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Research paper

Analysis Review on Image Compression Domain

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Abstract

This paper describes the types of pressure used to decrease the volume of data in lower media. This study is analyzed and categorized according to the two main types of study: Lossy Compression and Lossless compression. Each type has been studied through a number of transactions that determine the efficiency of compression files. The advantages and disadvantages for each type, which emerged from previous researches will also be discussed.

Keywords: *Compression, Decompression, Lossless Compression, Lossy Compression*

1. Introduction

One should know that for each code, there is a product from its logarithm and probability. Hence, entropy is introduced to produce the least number of symbols for a number of predefined symbols, but on a condition that the number of symbols produces less than them. Besides, it is also meant to take advantage of lowering the time required for storage and decrease the time specified in the transfer of data. In order to send to the source in less time and to decrease data, this process is called compression. If you need to refer to the original information from the compressed file, this process is called decompression [1-4]. When files containing videos, pictures or music are stored, they will be large, and this might be difficult to use and transfer not only because of their size but also because it will cost a lot of memory on a computer or hard drive. Here comes the importance of pressure to take advantage of the areas of the treasury and the ease of circulation and transfer files by converting files from original versions to compressed files. In general, a complex calculation, algorithm, is utilized to ensure that the lost data effects are invisible to human eyes in videos and photos, or inaudible to their ears when listening to music. Some of the lost visual data take advantage of the human eye's incapability to comprehend small changes in colour.
Apart from that, by using a good compression method, we should be aware that there is a loss in the image quality or the sound of the compressed file. However, if the file compression is more than acceptable and we use it to decrease the size of the file that has damage to this process, it makes the sound or the picture appears to look bad. Hence, the compression is applied so that the pictures will not lose even in the smallest file, and/or sound data will be noticeable. It is then analysed with bigger files and less compression unless there is no space to run.
The principle of compression of images arises from the theory of information called Entropy. This study is used to measure the amount of information produced by the source. For each character, its probability and algorithm are created. Entropy is a passive assembly to produce all the symbols of a set of specific symbols. Compression algorithms are methods in which the symbols used to represent the source of information (image) that can be decreased. Thus, lowering the total of time is needed to save information. To achieve the goal of lowering data is a process called compression. If you need to refer to the original information from the compressed file, this process is called decompression [1-4].There is a big problem with digital images; the amount of large data, so the compression of images is able to solve this problem. The concept of operation is to remove data redundant in digital images from a mathematical perspective, while process refers to the removal of terminated data. From a mathematical perspective, this volume is used to transform a 2-D pixel array into a statically not correlated data set. This conversion is done before storing or transferring the image [5] . This study explains the compression of images which is technically handling with an increased spatial resolution for image sensors from professional cameras. High-resolution images make it difficult to handle in terms of transport and general use of the Internet[5, 6]. Furthermore, image compression plays a major role in a number of significant and varied applications including remote sensing, document and medical imaging, facsimile transmission (FAX), tele video-conferencing, and the control of remotely piloted vehicles in military, space, and hazardous waste management applications [6].
One of the solutions is to compress the multimedia data before storage, processing or transfer. Certainly this study has to unzip the pressure to cope with it again that requires the need for this. For instance, with a compression ratio of 30:1, the space, bandwidth, and transmission time requirements can be reduced by a factor of 30 with a suitable quality. Applications of data compression are primarily in transmission and in information storage. Image transmission applications are in broadcast television remote sensing via satellite, military

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application via aircraft, radar and sonar, teleconferencing, computer communication, facsimile transmission, etc. Image storage is vital for educational business documents and medical images that escalate in computer tomography, magnetic resonance imaging and digital radiology, motion picture, satellite image weather maps, and many more. The application of data compression is also possible in the development of fast algorithm, in which the number of operations required to be implemented in algorithm is reduced by working with compressed data. One of the most important problems experienced by the images in the rapid development of the accuracy of the images is the large size of the imaging data. The reason for interest in this area is the rapid increase in the field of photography and the large size of images. The compression of the image is to reduce the size of the image data without compromising the image quality as much as possible. This reduction helps us to deal easily with the image in terms of transport and transmission.[7, 8]. It can classify the compression of images into two basic categories depending on the degree of loss of the image: the lossy compression techniques and the lossless compression techniques.

Lossy compression technique is a technique applied to the image that results in the loss of some image information. The similarity can be seen in both the compressed image and the original one, but there is some information loss which cannot be distinguished by the human eyes. Lossy techniques can be used in the compressing structures such as JPG and PNG. Comparatively, lossy compression has a higher compression ratio than the other lossless techniques. The performance of the lossy techniques is mainly measured by such metrics namely compression ratio, signal to noise ratio, and speed of encoding and decoding. Meanwhile, lossless compression techniques are one of the most important features of this without any loss of compressed image data. It is used in the important images that are intended to preserve its complete information and, if some of its information is lost, it may not be useful or convey the concept of sinner, and note this in medical pictures where the record of the situation or images of the patient is important to be stored with compression technology with no loss of any part of the image information. Nonetheless, this seems to be of obtaining low compression rate values compared to lossy techniques. In fact, entropy is used widely in lossless compressions. [7, 8].

2. Fundamental of Compression

Data compression is referred to the process of lowering the amount of data required to represent a given quantity of information. One of the general characteristics of images is more adjacent pixels are connected with the same colour gradients. The mission of data compression is to find this redundancy and decrease the insignificant repetition.

Irrelevancy reduction and redundancy are the two fundamental elements of compression. The latter aims at lowering and eliminating any duplication in the signal source (picture-video) such as changes in the signal that are not noticed by the signal receiver, namely the Human Visual System (HVS). If n1 and n2 represent the number of information-carrying units in the two data sets representing similar information, the relative data redundancy RD of the first data set (the one characterized by n1) [5, 6] can be defined as:

$$RD = 1 - 1/ CR \quad (1)$$

$$CR = n1/n2 \quad (2)$$

where
CR compression ratio
There are three types of redundancies can see in the image in Figure 1 as follows.

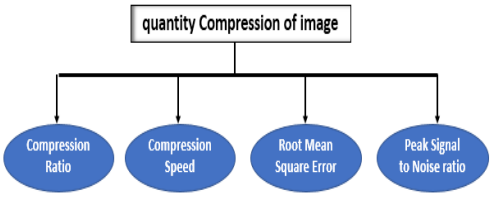


Fig 1: Fundamental components of compression

Based on Figure 1, redundancy consists of some categories such as coding redundancy and interpixel redundancy. In gray-colored images, this type is used because repetition is very similar to the new type of image. The resulting image is said to be code redundancy. Coding redundancy does not offer the link between the pixels [9] since this method is based on the pixel value. That research can predictably predict the value of the neighbouring pixel. The difference between the adjacent pixels is quite a few in order to decrease the interpixel redundancy in an image. The difference found in the successful pixels is then sent to the decoder side. This type of transformation is called mapping.

This principle is based on the fact that some information is relatively less important than the others, and it also has little impact on the process of normal visual. This information is reported as psychovisual which can delete this data because it has a very little effect, and is not necessary for normal visual processing. When deleting this data, loss of quantitative information must be produced [10].

All these algorithms fall within the two main categories: lossy algorithms and lossless algorithms and. Algorithm lossless produces similar original file with a lower quality compared to algorithm lossy. In this study, we can understand how it works based on its name, where there is a loss of data when pressed. For example, the algorithm lossless should be applied to the compression of the text without any loss of data because any loss may change the components of the text by losing its original meaning.[9-16].

3. The Quality Compression of Image

To understand the system compression, we need to get a good picture when the pressure is released. As such, there are four major factors to judge the quality of the image compression in algorithm as these characteristics are used to see how suitable it is for any application.

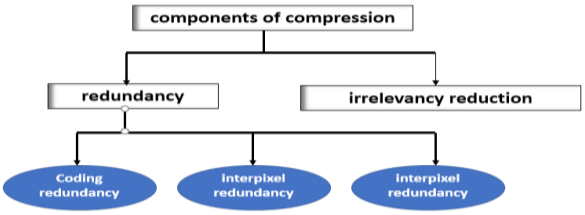


Fig. 2: Quantity compression of image

Based on Figure 2, there are four categories of image quantity compression. First, the original image of the compression ratio size is equal to the compressed image size. The higher ratio of compression on image quality is the weaker of adjustment between the picture's quality and ratio of the compression. This is very important in compressing images. Second, the compression time is defined, and the decompression time is the amount of compression and decompression of the image respectively. The measurement of this time depends on three main factors: the complexity in compression, the software effectiveness or the algorithm hardware application, and speed of the used processor or auxiliary hardware (televisions and computers). From this study, we can understand that whenever the two processes (compression and the decompression) are involved, the faster they become and their performance becomes better. Third, in this formula we can measure the cumulative square error between the original and the compressed image called square error measures, and it is defined as follows:

$$\mathrm{RMSE} = \left[\frac{1}{MN} \sum_{i=0}^{M-1} \sum_{j=0}^{N-1} \left[\hat{f}(i,j) - f(i,j) \right]^2 \right]^{1/2} \tag{3}$$

*M*N* is the dimensions of the image, *(i, j)* and *f(i, j)* are the matrix elements of the decompressed and the original image at *(i, j)* pixel. Fourth, the highest signal to reconstruct image measure known as PSNR is given below:

$$\mathrm{PSNR} = 10 \log_{10} \left[\frac{M \times N}{RMSE^2} \right] \tag{4}$$

The signal is an original image, while noise is an error found in reconstructed image. Generally, a good reconstructed image has low MSE and high PSNR, and it means that the image above has low error.

4. Advantages and Disadvantages of Image Compression

Table 1 illustrates the comparison of image compression in term of the implementation of advantages and disadvantages.

Table 1: advantages and disadvantages of image compression

no	Advantages	Disadvantages
1	decreases the data storage requirements.	the extra overhead incurred by encoding and decoding processes is one of the most serious drawbacks of data compression.
2	decrease the communication cost in transmitting	discourages its usage in some areas when the data become very important
3	Transfer high volumes of data over long-haul links via higher effective utilization of the available bandwidth in the data links.	ingle bit error in compressed code will cause the decoder to misinterpret all subsequent bits, producing incorrect data.
4	increases the quality of multimedia presentation through limited-bandwidth communication channels	Transmission of very sensitive compressed data (e.g., medical information) through a noisy communication channel (such as wireless media) is risky because the burst errors introduced by the noisy channel can destroy the transmitted data.
5	Because of the decreased data rate. Offered by the compression techniques, computer network and Internet usage is becoming more and more	the disruption of data properties, since the compressed data is different from the original data.
6	created new opportunities of creative applications such as digital library, digital archiving, video teleconferencing, telemedicine and digital entertainment	the extra complexity added by data compression can increase the system 's cost and decrease the system 's efficiency
7	enhance the database performance because more compressed records can be packed in a given buffer space	
8	great implications in database access.	
9	greatly enhanced by encrypting the decoding parameters and transmitting them separately from the compressed database files to restrict access of proprietary information.	
10	The rate of input-output operations in a computing device can be greatly	
11	increased due to shorter representation of data.	
12	decreases the cost of backup and recovery of data in computer systems	
13	will enable more multimedia applications with decreased cost.	

From the Table 1, it can be concluded that the importance of data compression is one of the most important data storage intrusions, which will materially reflect on the use of a few sizes of storage media and also because of the size constraints. This will help us send faster and better use of communication instead of wasting time in sending large files. This will also be reflected in the transfer of larger data at the same speed. The most important reasons are the ability to decrease the backup cost and the data recovery in computer systems as this will enable more multimedia applications with a lower cost.[1-6, 17].

5. Conclusion

The main purpose of data compression in this study discussed previously is meant to decrease data size using lossless and lossy modes. In lossy compression, image quality may decrease in order to meet the required pressure level for storing or transporting the issue in lossy compression. This study also highlights how lossy compression can decrease the degradation of the image quality given the data rate. In lossless compression, most of the algorithms used by researchers convert pixels to transform domain [4] DWT(Discrete Wavelet Transform) or the DCT(Discrete Cosine Transform).
The key difference between lossy compression and lossless compression is the ability to remove the non-useful part of the data that is unnoticeable, while lossless compression rebuilds the exact data as it is able to decrease the data size at a lower extent. In contrast, lossy compression has the ability to decrease the size of the file to a greater extent. However, the quality of the data worsens in case of lossy compression whereas lossless does not worsen the quality of the data. Lossy technique cannot be implemented in all types of files since it is effective only when some parts of the redundant data are removed, in which this is impossible when it is related to text.

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