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Image Compression Technique based on Fractional Compression using Neural Networks

Dr Mohitkumar P Bhadla[1]

[1] Associate Professor, Information Technology Department, Alpha College of Engineering & Technology, Ahmadabad, Gujarat, 382481. India
mbhadla@gmail.com

Abstract

This Paper gives review of different types of Images and the different techniques for machine learning with Image Compression. Based on this Review we recommended general process for Image Compression. Image Compression is the technique of reducing the image size without degrading the quality of the representation. Various types of images and unusual compression techniques are discussed here. Image Compression is the explanation associated with transmission and storage of large amount of information for digital Image. Transmission of Images includes different applications like dissemination of small screen, inaccessible sense via satellite and other long distance announcement while Image storage space is required for medical images, satellite images, documents and pictures. Image firmness deals with these types of applications.

Keywords: *Image, Image compression technique, Huffman Coding, Run Length Encoding, Compression, Decompression, Run Length Encoding, Transform Coding, LZW, Loss less and lossy image compression*

1-Introduction

Image is a 2 Dimensional signal represented by Digital system. Normally Image taken from the camera is in the analog form. However for processing, transmitting and storage, images are converted in to digital form. A Digital Image is basically 2- Dimensional array of pixels [1]. Basically compressing of image is different than compressing digital data. General purpose Data compression algorithm can be used for Image compression but the result is less than optimal. Different types of images are used in remote sensing, bio medical and video processing techniques which require compression for transmission and storage. [2].Compression is achieved by removing redundant or extra bits from the image.

1.1 Need of Compression

Uncompressed images can occupy a large amount of memory in RAM and in storage media, and they can take more time to transfer from one device to another. Table 1 below shows the comparative size from normal text to high compressed image. Examples given in Table1clearly shows need for sufficient storage space and more bandwidth because long transmission time is required for uncompressed image. So there is only one solution is to compress the image.

Data	Image Size	Bits/Pixels	Uncompressed Size	Transmission Bandwidth	Transmission Time
Page	11''x8.5"	Depends on resolution	5.8KB	32.55KBPS	1.4-3.4 sec
Camera Image	800X600	8bps	1.3MB	100MBPS	50 mins
Color Image	512X512	24bpp	786KB	6.30MBPS	5mins
Medical Image	2048X1680	12 bpp	5.16 kB	41.3 MBPS	32mins

Table 1 Different Uncompressed Images and its storage space

1.2 Review and Investigation

Digital image is basically array of various pixel values.[1] In the digital image Pixels of neighborhood are correlated and so that this pixels contain redundant bits. By using the compression algorithms redundant bits are removed from the image so that size image size is reduced and the image is compressed. Image compression Have two main Components: redundancy reduction and irrelevant data reduction redundancy reduction is achieved by removing extra bits or repeated bits. While in irrelevant reduction the smallest or less important information is omitted, which will not received by receiver. There are three types of redundancies.

1.3 Performance Parameters.

There are two performance parameters are used to measure the performance of the image compression algorithms. One is PSNR (peak signal to noise ratio) and second is Mean square error (MSE). PSNR is the measurement of the peak error between the compressed image and original image. The higher the PSNR contains better quality of image.

To compute the PSNR first of all MSE (mean square error) is computed.

Mean Square Error (MSE) is the cumulative difference between the compressed image and original image. Small amount of MSE reduce the error and improves image quality.

$$MSE = \frac{\sum_{M,N} [I_1(m,n) - I_2(m,n)]^2}{M * N} \quad \textbf{1.1}$$

In the previous equation, *M* and *N* are the number of rows and columns in the input images.

The PSNR is computed from following equation

$$PSNR = 10 \log_{10} \left(\frac{R^2}{MSE} \right) \quad \textbf{1.2}$$

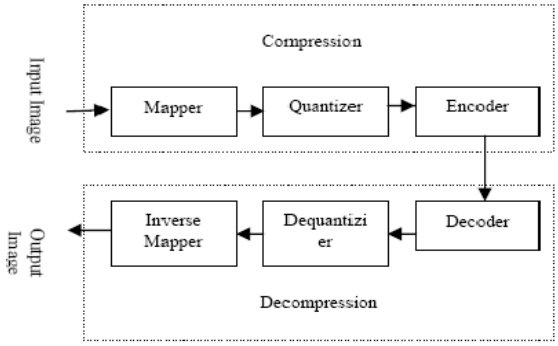

Fig 1 General Compression Decompression

As shown in Fig.1, First of all the image is taken from the image dataset. The mapped converts the input image into inter pixel coefficients. Transformation for the mapper may be DCT, wavelet or Curvelet transform. Each has its own advantages and disadvantages.

Second stage is the quantized which simply reduces the number of bits needed to store the transformed coefficients. It is many to one mapping in which larger values are quantized into smaller value. It is a lossy process and it is the main source of compression in an encoder. Quantization reduced the number of bits so it results some kind of information loss. Quantizer can be scalar or vector quantization. In scalar Quantizer quantization is performed on each coefficient while in vector quantization it can be performed on groups. An entropy encoder compressed the quantized values and improves the compression. The reverse Process Decoder, De quantizer and inverse mapper is obtained to reconstruct the image and it is called decompression.

Model Investigation:

In this paper, we present a review of various types of images is discussed in section II and its compression techniques in section III. In section IV the general guidelines are mention to compress the image.

2. Types of Images

A. TIFF

The TIFF (Tagged Image File Format) is a flexible format which can be used for lossless or lossy Compression [4].In practice, TIFF is used as a lossless image storage format in which image compression is not used. For web transmission TIFF files are not used because TIFF files require large size.

B. GIF

Graphics Interchange Format (GIF) is useful for images that have less than 256 colors, grayscale.GIF is limited to an 8 bit or 256 colors. so that it can be used to store simple graphics ,logos and cartoon style images. It uses loss less compression.

C. RAW

RAW file format includes images directly taken from Digital cameras. These formats normally use loss less or lossy compression method and produce smaller size Images like TIFF. The Disadvantage of RAW Image is that they are not standardized image and it will be different for different manufactures. So these images require manufacture's software to view the images.

D. PNG

The PNG (portable Network Graphics) file format supports 8 bit, 24 bit, 48 bit true color with and without alpha channel. Lossless PNG format is best compare to lossy JPEG. Typically, an image in a PNG file can be 10% to 30% more compressed than in a GIF format [5].PNG format have smaller size and more colors compare to others.

E. JPEG

Joint Photographic Expert Group (JPEG) is a lossy compression technique to store 24 bit photographic images. It is widely accepted in multimedia and imaging industries. JPEG is 24 bit color format so it have millions of colors and more superior compare to others[6].it is used for VGA(video graphics Array) display.JPEG have lossy compression and it support 8 bit gray scale image and 24 bit color images.

3. COMPRESSION ALGORITHM

There are Two types of compression algorithm: Lossless and Lossy. In the loss less compression the compressed image is totally replica of the original input image, there is not any amount of loss present in the image. While in Lossy compression the compressed image is not same as the input image, there is some amount of loss is present in the image.

3.1 Lossless compression Techniques

In lossless compression scheme reconstructed image is same to the input image. Lossless image compression techniques first convert the images in to the image pixels. Then processing is done on each single pixel. The First step includes prediction of next image pixel value from the neighborhood pixels. In the second stage the difference between the predicted value and the actual intensity of the next pixel is coded using different encoding methods. Different Encoding and Decoding Methods for Loss less compression are discussed below.

a. RLE (Run Length Encoding)

RLE is the simplest image compression technique in which sequence of identical symbols are replaced by a pair containing the symbol and the length at which the number is repeated.[8]. it is widely accepted compression technique in the fax standard.

b. Statistical Coding

The following techniques are included. 1. Huffman Encoding, 2. Arithmetic Encoding 3. LZE Encoding. [9][10]

1. Huffman Encoding

Huffman coding can reduce the file size by 10% to 50% by removing the irrelevant information. In this technique smaller bit code is given to the pixel values which occur frequently and the higher bit code for repeated pixel value. In order to encode images

- First of all image is divided in to 8X8 blocks
- Then each block is coded with particular symbols
- Huffman code is applied to the each block
- Encoding all the blocks

2. Arithmetic Encoding

Arithmetic encoding was introduced by Rissanen in which the last symbol is encoded and decoded first.[11]Arithmetic encoding is based on following principle.

- The symbol alphabet should not infinite.
- All possible symbol sequence of give length should not infinite
- The number of real number in the interval [0,1] can assign a unique subinterval for any given input sequence of symbols.

3. LZW coding
   It is dictionary based coding, in the static dictionary coding the dictionary is fixed during the encoding and decoding while in dynamic dictionary coding the dictionary is updated when new word is introduced.

4. Area coding
   It is an enhanced version of the RLE. Area coding is highly effective and it can give better compression ratio but it has certain limitation that it can be applied to non linear transformation

3.2 Lossy Compression Techniques

Lossy compression technique provides higher compression ratio compare to lossless compression. In this method, the compressed image is not same as the original image; there is some amount of information loss in the image. Lossy compression scheme is shown in fig. 2

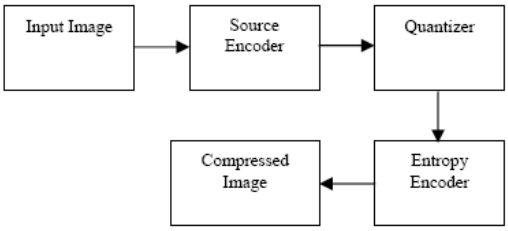

Fig 2 Lossy Compression Techniques

a. Transform Coding

Transform Coding algorithm usually starts by partitioning the original image into small blocks of smaller size. Then for each block related transform coefficients are obtained based on their transform, DCT, wavelet and Curvelet are the example of the transform coding. The resulting coefficients are then computed by quantization techniques and then the output of the quantizer is used for symbol encoding technique to produce the output. At the decoder the reverse process is obtained and image is reconstructed.

b. Block Truncation coding

In this the image is divided into non overlapping blocks of pixels. Then the quantized is used to find mean of the pixel values of the all the non overlapping blocks. After that thresholding is done so that the image pixels above the threshold values are set to zero or one. Then for each division in the bitmap the related reconstruction value is obtained. Larger block size gives greater solidity ratio but it reduces the quality of an image.

c. Sub –band Coding

The sub band coding split the frequency bands of a signal and then each sub band is coded by encoder and bit rate which is related to that particular band.[12]. SBC is generally used in speech coding and image coding. At the decoder the sub band signals are decoded and un sampled and passed through a synthesis filters. Then all the sub band coefficients are properly summed up to yield the compressed image.

d. Vector quantization

Vector quantization (VQ) technique is the extension of Scalar quantization in multiple dimensions. This technique develops a dictionary of fixed-size vectors which are called code vectors. A given image again partitioned into non-overlapping blocks called image vectors. Then for each image vector, the closest matching vector in the dictionary is determined and its index in the dictionary is used as the encoding of the original image vector [13]. Because of its fast lookup capabilities at the decoder side, Vector Quantization-based coding schemes are normally used in multimedia applications.

5. Conclusion

Hence all basic image looseness techniques have been discussed. To conclude all the image compression techniques are useful in their related areas and every day new compression technique is increasing which gives better density ratio. This

review paper gives clear idea about basic density techniques and image types. Based on review of different types of images and its Compression algorithms we conclude that the density algorithm depends on the three factors: quality of image, amount of density and speed of compression.

6. REFERENCES

[1] *Subramanya A.* "Image Compression Technique,"potentials IEEE, Vol. 20, issue 1, pp19-23, Feb-March 2017.
[2] Woods, R. C. 2008. Digital Image processing. New Delhi: Pearson Pentice Hall, Third Edition, Low price edition, Pages 1-904.
[3] http://en.wikipedia.org/wiki/Image_file_formats
[4] *Keshab K. Parhi, Takao Nishitan*; "Digital Signal processing for multimedia systems", ISBN 0-8247-1924
[5] "Understanding Image Types"http://www.contentdm.com/USC/tutorial/image-filetypes.pdf.1997-2015,DiMeMa,Inc,Unpublished.
[6] http://www.find-images.com
[7] *John Miano*; "Compressed image file formats: JPEG,PNG, GIL, XBM, BMP", Edition-2, January-2020, page 23.
[8] *Majid Rabbani, Paul W.Jones;* "Digital Image Compression Techniques". Edition-4, 1991.page 51.
[9] *Ronald G. Driggers*; "Encylopedia of optical engineering", Volume 2, Edition 1,2003.
[10] *Ioannis Pitas*; "Digital image processing algorithms and applications.", ISBN 0-471-37739-2
[11] A.S. Ragab, Abdalla S.A. Mohmed, M.S. Hamid, "Efficiency of Analytical Transforms for Image Compression" 15th National Radio Science Conference, Feb.24-26, 1998, Cairo- Egypt.
[12] *Rafael C. Gonzalez, Richard Eugene;* "Digital image processing", Edition 3, 2018, page 466.*Alan Conrad Bovik;* "Handbook of image and video processing", Edition 2 1005, page 673
[13] *Deke McClelland, Galen Fott;* "Photoshop elements3fordummies"Edition 1, 2002, page 126.
[14] *Keshab K. Parhi, Takao Nishitan*; "Digital Signal processing for multimedia systems", ISBN 0-8247-1924-7, United States of America, page 22.
[15] *Majid Rabbani, Paul W. Jones;* "Digital imagecompression techniques"; ISBN 0-8194—0648-1,Washington, page 129.
[16] *Vasudev Bhaskaran, Konstantinos Konstantinides* "Image and video compression standards: algorithms and architectures". Edition 2, 1997, page 61.