tailored to certain media types such as such as image, audio, and video files.

Uncompressed images will take longer to transmit and use more bandwidth, but if they are compressed before being stored and sent, their size may be proportionate to the amount of compression used.

Image compression techniques reduce file size, and that will minimize storage space and bandwidth requirements, enabling faster image transmission. Image compression trying to reconstruct the image in less bits as possible while preserving crucial information of image [2] [3].

Digital images are pixel arrays with redundant bits. Compression algorithms remove these bits, reducing image size and removing irrelevant data. Redundancy reduction removes extra bits, while irrelevant reduction omits less important information. Data redundancy may be classified into three form [4]:

1) Psycho Visual Redundancy or Irrelevant Information Redundancy

The principles of human vision serve as the foundation for psycho visual redundancy. The sensitivity of a human eye's response to all visual input is vary. Certain elements of information are deemed less important [3]. So removing some of the less critical information from our visual processing may suffice [5].

2) Spatial Redundancy or Inter-pixel Redundancy

Nearby pixels in an image are correlated strongly by each other. the value of every given pixel may be inferred from the values of its nearby pixels. so the correlated pixels representations duplicate information without needing to. The redundancy can be decreased and this prediction is comparably less relevant when employing a single pixel. wavelets method can be used for this type of redundancy [3].

3) Coding Redundancy

The set of symbols that represent information is known as code. Each piece of information is assigned a code word, that is a group of symbols. the length of code word is determining by its amount of symbols. in mostly, 2-D arrays use 8-bit codes for expressing the intensities, despite these codes frequently use more bits than necessary. Huffman-coding can help to reduce this type of duplication [6].

This paper reviews and lists widely used image compression algorithms based on lossy and lossless techniques. The goal is to provide the best guidance for choosing a suitable image compression method for the current challenges.

This paper is organized as follows. Under Section II (**Some Types of Image Formats**), I'll show different types of image formats. In Section III (**Compression System Model**), I'll explain the parts of a compression system model. in Section IV (**Some of the Performance Metrics in Image Compression**) part of the performance metrics will illustrate, in Section V (**Image Compression Techniques**), I'll give a review of different approaches in image compression, in Section VI (**Conclusion**) illustrated the conclusion from the audit work.

II. SOME TYPES OF IMAGE FORMATS

A. Lossy image format

1) JPEG (Joint-Photographic-Expert-Group)

JPEG is a lossy compression technique used in multimedia, photographic and imaging sectors for storing 24-bit color images or 8-bit grayscale images and it is more advanced than other formats. Its unique feature is its adjustable compression rate, allowing for better quality with smaller image sizes and verse versa. it is the primary format for internet image storage and transmission.

- **JPEG 2000 (Joint Photographic Experts Group 2000)**

JPEG 2000 is an image compression standard based on a wavelet, evolved to replace JPEG's discrete cosine transform. It offers superior compression ratios and lacks uniform blocks, but generally results in blurred images.

B. Lossless image format

1) GIF (Graphics-Interchange-Format)

GIF is a lossless compression format used for saving grayscale images. It can able to handle 256 colors or 8 bits. logos, basic drawings, and images in a cartoon style may be stored in GIF format.

2) TIFF (Tagged-Image-File-Format)

It is an elastic and lossless compression format, widely used for storing high-color depth images, line art, and photographs. TIFF files are not utilized for online transmission since they need a big file size. TIFF is widely supported by image-processing software, as well as scanning, word editing, and other applications.

3) PNG (Portable-Network-Graphics)

PNG is a lossless compression format; it design to replaces GIF format. PNG has less size and supports more colors than other formats, 8 and 24-bit of grayscale and RGB images are supported by this format. It employs the DEFLATE algorithm which is a combination of Huffman coding and LZ77. PNG is intended for internet image distribution, not qualified graphics.

4) BMP (Bitmap)

BMP is a large, uncompressed graphic file used in Windows programming, containing binary images and lacking true color support [4] [5].

III. COMPRESSION SYSTEM MODEL

The system model of image compression consists of two components:

The compressor part is divided into four stages (pre-processing, mapping, quantization, and encoding). pre-processing is the initial step which also mean Data reduction. The data of image reduced by spatial quantization or/and grey level, or other desirable enhancement (e.g. noise reduction). The 2nd stage is the mapping technique, which converts the data of original into different mathematical space where compression is easier. next step is quantization, which converts possibly continuous data from mapping stage into discrete data. Coding the generated data is the last step in the encoding process. The phases of the compression method may all be present, or they may only be present in one or two instances.

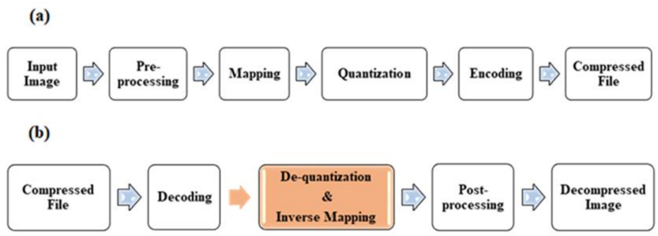

Figure 1 : Compression system model
(a) Compressor. (b) Decompressor [5] [7]

IV. SOME OF THE PERFORMANCE METRICS IN IMAGE COMPRESSION

The efficiency of image compression techniques may be measured using a variety of metrics such as: -

1) CR (Compression Ratio)

The compression ratio is the ratio of the uncompressed image (original) to the size of the compressed image.[8]

$$CR = \frac{I_2}{I_1} \qquad \text{------ -(1)}$$

Where I_2 represent the original image and I_1 represents the image that was compressed [8].

2) MSE (Mean Square Error) and Root Mean Square Error (RMSE)

Mean Square Error (MSE) is the overall difference between the uncompressed image (original) and the compressed image. small value of MSE means lower error and good image quality [4].

$$MSE = \frac{1}{M \times N} \sum_{i=0}^{M-1} \sum_{j=0}^{N-1} [I_1(i,j) - I_2(i,j)]^2$$

----(2) [8]

Root mean square error is a superior quantification of accuracy [9] and expressed by: -

$$RMSE = \sqrt{MSE} \qquad \text{--------(3)} \quad [9]$$

3) PSNR (Peak Signal to Noise Ratio)

PSNR is used to calculate the peak error between the original image and compressed image. Better image quality is contained in larger PSNR values [4].

$$PSNR = 10 \log_{10} \left[\frac{255^2}{MSE}\right] \quad \text{----(4)[8]}$$

V. IAMGE COMPRESSION TECHNIQUES

There are two types of image compression techniques: lossy and lossless [10].

A. Lossy Compression Techniques

Lossy compression eliminates redundant pixel information, causing the original data is not precisely retrieved. They are commonly used for photographs and multimedia data but not text-based documents.
This technique is useful for compressing small files, reducing time and making them easy use in internet applications and easy to move and store. The compression ratio is larger with this method than with the lossless method. but rebuilding is an approximation of the original data, with minimal data loss.
The primary drawback of Lossy Compression methods is that they do not enable image modification. Because of the poor resolution and quality of the processed images, printing them may not produce the best results [3].
The following is a list of some techniques that use lossy compression:

1) Vector Quantization (VQ)

The LBG-VQ algorithm for dividing large vectors into groups, encoding values into a lower-dimensional subspace, reducing storage space and compressing data for voice and images [3]. Vector quantization involves three steps: encoder, channel, and decoder . The encoder section generates image vectors, codebook generation, and indexing, while the channel transmits indexed numbers to the receiver.

The decoder section decodes the received indexed numbers, assigning them to corresponding codewords, ensuring the reconstructed image size matches the input image [11]. Figure 2. Show the steps of VQ.

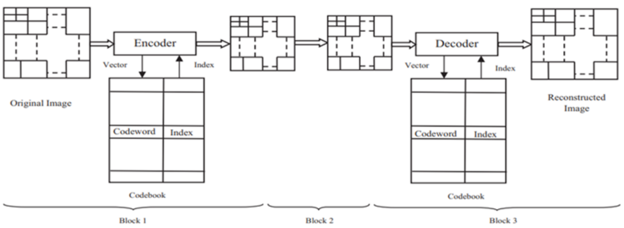

Figure 2: vector quantization [11].

2) Scalar Quantization (SQ)

Scalar quantization is the process of using a quantization function Q, for mapping x scalar input value to Y scalar output value, which is written as: -

$Y = Q(x)$

It could be simple and intuitive, like rounding large values to nearest integer or double [12].

3) Transform Coding

Transform Coding algorithm partitions image into smaller blocks then obtains transform coefficients for each block using (DCT, DWT) Which are examples of transform coding. The resulting coefficients are then calculated by utilizing quantization techniques, and the quantizer output is used to generate the output using a symbol encoding strategy. At the decoder, the process is reversed, and the image is reconstructed [4].

a) Discrete Cosine Transform (DCT)

DCT compresses image and audio files by summating cosine waves at different frequencies.

b) Discrete Wavelet Transform (DWT)

DWT characterizes images as sum of wavelet-functions with dissimilar scale and location, DWT applied on blocks using hierarchical filter structure [3].

4) Block Truncation Coding (BTC)

separated the image into non-overlapping blocks, with determining the mean or threshold and the values of reconstruction for each block. A bitmap is formed by replacement pixels with zero or one depending on threshold, and the reconstruction value for each segment is determined as the average of related pixels in the original block [1]. Larger blocks increase compression, but quality decreases [10].

5) Fractal Coding

This technique converts image segments into fractal codes, resembling other segments, enabling resolution-independent image reconstruction (without loss of quality) [3] [10].

6) Sub Band Coding (SBC)

Sub band coding analyzes images for frequencies in different bands, divides frequency range into sub-bands, codes each with coder and bit rate, allowing variable bit assignment between sub-bands as well as coding error containment within sub-bands. Unstamped sub-band signals are routed through synthesis filters before summed at the decoder [1] [10].

7) Singular Value Decomposition (SVD)

SVD is a data reduction approach, it is a matrix factorization that allowing for the extraction of algebraic and geometric information from images. SVD seeks the best approximation of original data points in the smallest dimensions [10].

B. Lossless Compression Techniques

Lossless compression techniques reconstruct images as similar as the original. It can only provide a restricted degree of compression. Lossless compression is a technique used for compressing large-size files, such as graphic images, medical images, and computer data files. It allows for accurate data restoration and high-quality retrieval of original images. However, it also has drawback such as low compression ratio, high transfer time, and difficulty in decoding images to recover original images after transmission [10].

The following is a list of techniques that use lossless compression:

1) Run Length Encoding (RLE)

RLE is the most basic image compression approach. It replaces the original data with a pair of (value, length) values. The value is one-of-a-kind, and the length shows the number of times it has been repeated. It stores compressed data in smaller chunks for easier retrieval and it known as runs. Runs are patterns where the same data value appears in multiple items in a row, preserving them as a single data value and count instead of original run [10].

It is a frequently used compression method in fax. For example: a grayscale image Run is expressed as $\{V_i . L_i\}$, in which V_i is pixel intensity and L_i is the length, as shown in figure 3. This is especially helpful only for large file, such as basic visual graphics like icons, line drawings, and animations [12].

75	75	75	80	80	80	80	64	64	64

{75,3}	{80,4}	{64,3}

Figure 2: Run Length Encoding [12].

2) Entropy Encoding

Entropy Encoding generates and assigns a distinctive prefix-free code to every unique symbol in the input, and replacing every fixed length input symbol of image with the appropriate variable length prefix free output code word [12].

3) Statistical Coding

It involves the following techniques: -

a) Huffman Encoding

By deleting unnecessary information, Huffman coding may lower file size from 10% to 50%. A variable-length code table (Code Book) is use for encoding an original symbol. The image pixels are considered symbols. Symbols which appear repeatedly are allocated less bits, and symbols which appear less repeatedly are assigned more bits. To encode an images, first divide it into (8×8) blocks, then code every block with certain symbols, then apply the Huffman code to each block, and finally encode all of the blocks. This code is used for image, video and text compression [3] [4] [10].

b) Arithmetic Encoding

Instead of coding each symbol individually, this method codes the entire visual sequence using single code. As a consequence, the connection of neighbouring pixels is used. Arithmetic coding is governed by the following concept: -

- The symbol alphabet is finite.
- all possible symbol sequences are not infinite.
- any given input sequence of symbols may be assigned a unique subinterval based on the real values in the range [0,1].

c) LZW Encoding

LZW is a coding algorithm based on dictionary. Dictionary coding might be dynamic or static. The dictionary is stable in static dictionary coding during the encoding and decoding procedures. The dictionary is updated on the dynamic dictionary coding. this strategy is utilized for image of GIF format [12].

4) Predictive Coding

This method estimates the value of every pixel depending on the values of its neighbours. As a result, rather than its original value, each pixel is stored with a prediction error. When compared to the original value, these mistakes are far less, requiring fewer bits to store bits [3].

Table 1 shows a survey of different techniques based on lossy and lossless approaches.

TABLE 1. A survey of different techniques based on lossy and lossless approaches

Ref	year	TECHNIQUE\ Methodology	P (Parameters)\ PL (Programing language)\ MM (Performance METRICS)	Domain\ Data set	Result of Compression	Future work\ Cons
[13]	2010	duplication free-run length coding (DF-RLC)	**P**\ i=0, count =0, **PL**\ C++ **MM**\ CR	Standard grayscale images	the suggested technique achieves better compression ratios than existing RLC methods and does	**Future work**\ obtain better compression ratios using image statistics and implement rule-based

					not increase the image file size.	generative coding approach in various applications.
[14]	2011	Enhanced Run Length Encoding using (threshold value)	**P**\ i=0, j=0, C=0, TH=10 **PL**\ visual basic 6.0 **MM**\ CR	ten BMP 24-bit true color images	The new approach reduces image size better than traditional RLE	-
[15]	2013	Absolute-Moment Block-Truncation-Coding (AMBTC) + Clifford-Algebra	**P**\ 4 × 4 blocks size, integer numbers range from [15 to 0], $\alpha = 0.267$ **PL**\ - **MM**\ PNSR, Weighted PSNR, BR, SSIM	grayscale images of size 512 × 512	The suggested approach outperforms conventional BTC and AMBTC	-
[16]	2013	Wavelet-based-Contourlet-Transformation (WBCT) + scalar-quantization (SC) + Modified-Set-Partitioning-in-Hierarchical-Trees (MSPIHT)	**P**\ - **PL**\ - **MM**\ CR, Root MSE (RMSE), PNSR	(Pepper, Lena, Barbara) images	The suggested method (WBCT) surpasses wavelet-based scalar quantization in CR, PSNR, and RMSE.	**Future work**\ employ a better encoding technique
[17]	2013	Enhanced Run Length Coding	**P**\ CoeffNo = 0, Run = 0, Flag = 1 **PL**\ - **MM**\ CR, MSE	JPEG Image\ (cameraman) image	The suggested run length scheme gives effective outcomes.	-
[18]	2013	Modified arithmetic coding Using (Kullback–Leibler distance)	**P**\ - **PL**\ - **MM**\ bitrate (bpp),	12 grayscale images of size between 464×352 to 672×498 pixels	considerable improvements over standard arithmetic encoders, with bitrates reduced by an average of 15.5 and 16.4%, respectively.	-
[19]	2014	Predictive Coding + Bit Plane Slicing (BPS) + Run Length Coding (RLC)	**P**\ high order bit planes, block size of bit plane7 **PL**\ - **MM**\ CR	Natural and medical grayscale images of size 256×256	High system performance achieved with a greater compression ratio for lossless reconstruction.	-

[20]	2015	HAAR Wavelet Transform and Discrete Cosine Transform	**P**\ - **PL**\ MATLAB **MM**\ CR, MSE, PNSR, entropy, bits per pixel,	medical image (MRI/CT/DICOM)	The new techniques are enhanced to solve problems in previous studies.	**Future work**\ using various compression techniques and morphological operators on medical color images for improving results.
[21]	2016	Transform Coding	**P**\ - **PL**\ Matlab **MM**\ CR, MSE, PNSR	Images of (boy, mandrill, urban, bridge).255	The JPEG method effectively compresses photographic images with high CR, allowing users to choose between high-quality or small outputs.	-
[22]	2016	New Arithmetic Coding By dividing the image into blocks	**P**\ 64 x 64 block size **PL**\ - **MM**\ CR, Elapsed time(sec)	different format and size of gray scale medical images	the algorithm achieves high compression ratio 90%, the fast and easy recovery of image exactly without loss.	-
[23]	2017	LZW and Hybrid LZW Coding using (pre-processing, feature extracting)	**P**\ - **PL**\ MATLAB **MM**\ CR,	CASIA Iris (CASIA-Iris) Image Database	hybrid LZW coding has the best performance (getting high compression ratio and low cost) in comparing to (Huffman Encoding, LZW) methods	**Future work**\ improved the compression technique and utilize it for image of high-dimensional data such as fingerprint and palm print biometrics images.
[24]	2017	singular value decomposition (SVD)	**P**\ number of columns (k) **PL**\ R programming platform **MM**\ CR, MSE	image of size 700Kb	compression can be achieved by selecting an appropriate k value. SVD offers less computational complexity	**Cons**\ Because the compression process is sequential, scaling may be an issue in this strategy.

						Future work Enhanced cons by parallelizing the SVD computation for R, G, and B matrices.
[25]	2017	Block-Truncation Coding-with-two-different methods of color-feature-extraction	**P** - **PL** Matlab **MM** Precision and Recall**,** confusion matrix	Corel, dataset in JPEG format.	block truncation coding outperforms other approaches, show more precise values, reducing semantic gap and improving image indexing.	**-**
[26]	2017	Discrete Wavelet Transform And Discrete Cosine Transform	**P** - **PL** - **MM**CR, PNSR	Lena image with 256X256	Suggested approach show improved results in CR and PSNR criteria.	**Future work** To boost implementation speed, program and translate the model to hardware using the FPGA approach.
[27]	2017	PE-VQ (prediction error + vector quantization (VQ)) - genetic algorithms + artificial-bee-colony are used for codebook generation	**P\\ ANN** \\ no. input-neurons =3, Input-weights =30 × 32, Output-weights = 10×32, hidden-layer-Bias =10×32, no. of bytes for sending ANN parameters = 1225. **VQ** Max.no. bits for PE's=6, size of code word = 10,20,40,60,80, size of Codebook = 128,256,512 **PL** - **MM** CR , PSNR	Three databases (CLEF-med-2009 (DB1), Corel-1-k (DB2), typical images (DB3))	When compared to other algorithms like (IP-VQ, JPEG2000, SVD, and WDR), PE-VQ has shown the largest PSNR value.	-
[11]	2018	CS-LBG (vector quantization (VQ) + Cuckoo search (CS))	**P** Image size 4×4 . population size $n = 30$. iter $= 20$. mutation	5 grayscale image (Lena.jpg, Baboon.jpg, Pepper.png,	CS-LBG algorithm outperforms PSO-LBG, LBG, Quantum-PSO-	**Future work** Modify the proposed algorithm so Solve

		- Linde Buzo Gray (LBG) use for codebook design	probability Pa = 0.55. β = 2 **PL**\ MATLAB version 7.9.0 (R2009b). **MM**\ PSNR, average computation time	Barb.jpg, Goldhill.jpg)	LBG, FA-LBG, HBMO-LBG in terms of fitness and PSNR. Additionally, it contains fewer parameters.	convergence time. **Cons**\ CS-LBG algorithm slower than HBMO-LBG and FA-LBG algorithms in convergence by 1.425 times
[28]	2019	Discrete Wavelet Transform and Vector Quantization (DWT-VQ)	**P**\ n = 3, window size n × n **PL**\ - **MM**\CR, PNSR, MSE, RMSE, SSIM	Medical images (MRI, CT, Ultrasound)	the suggested strategy outperforms other existing approaches, and achieved best performance when two levels of DWT are applied before quantization.	**Future work**\ study improvement using a multiwavelet decomposition and physical filter design.
[29]	2019	Optimized Run Length Encoding (RLE) using (Orientation, automatic-thresholding, Sign-Change-and-Selective-Value-Count (SVC)) approaches	**P**\ flag, flag1, flag2=0, Counter=0 **PL**\ - **MM**\ CR	binary images of (document, lines vertical and horizontal, chessboard) in shap of portrait and landscape	Optimized RLE Algorithm achieves the best compression ratio in all scenarios	-
[30]	2019	context-adaptive entropy model	**P**\ N, M, patches= 256×256, λ ranging [0.01 to 0.5], training networks= 18, training iterations= 1M, initial learning rate to 5×10−5 **PL**\ Python **MM**\ MSE, MS-SSIM, bits per pixel (BPP), PSNR	Kodak PhotoCD dataset of PNG images	Proposed method outperforms traditional methods like (BPG and JPEG2000, previous ANNs, Balle) in PSNR/MS-SSIM index values.	**Future work**\ One way, generalize the distribution models that underpin the entropy model. Moreover, raising the degree of contexts
[31]	2019	Enhanced Run Length Encoding By implementation (elegant pairing function, discrete	**P**\ - **PL**\ MATLAB R2018a.	Medical MRI images	The suggested method achieve larger CR with no information loosing, resulting	**Future work**\ The proposed approach can be employed in future studies.

		wavelet transform, enhanced entropy coding)	**MM** CR, MSE,PSNR, SSIM, Execution Time		in more efficient medical diagnostics that is suitable for storage or transmission.	
[32]	2020	LZW + (Wavelet or DCT)	**P\\ DCT** Q_0 [10.20]. Q_1 [11.25] α [0.1, 0.4], B_1 {4.8.16} **P\\ WAVELET** N_{pass} [2.5]. Q_0 [2.8]. Q_1 [20.30]. α [0.5,1.2], β [1,1.5] **PL\\ -** **MM** CR, PSNR, time	7 color and gray image	The proposed techniques demonstrated high efficiency in improving compression while maintaining acceptable quality levels. CR for Color Lena is 20 and for gray is 12.4 and both have a PSNR of 32 dB.	**Future work** utilizing polynomial of higher order and quadtree for image compression
[33]	2021	LZW Hashing Ciphering Algorithm using (scalar quantization, S Shift Coding + huffman coding)	**P\\ -** **PL** VB6 **MM** CR, MSE, PSNR	color art digital images of size 256*256	Proposed approach preserves image quality, achieving high PSNR value in reconstructed images compared to current approaches	-
[34]	2021	Arithmetic Coding (AC) and with the using of (Discreet Cosine Transform (DCT), conversion to YCbCr color, quantization table, zigzag scan)	**P** N=8, k=0 **PL** MATLAB **MM** CR, MSE, PSNR, Time in sec	colored BMP images sized 512×512	The suggested technique shows a good CR with great image quality. CR increase by 1.14% when breaking an image into blocks, using DCT raises the ratio by 5.5%, employing DCT with a zig-zag scan shortens the compression process time.	**Future work** To get a larger compression ratio it may use wavelet transform or WalshHadamard transform.
[35]	2021	vector quantisation (VQ) and linear	**P\\ -** **PL\\ -** **MM** CR, PNSR	16 standard grayscale images	Proposed scheme significantly improves image	**Cons** as threshold value increase the

		regression prediction - (LBG) use for codebook design			compression ratio, reduces time consumption	PSNR value declines
[36]	2022	DISCRETE WAVELET TRANSFORM	**P** - **PL** MATLAB **MM** MSE, PNSR	sparrow colored RGB image with two-level haar wavelet	The resulting of the suggested approach in PSNR is 54.4 dB, and MSE is 0.23.	**Future work** Implementing the suggested approach on FPGA boards and comparing results with MATLAB enhances compression techniques
[37]	2022	run-length encoding for 3D	**P** D, S and O, $i.i_0.i_1.i_2 = 1$ **PL** - **MM** CR	Four datasets (abdominal CT, MRI-T2 (SPIR) sequence, MRI-T1 dual sequence, distributed random image)	the suggested approach outperforms previous state-of-the-art procedures by a factor of 1:30 on average.	**Future work** Examine the proposed approach on other types of dataset such as PET imaging

VI. CONCLUSION

Image compression is important tool in internet world. Image compression techniques that have been discussed in this study are organized into lossy and lossless. Some types that fall under each approach have been clarified and reviewed. Compression ratio (CR), PSNR, MSE, and computation time, is an efficient way to determine the efficiency of compression technique used. From all of these reviews in Table 1, we can conclude that each technique is useful in their related area and under specific parameters, so if we are concerned about the quality of the retrieved image (PSNR) we can use lossless techniques and if we are concerned about reducing the size (CR) we can use the lossy technique. The real challenge in today's world is to develop a mechanism to get that balance by achieving an image with less size (getting more CR value) while preserving the quality of that image (getting well PSNR value).

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