Analysis of Image Compression and Decompression using JSS algorithm- A Review

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Abstract: -***The need of an efficient technique for compression of Images ever increasing because the raw images need large amounts of disk space seems to be a big disadvantage during transmission & storage. Even though there are so many compression technique already present a better technique which is faster, memory efficient and simple surely suits the requirements of the user is JSS***

1. Introduction

Image compression is very important for efficient transmission and storage of images. Demand for communication of multimedia data through the telecommunications network and accessing the multimedia data through Internet is growing explosively. With the use of digital cameras, requirements for storage, manipulation, and transfer of digital images, has grown explosively. These image files can be very large and can occupy a lot of memory. A gray scale image that is 256 x 256 pixels has 65, 536 elements to store, and aa typical 640 x 480 color image has nearly a million. Downloading of these files from internet can be very time consuming task. Image data comprise of a significant portion of the multimedia data and they occupy the major portion of the communication bandwidth for multimedia communication. Therefore development of efficient techniques for image compression has become quite necessary. A common characteristic ofmultimedia communication. Therefore developmentof efficient techniques for image compression has become quite necessary. A common characteristic of most images is that the neighboring pixels are highly correlated and therefore contain highly redundant information. The basic objective of image compression is to find an image representation in which pixels are less correlated. The two fundamental principles used in image compression are redundancy and irrelevancy. Redundancy removes redundancy from the signal source and irrelevancy omits pixel values which are not noticeable by human eye. JPEG and JPEG 2000 are two important techniques used for image compression [1].

2. Need for image compression

The need for image compression becomes apparent when number of bits per image is computed resulting from typical sampling rates and quantization methods. For example, the amount of storage required for given images is (i) a low resolution, TV quality, color video image which has 512 x 512 pixels/color,8 bits/pixel, and 3 colors approximately consists of 6 x 10. Bits ;(ii) a 24 x 36 mm negative photograph scanned at 12 x 10..mm:3000 x 2000 pixels/color, 8 bits/pixel, and 3 colors nearly contains 144 x 10. Bits; (3) a 14 x 17 inch radiograph scanned at 70 x 10..mm: 5000 x 6000 pixels, 12 bits/pixel nearly contains 360 x 10. Bits. Thus storage of even a few images could cause a problem. As another example of the need for image compression, consider the transmission of low resolution 512 x 512 x 8 bits/pixel x 3-color video image over telephone lines. Using a 96000 bauds (bits/sec) modem, the transmission would take approximately 11 minutes for just a single image, which is unacceptable for most applications [2].

3. Principles behind compression:

Number of bits required to represent the information in an image can be minimized by removing the redundancy present in it. There are three types of redundancies: (i) spatial redundancy, which is due to the correlation or dependence between neighboring pixel values; (ii) spectral redundancy, which is due to the correlation between different color planes or spectral bands; (iii) temporal redundancy, which is present because of correlation between different frames in images. Image compression research aims to reduce the number of bits required to represent an image by removing the spatial and spectral redundancies as much as possible.

4. Types of compression:

Lossless versus Lossy compression: In lossless compression schemes, the reconstructed image, after compression, is numerically identical to the original image. However lossless compression can only a achieve a modest amount of compression. Lossless compression is preferred for archival purposes and often medical imaging, technical drawings, clip art or comics. This is because lossy compression methods, especially when used at low bit rates, introduce compression artifacts. An image reconstructed following lossy compression contains degradation relative to the original. Often this is because the compression scheme completely discards redundant information. However, lossy schemes are capable of achieving much higher compression. Lossy methods are especially suitable for natural images such as photos in applications where minor (sometimes imperceptible) loss of fidelity is acceptable to achieve a substantial reduction in bit rate. The lossy compression that produces imperceptible differences can be called visually lossless [6].

4.1 JPEG technique

JPEG stands for the Joint Photographic Experts Group, a standards committee that had its origins within the International Standard Organization (ISO). JPEG provides a compression method that is capable of compressing continuous-tone image data with a pixel depth of 6 to 24 bits with reasonable speed and efficiency. JPEG may be adjusted to produce very small, compressed images that are of relatively poor quality in appearance but still suitable for many applications. Conversely, JPEG is capable of producing very high-quality compressed images that are still far smaller than the original uncompressed data. JPEG is primarily a lossy method of compression.JPEG was designed specifically to discard information that the human eye cannot easily see. Slight changes in color are not perceived well by the human eye, while slight changes in intensity (light and dark) are. Therefore JPEG's lossy encoding tends to be more frugal with the gray-scale part of an image and to be more frivolous with the color. DCT separates images into parts of different frequencies where less important frequencies are discarded through quantization and important frequencies are used to retrieve the image during decompression. Compared to other input dependent transforms, DCT has many advantages: (1) It has been implemented in single integrated circuit; (2) It has the ability to pack most information in fewest coefficients; (3) It minimizes the block like appearance called blocking artifact that results when boundaries between sub-images become visible [1]

4.2 Discrete Wavelet Transform (DWT)

A single-stage wavelet transformation consists of four frequency bands as shown in Fig. 1. The top-left corner of the transformed image "LL" is the original image, low-frequency coefficients and the top-right corner "HL" consists of residual vertical frequencies (i.e. the vertical component of the difference between the "LL" image and the original image). The bottom-left comer "LH" contains residual horizontal frequencies, whilst the bottom-right corner "HH" contains residual diagonal frequencies. The main reason for use DWT, for reduce an image dimensions, and the high-frequencies coefficients are ignored, this will effects on the image quality, while this process increasing compression ratio [11].

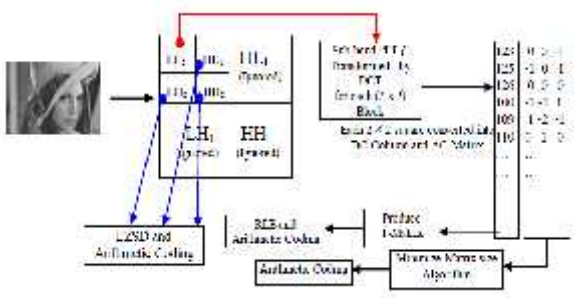

Fig 1 Discrete Wavelet Transform (DWT)

4.3 Sequential Search Algorithm

This technique used for search for the missing data and the data must be inside limited values. We designed this technique for search of D-Matrix values; the probabilities of data for the D-Matrix is represent the limited values. Sequential search algorithm finds the values of D-Matrix by looking for inside the probabilities of D-Matrix [1].

5. Literature Survey

Mohammed Mustafa Siddeq introduce and idea for image compression, based on JPEG technique and Sequential Search Algorithm, at first using Discrete Wavelet Transform (DWT) to obtain LL sub-band, then apply JPEG technique on the LL sub-band. JPEG technique consist of; JPEG Transformation, and JPEG Coding. The LL sub-band transformed by JPEG transformation for obtaining more compression ratio. Before apply JPEG coding, our algorithm used feedbacks system for inverse JPEG transformation to get decoded LL sub-band, and then the difference between decoded LL and original LL are stored in a new matrix called D Matrix, finally the D-Matrix compressed by Sequential Search Algorithm. The Decompression algorithm consists of; Inverse JPEG transformation to get decoded LL, Sequential Search Algorithm to find D-Matrix, Add D-Matrix with the decoded LL and apply inverse DWT to get decompressed image. Our algorithm tested on two different gray level images and compared with JPEG and JPEG2000 [1].

The basic idea of data compression is to reduce the data correlation. By applying Discrete Cosine Transform (DCT), the data in time (spatial) domain can be transformed into frequency domain. Because of the less sensitivity of human vision in higher frequency, we can compress the image or video data by suppressing its high frequency components but do no change to our eye. Moving pictures such as video are data in three-dimensional space consists of spatial plane and time axis. Therefore, in addition to reducing spatial correlation, we need to reduce the time correlation. We introduce a method called Motion Estimation (ME). In this method, we find similar part of image in previous or future frames. Then replace the image by a Motion Vector (MV) in order to reduce time correlation. In this paper, we also introduce JPEG standard and MPEG standard which are the well-known image and video compression standard, respectively [2].

Data compression involves the development of a compact representation of information. Most representations of information contain large amounts of redundancy. Redundancy can exist in various forms. It may exist in the form of correlation: spatially close pixels in an image are generally also close in value. The redundancy might be due to context: the number of possibilities for a particular letter in a piece of English text is drastically reduced if the previous letter is a q. It can be probabilistic in nature: the letter e is much more likely to occur in a piece of English text than the letter q. It can be a result of how the information-bearing sequence was generated: voiced speech has a periodic structure. Or, the redundancy can be a function of the user of the information: when looking at an image we cannot see above a certain spatial frequency; therefore, the high-frequency information is redundant for this application. Redundancy is defined by the Merriam-Webster Dictionary as “the part of the message that canbe eliminated without the loss of essential information.” Therefore, one aspect of data compression is redundancy removal. Characterization of redundancy involves some form of modeling. Hence, this step in the compression process is also known as modeling. For historical reasons another name applied to this process is decorrelation [3].

The tolerance of Huffman Coding to memory faults is considered. Many pointer based and array-based data structures are highly non resilient to faults. A single fault in a memory array or a tree node may result in loss of entire data or an incorrect code stream. In this paper Cung Nguyen developed a fault tolerant design scheme to protect the JPEG image compression system [4].

In this paper S.Vijayaraghavanet. al. presents an approach towards FPGA implementation for image compression. The design follows the JPEG2000 standard and can be used for both lossy and lossless compression. The embedded block coding with optimized truncation (EBCOT) is a key algorithm in JPEG 2000 image compression system. Various applications, such as medical imaging, satellite imagery, digital cinema, and others, require high speed, high performance EBCOT architecture. Though efficient EBCOT architectures have been proposed, hardware requirement of these existing architectures is very high and throughput is low. To solve this problem, the performance of the coder is improved and the entire design of EBCOT encoder is tested on the field programmable gate array platform [5].

Image compression is the application of data compression on digital images. Image compression can be lossy or lossless. In this paper it is being attempted to implement basic JPEG compression using only basic MATLAB functions. In this paper the lossy compression techniques have been used, where data loss cannot affect the image clarity in this area. Image compression addresses the problem of reducing the amount of data required to represent a digital image. It is also used for reducing the redundancy that is nothing but avoiding the duplicate data. It also reduces the storage area to load an image. For this purpose we are using JPEG. JPEG is a still frame compression standard, which is based on, the Discrete Cosine Transform and it is also adequate for most compression applications. The discrete cosine transform (DCT) is a mathematical function that transforms digital image data from the spatial domain to the frequency domain [6].

6. Conclusion

The basic concepts of image compression using JPEG and sequential search algorithm and the overview of JPEG standard. Although there is much more details we did not mentioned, the important parts are discussed in this synopsis. The JPEG standard has become the most popular image format; it still has some properties to improvement. The compression ratio can be higher without block effect by using wavelet-based JPEG 2000 standard.

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