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COMPARATIVE STUDIES OF VARIOUS TECHNIQUES FOR IMAGE COMPRESSION ALGORITHM

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Abstract: With the increase of modern communications technology, there is a great need of data compression so that it will allocate less storage. This book provides an overview of compression–level principles, classes of compressions, various algorithm of compression. Well, compression of image is a solution to problems relating to digital image transmission and digital data storage. Image compression includes programs such as remote satellite viewing, television broadcasting and other long distance communications. Image storage is required for satellite images, medical images, documents and pictures. Image compression is essential for these types of applications.With the help of this article we will able to know the best method of selecting popular image compression algorithms based on criteria like Wavelet, JPEG / DCT, VQ, and Fractal Methods. Pros and cons of these compression algorithms are also being discussed .With a limited bandwidth the best way to utilize digital images effectively is make a need of compression techniques. Image compression is a technique for reconstructing the image in such a way that the quality of the original image is not effected.

Keywords: Image compression techniques, DCT, JPEG, VQ, Fractal, Wavelet, Genetic algorithm, Lossless and Lossy image Compression, Run Length encoding, Transform Coding

INTRODUCTION

As growing of media communication and video on demand is desired, image data compression has received an increasing interest. The primary purpose of image compression is to gain the low transmission speed and to have the high image quality of the expanded image. Image compression are used all fields of media communication such as multimedia, medical image recognition, digital image processing.The basic video compression technique is based on gray compression and color compression .Basically images which we take from camera are in analog form and to process, transmit it we have to convert it to digital format .Image is 2–D array of pixels. Basic image compression different from compression of digital data. We can use the compression algorithm for data compression, but the output is less than the optimal result. By removing some additional data we can achieve Compression. The two main components of compression are to eliminate redundancy and minimize irrelevance eliminating Redundancy aims to eliminate duplication of source signals (images / videos). Removing the part of signal which is not noticed by the receivers is considered as irrelevant like (HVS) which is called as reducing the irrelevance.

Uncompressed images load large files in storage media and takes a long time to transfer from one device to another .So if we want to transfer or save the digital image, we have to first compress it for faster transfer rate and use less space which increases the importance of compression.

PERFORMANCE PARAMETERS

There are various parameters present which are used to measure the performance of different compression algorithm. Most important performance parameters of image compression are given below:

a) Peak signal to noise ratio (PSNR): It is one of the most important performance parameter in image processing. Is been calculated by the peak error present between the original image and the compressed image. Higher PSNR is always preferred as it leads better quality of image.
b) Compression ratio: CR is a proportion of the size of the image compressed to the size of the original image. The compression ratio should be as high as possible for better compression.

Compressed ratio = uncompressed size/ compressed size

c) Mean square error: Mean Square Error (MSE) is the difference between original and compressed images. MSE should be as small as possible

TYPES OF COMPRESSION

Compression of images can be lossy or loslesss. Compression without losing weight is used for archival purposes and often for medical, painting, comic. This is because you lossy the compression method, especially when used, with little bit rates introduced with compression artifacts [1]. Higher compression ratio can be obtained if error is usually encountered that is difficult to detect, allowed between the expanded image and the original image. It is a loss of compression. In many cases it is not necessary or would like to create the original image without errors.

For example, if there are some disruptions, the error caused by the noise will be significantly reduced by some denoising methods. In this case, a small number of errors that are suggested by lossy compression might be optimal. Another use of lossy compression is the ability to send images online quickly over internet as we all know that the original file need more storage as compared to zip compressed file but it is also not true to compress image repeatedly lead to smallest in fact it usually lead to increase in size.

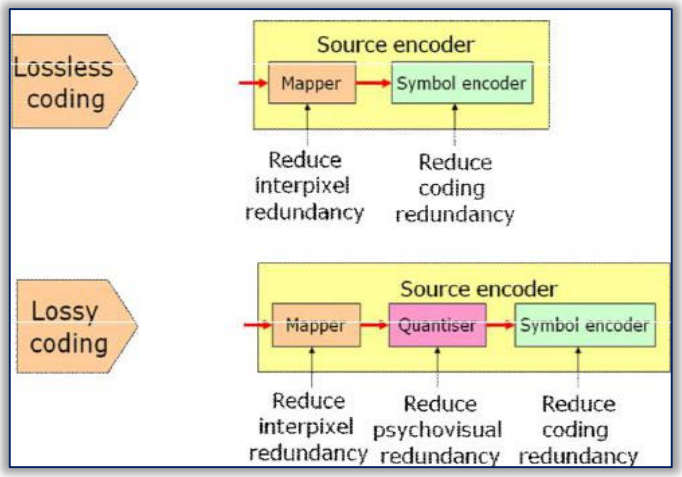


Figure 1. Image compression Model

IMAGE COMPRESSION STANDARD

During the past two decades, a range of compression methods have been developed to address main challenges faced by digital imaging. These compression methods can be classified broadly as Lossy Compression Methods and Lossless Compression Methods.

— Lossy Compression methods

Basically, almost all lossy compressors (Figure 2) are three–step algorithms, each of which is corresponding with three abbreviations of redundancy mentioned above.

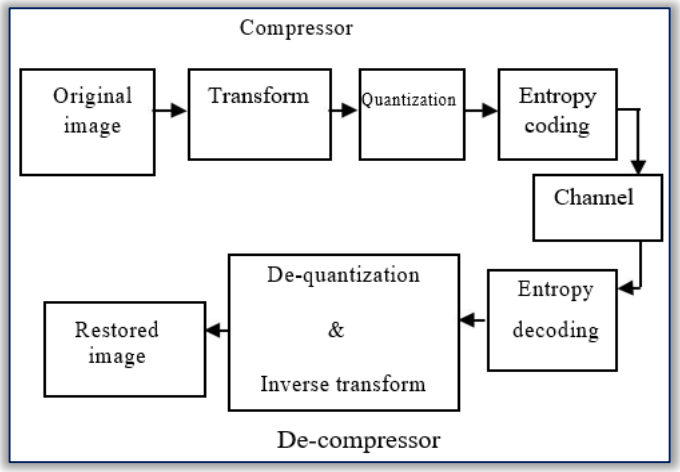


Figure 2. Lossy image compression

In the first stage a change is done to eliminate the inter–pixel redundancy to group information competently. Then psycho–visual redundancy is removed by a quantizer as to symbolize the collected information with as few bits as achievable. The quantized bits converted to a resource to get some extra compression from the coding redundancy.

» Quantization

Quantization is one by one, which replaces a set of values with a single value. Scalar and vector quantization are two significant types of quantization. SQ (scalar quantization) performs differently than creating a map for each value. VQ (Vectors) replaces each pixel block with a vector index in a codebook near the input vector by using a few closeness dimensions. Decoders get only the indexes and find the equivalent vector in the code book.

Shannon debuted for the first time that VQ would end at a lower bit rate than SQ. But VQ has to deal with due to short of generality codebook ought to be taught on some set of initial images. As a result, the bit rate and distortion [20] is being affected by the plan of the codebook. Riskin and. Al. Offer VQ design with variable–rate VQ and apply it to MR picture. Cosman and. Al. Use similar compression methods of CT and MR scans [1].

» Transform Coding

Transform Encoding becomes a common method for compressing lossy pictures. It uses a reversible and linear transformation to gainsay the real image into a set of coefficients in the transformed region. Then coefficients are measured and decoded gradually in the transformed region.

Numerous changes had done in some programs. The discrete KLT (Karhunen–Loeve transform), who's base is hotelling transformation which is best as it has packing properties but not able to make it practical. The DFT (discrete Fourier transform) and DCT (discrete cosine transform) are most accurate for energy packing efficiency of the KLT while DCT is most used transformation because of the DCT coefficients uses two timeless storage space.

» Block Transform Coding

To reduce the calculation, correlation of pixels inside a small blocks that divide the image is exploited by the block transform coding. As a result, each blog goes through the task like altered, quantized and independently encoded. Square of 8x8–pixel block and DCT block is used in the ISO JPEG (Joint Photographic Expert Group) to create an international standard for compression of images which is further followed by Huffman or the arithmetic code,. The disadvantage of this approach is that the blocking (or tiling) artifacts can be seen by rising the compaction ratio.

As the acceptance of the JPEG standard, the algorithm has been the topic of great research. Collins studied the effects of a 10:1 lossy image compression method based on JPEG, with alterations to reduce the blocking

artifacts are reduced. Baskurt used an algorithm analogous to JPEG to compress mammograms with a bit rate as low as 0.27 bpp (bits per pixel) while retaining recognition ability of pathologies by radiologists. Kostas uses JPEG, which can process 12–bit images and quantization tables for compression of x–ray of the chest and mammograms.
Furthermore, the ISO JPEG commission is at the present developing a replacement of still–image compression referred to as JPEG–2000 for delivery to the marketplace by the tale of year 2000. The new JPEG–2000 commonplace relies upon wavelet decompositions put together with lots powerful quantization and secret writing methods like embedded quantization and context–based arithmetic. It offers the possibility of obtaining numerous advantages over the obtained JPEG standard.Compression efficiency at low bit rates is being improved .Performance improvements include improved compression at low bit rates for large images, while new features consist of multi–resolution representations, scalability and integrated bit stream design, lossless progression, ROI (region of interest and an enriched file format [3].

— Lossless Compression Methods

The lossless compressing machine (Figure 3) is generally a two–step algorithm. The first step changes the real image to another format, which reduces the pixel redundancy. In The second coding redundancy is done by the use of an entropy encoder. Ideal inverse of lossless compressor is the lossless decompressor [8].

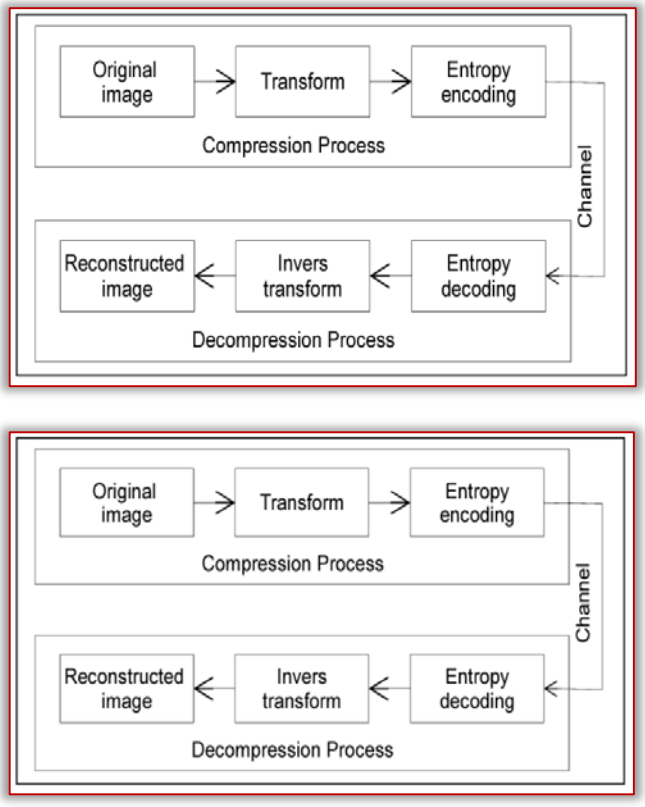


Figure 3: Lossless image compression

» Run length coding

Run length coding replaces data by a (length, value) duo, where "value" is the recurring value and "length" is the quantity of repetitions. This method is especially winning in compressing bi–level images since the happening of a long run of a value is unusual in usual gray–scale images. A resolution to this is to decay the gray–scale image into bit planes and compress individual bit–plane separately. Efficient run–length coding technique is one of the variations of run length coding [7].

» Lossless Predictive Coding

Lossless predictive coding by using adjacent pixel values for prediction the value of other pixel. As a result, each pixel is encoded with a forecast error a little more than its actual value. In general, errors are much smaller than the actual value, so less bits are needed to store them.
DPCM (differential pulse code modulation) is a predictive coding based lossless image compression scheme. It is too the base for lossless JPEG compression. A variation of the lossless predictive coding is the adaptive prediction that divides the image into blocks and calculates the prediction coefficients separately for every block to attain high prediction performance. It can to be combined with other scheme to get a hybrid coding algorithm with superior performance.
DPCM (differential pulse code modulation) based on predictive coding is lossless image compression method. well it is the basic of JPEG compression without loss of data adaptive prediction is variant of predictive coding without any kind of loss of data that divides the image into blocks and calculate the prediction coefficients independently so that each block have high prediction performance. It can also be combined with another scheme to achieve a hybrid coding algorithm with superior performance.

» Multi–resolution Coding

HINT (hierarchical interpolation) is based on sub sampling is a multi–resolution digital coder. In the beginning a low resolution version of the actual image and then the pixel values are interpolates to produce superior resolutions. The error between values between low–resolution image and the error values is recorded together with the first low –quality image. Compression is achieved because both the low quality image and the error value can be saved with a bits smaller than the actual image Algorithms with better results.
The Laplacian Pyramid is a compressed method for multi resolution designed by Bert and Adelson. It subsequently creates a low resolution of the real image by choosing so the number of pixels is reduced by factors of 2 on each scale. The difference between the subsequent solutions with the lowest resolution

image is saved and used to recover the actual image. But it cannot achieve a higher compression ratio, because the amount of data is refined by 4/3 of the actual image size.

In general, images are reversed in a set of set of dissimilar resolution sub–images in multi resolution coding.. Usually it reduces entropy. Some types of tree kind representation can be worn to get more compression rate by exploiting using tree structure of the Multi–resolution Method.

VARIOUS COMPRESSION METHODS

—JPEG Uploading an image based on DCT.

Image Compression in JPEG / DCT has become a new standard. JPEG is designed to compress the full–color image or grayscale image of a natural realistic set. To take benefits from this system, without any kind of overlapping 8x8 blocks are created as by dividing the image. For each block, separate Cosmetic Change (DCT) is applied to every block as to convert the degree of gray pixel into the spatial domain to coefficient of the frequency domain [3]. According to the quantization tables provided by the JPEG standard. The coefficients are normalized to different scales, which has some psychological evidence. The quantitative coefficients have been redesigned to further to compress by a lossless coding such as Huffman coding. Quantization process only leads to information loss. For all images that are not suitable 8x8 standard quantization table is set by The JPEG standard. To obtain better coding quality for different images by the same compression using the quantization DCT method can be used instead of the standard quantum table [2].

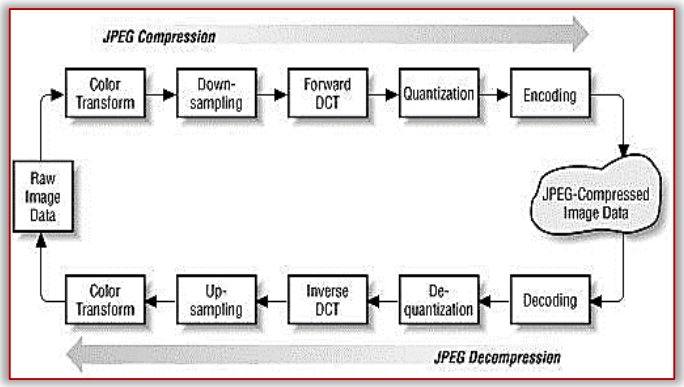


Figure 4. JPEG/DCT compression

—Wavelets

Wavelets are functions that determine the gaps and the mean values of zero. The main idea behind wavelet transform to represents any random function (t), as a superposition of a set of wavelet or basis functions. These basic functions or baby waves are derived from the model of the mother vector, called the iodine by dilations The Discrete Wavelet Transform of a finite length signal x(n) have N components, for example, is expressed by an N x N matrix . Despite all the advantages of the DCT–based JPEG compression plan is that it is very simple approach, and performance is quite good and availability of special purpose hardware for deploying.

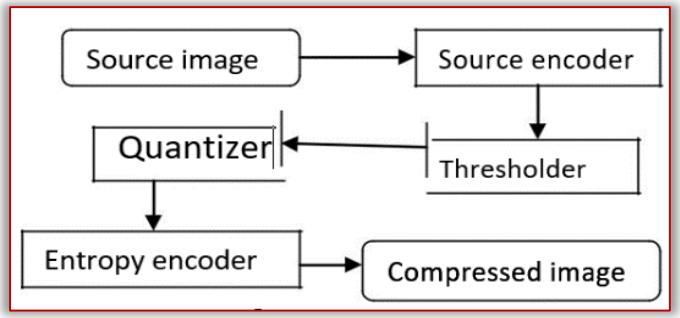


Figure 5. Compression plan

—Vector quantization

Vector quantization are signal processing techniques that allow the model of the probability density function of the distribution of prototype vectors. Basically it Works by values which are been encoded from the multi–dimensional vector to the set of values from the discrete subspace of the low size .The data is compressed easily as The low space vector requires less space Because of the density properties corresponding to the amount of vectors, compressed data errors that are inversely proportional to their density [6].

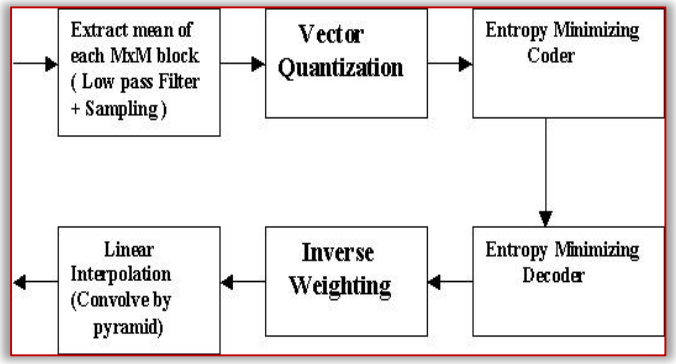


Figure 6. Vector quantization compression

—Fractal conversion

Fractal conversion is a compression method in digital images, which is lossy and based on fractals. This approach is best suited for texture and natural images, depending on the fact that part of the image is always similar to the other parts of the image.

In The Fractal algorithm parts are converted to mathematical statements, that we call the fractal code that are further useful for encoding images. There is a very interesting and important feature that we call the resolution–independent decoding property.

In this using decoding we can enlarge an encoded image having smaller size so that compression ratio may increase exponentially.

— **Genetic Algorithms** (GAs)

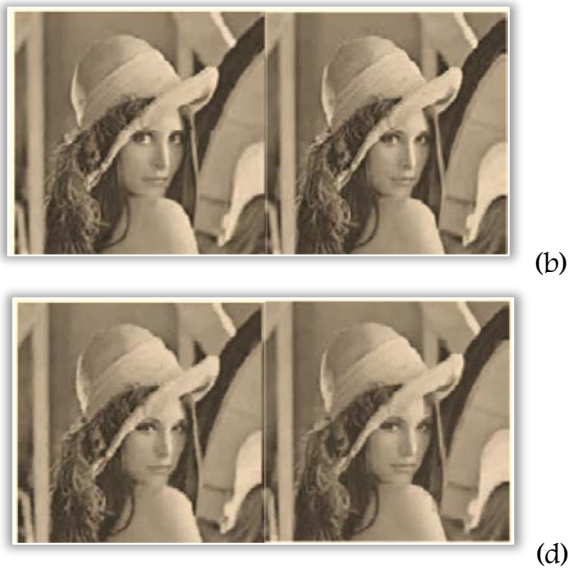
Genetic Algorithms (GAs) are methods that take after the standards of normal determination and regular hereditary genetics code, that have turned out to be extremely proficient scanning for approximations to worldwide optima in vast and complex spaces in moderately brief time.Genetic Algorithms (GA) is a procedure that follows the principles of natural selection and the natural code of nature that have proved to be most effective in jointly exploring global optimism in large and complex complexity over the short term.

The basic components of GAs are:

- genetic operators (mating and mutation)
- an appropriate representation of the problem that is to be solved
- a fitness function
- an initialization procedure

With these basic GA compounds, the procedure is as follows. Start with the beginning procedure to create the first population Members of the majority of the people are string of symbolic symbols (chromosomes) that provide solution of the unsolved problem need to be addressed. Each member of this generation is evaluated and depending on their ability is determined to be selected for reproduction. Using this probability, the genetic operator chooses some people.

Figure 7: Original image



(a) (b) (c) (d)

Figure 8: Decoded image of Lena (a) Wavelet; (b) JPEG; (c) VQ; (d) Fractal Algorithm

New people are bought by practicing these operators. The contact operator chooses two members and integrates their respective chromosomes to produce offspring. The mutation operator selects a member of the population and changes some part of its chromosomes. The elements of the populations with the worst fitness measure are replaced by the new individuals compression on original using different compression algorithm.

LITERATURE REVIEW

- S.N Raj – *A Set of Partitioning in Hierarchical Trees Algorithm for Image Compression*. This method [5] provides high quality of images which use SPIHT with the best PSNR value and is the best method for transferring the image. In this work, SPIHT is compared to the DCT, DWT algorithm. Different images are accepted as inputs in the name, size of quality are compared with PSNR and MSE values. Before and after compression for each and every picture value it is been calculated. This demonstrates that SPIHT is more efficient and effective than existing algorithms, which means that it can compress and restore the original image without affecting the source and quality of the image. Future scope are machine learning methods and artificial intelligence are used to compress images and compare them with SPIHT algorithms.
- In 2010, Jau Ji Shen et al demonstrated *The Technique of Compressing Images Based on Vector* [6]. In this paper, the encoding of differences between the original and the compressed image has already been adjusted and then restored to a compressed VQ version. The results of this experiment show that even though the process required to provide additional data, it can improve the quality of the Vector quantized compressed image, and is further correlated with the map of the difference in compression loss to lossless compression.
- *New Algorithm for Compression of Images Using Modified Filter Banks* by Gaurav Sharma and K.G.Kirar [7]. This research describes new algorithms for compressing images with modified wavelet filter–bank using Kaiser window, and this technique is used with many test images. It provides a highly compressed scheme without affecting image quality. From the results, the compression technique suggested good results compared to previous works.
- Suresh Yerva et al *Introduced Methods to Compress Lossless Images Using a New Concept of Folding*. In 2011 [8]. In this method, column folding followed by row folding is applied iteratively on the image till the image size reduces to a smaller pre–defined value this method is compared to the lossless compression algorithm, and the result shows the comparison between

different methods. Data folding method is a simple image compression technique that offers good performance and simplicity of calculation, lower than the SPIHT technique for lossless compression.

A Wavelet Based Biomedical Image Compression ROI Coding by Pooja Sharma and Dr. Rekha vig [9]. This article uses the DCT and DWT method for medical images. For this method to be more effective, ROI extraction is performed. The experimental work showed that the information could be extracted, and then the segmentation was carried out to protect the information. Using DCT and DWT, the loss of information is minimized. The results show that previous compression was high when information was lost. Chances of information lost is reduced using PSNR and MSE values.

New Image Compression Method Called Five Modular Methods by Firas A. Jassim. In this method, they convert each pixel value to a multi–dimensional 8x8 layout into multiple of 5 for each RGB array [13]. Then, the value is divided by 5 to get a new value, which is known as the bit length for each pixel, and uses less space to store than the original values which is 8 bits. This article demonstrates the potential of FMM compression technology. The advantage of this approach is that it provides best compression using a high PSNR although it has low CR (compression ratio). This method is ideal for 2–level black and white medical images, in which pixel are presented using one byte that is 8 bit .According to the recommendation, the method for the Variable Module (X) MM can be created where X can be any number in further research.

Image Compression technique Utilizing reference Points Coding with Threshold Values. In 2012, Yi–Fei Tan, et al exhibits a procedure which uses the reference points coding with limit esteems for picture compression. This paper gives the possibility of a picture compression technique which can be utilized to perform both lossy and lossless compression [12]. A threshold is related in the compression procedure, by shifting this edge esteems, distinctive compression proportions can be accomplished and if we set the threshold value to zero then lossless compression can be performed .quality of the decompressed image can be calculated during the process of compression. When the threshold value of a parameter assumes positive values, lossy pressure can be accomplished. Additionally study can likewise be performed to decide the ideal limit esteem T.

COMPARESION BETWEEN COMPRESSION TECHNIQUES

There are given a comparison between image compression techniques. These techniques have some advantages and disadvantages which consider in table.

Tabel 1. Comparison between image compression techniques

Method	Advantages	Disadvantages
Wavelet	a)High compression ratio b)state-of-the art c)low encoding complexity d)it produces no blocking artifacts	a)Coefficient quantization b)bit allocation c)less efficient
JPEG/DCT	a)current standard b) high quality and small degree of compression c)comparatively fast with others methods	a)Coefficient quantization b)bit allocation
VQ	a)Simple decoder b)no coefficient quantization	a)slow codebook generation b)small bpp
Fractal	a)good mathematical encoding frame b)resolution free decoding	a)slow encoding
Genetic algorithm	a)capable of handling complexity and irregular solution spaces b)robust technique	a)repeated fitness function evaluation for complex problem b)not more efficient

CONCLUSION

Fundamental idea of picture compression and different technologies utilized are talked about in this paper. All the picture compression methods are helpful in their related zones and consistently new compression procedure is creating which gives better compression ratio.

We have additionally examined favorable circumstances and parameters of some lossy image compression systems. This survey paper additionally gives the thought regarding different image composes and execution parameter of image compression. Basically Quality of image, amount of compression and speed of compression are the major factor on which compression is totally dependent.

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