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Lossless image compression based on data folding

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Abstract*— Image compression techniques reduce the number of bits required to represent an image by taking advantage of these redundancies. An inverse process called decompression (decoding) is applied to the compressed data to get there constructed image. The objective of compression is to reduce the number of bits as much as possible, while keeping the resolution and the visual quality of the reconstructed image as close to the original image as possible. Image compression systems are composed of two distinct structural blocks: an encoder and a decoder. The existing method Huffman encoding technique is used for loss less compression. It has the drawbacks of Images like they are often used in prepress are better handled by other compression algorithms. It always produces rounding errors, because its code length is restricted to multiples of a bit. This deviation from the theoretical optimum is much higher. In this research propose a novel method for encoding namely Arithmetic Coding to provide lossless image compression. The proposed arithmetic coding provides the better Compression Ratio (CR) and lesser Bits Per Pixel (BPP). Though none of the technique can be considered as completely lossless but using these techniques the loss has been expected to be minimal. The proposed arithmetic coding is a entropy coder for lossless compression. It encodes the entire input data using the real interval. It is very efficient than the Huffman coding. In addition, proposed system uses the fractal compression is a lossless compression method for digital images, based on fractals. The method is best suited for textures and natural images, relying on the fact that parts of an image often resemble other parts of the same image. Enhanced Fractal algorithms convert these parts into mathematical data called "fractal codes" which are used to recreate the encoded image.

***IndexTerms*—lossless image compression, data folding,JPEG-LS,SPIHT**

INTRODUCTION

1. An Image Multiresolution Representation for Lossless and Lossy Compression

In this paper, proposed a new image multi-resolution transform that is suited for both lossless reversible and lossy compression The new transformation is similar to the subb and decomposition but can be computed with only integer addition and bit shift operations During its calculation the number of bits required to represent the transformed image is kept small through careful scaling and truncations Numerical results show that the entropy obtained with the new transform is smaller than that obtained with predictive coding of similar complexity. In addition propose entropy coding methods that exploit the multi-resolution structure and can efficiently compress the transformed image for progressive transmission up to exact recovery. The lossless compression ratios are among the best in the literature and simultaneously the rate vs distortion performance is comparable to those of the most efficient lossy compression methods.

The progressive resolution transmission schemes are easily implemented from the multi resolution transform because in this case the encoder just has to code the pixels beginning from the highest level of the pyramid. The decoder after receiving the data upto level can recover an image with dimensions smaller than the original for entropy coding the S+P transform they use the fact that there is a statistical dependence between pixels of the transformed image which cannot be further reduced by linear predictive methods but that can be exploited during coding.

In practice should also pay attention to the complexity of the coding methods and observe that there are components of the transformed image that cannot be efficiently compressed and may be transmitted un-coded This fact was used to define one entropy coding method in the JPEG still picture compression standard. In JPEG-s method an integer value is decomposed in three parts the length in bits the design and a magnitude difference. The magnitude difference is the difference between the actual magnitude and the lowest magnitude in a particular predefined set of transforms pixel magnitudes.

The length which is the number of bits needed to express the sign and this magnitude difference is entropy coded forming the variable length code VLC and then the sign and the magnitude difference are transmitted uncoded in the variable length integer VLI format.With this representation there is a small loss due to the fact that the VLI-s are not entropy coded but with the advantage that the number of VLC symbols is small which simplies the entropy coding process In other words with this representation can get bit rates near those that would be obtained if the complete integers were entropy coded but with a smaller complexity.

Disadvantages

The proposed a new image multiresolution transformation called S+P transform which is suited for both lossy and lossless compression. It is shown that it can be computed with a small computational effort using only integer additions and bit shifts Numerical results show that the entropy of the transformed images is smaller than that obtained with predictive coding methods of similar complexity In addition proposed coding methods that exploit the multiresolution representation for efficient progressive transmission. The methods for progressive resolution transmission have low complexity and still can compress the images to rates among the best in the literature. An embedded coding method was proposed for progressive delity transmission and it is shown that it yields a rate vs distortion curve superior to much more sophisticated vector quantization methods and inferior only to the most efficient lossy compression methods employing wavelet transforms. At the same time its rates to code the image for lossless recovery are very near those obtained with the progressive resolution methods. Thus have shown that with the proper multi-resolution representation, it is possible to have compression schemes allowing efficient and fast inspection of the images in a reduced resolution or in a lossy re-construction and simultaneously code the images with performance comparable to the best known schemes for lossy or lossless compression.

2. Implementation of LOCO-I Lossless Compression Algorithm using Fuzzy logic

In this paper describe a new image compression technique LOCO-I lossless compression algorithm along with fuzzy logic have been designed. Image compression is a powerful and useful technology used in the present world because image compression is an excellent method that plays an important role for storage of information. As there are several methods for image compression, the ideas and the conditions used are different based on the criteria. Those criteria are compression ratio, compression quality. Generally, the compression method which gives lossless compression with low time complexity and good compression ratio for good quality images are in use.

Some of the compression techniques may give poor compression ratio and some may with good compression ratio. So, the compression method used here is LOCO-I algorithm. This is a new compression algorithm enhanced with the use of fuzzy logic. The role of fuzzy logic is to predict the exact low time complexity lossless image. This is entirely a new idea which has not done before. The codes used are Golomb-Rice encoder provides enhanced version of images. Here it discusses the principles underlying the design of LOCO-I, and its standardization is extended with fuzzy logic. Experimental results sure have a best quality compressed image ratio in comparison with the other used compression techniques.

The LOCO-I lossless compression algorithm is the new ISO/ITU standard for image compression/nearly lossless JPEG images. This algorithm is based on simple fixed context model. Prediction, residual modeling and context-based coding of the residuals are the basis of LOCO-I algorithm. LOCO-I attains compression ratios superior or similar to those obtained with state-of-the-art schemes based on arithmetic coding. Typically, compression using lossless operation mode can be achieve around 2:1 compression ratio for color images. This algorithm is flexible and easy to understand and also implements the method with less complexity in terms of compression ratio.

Advantages

An advanced compression technique used is LOCO-I lossless compression algorithm along with fuzzy logic. The LOCO-I algorithm is used to achieve low time complexity lossless compression. The aim of the project is to design and develop architecture for LOCO-I based compression technique to achieve better performance by using fuzzy logic which is entirely a new idea. The Golomb-Rice code with LOCO-I compression algorithm performs the lossless image compression. The role of fuzzy logic is to predict the exact low time complexity lossless image.

Fuzzy logic is used for further compression where the compressed output given by compression algorithm is provided to fuzzy register. Fuzzy register will compare the compressed value with the error value to give final best lossless compressed value. The compression is said lossless through manual calculation. From the results, the conclusion obtained is by using this method remarkable low time complexity is achieved. This method is efficient and exactly gives proper lossless compression with good compression ratio.

Disadvantages

LOCO-I (Low Complexity Lossless Compression for Images) is a lossless compression algorithm for continuous-tone images which combines the simplicity of the algorithm is based on a simple context model, which has the capability of more complex universal context modeling techniques for capturing high-order dependencies. The model is tuned for effective performance along with Golomb-Rice code. To say truly, LOCO-I is being considered by the ISO committee as a replacement for the current lossless standard in low-complexity applications.

Depending on this behavior of LOCO-I can able to obtain lossless image compression with low time complexity and good compression ratio. The coding part contains Golomb-Rice coder. Finally, fuzzy logic unit is designed to predict appropriate low time complexity lossless output which achieves good compression ratio. Hence it discusses the principles underlying the design of LOCO-I, and its standardization is extended with fuzzy logic. From the results can conclude that using this method can remarkably make the low time complexity. A DCT-based method is specified for “lossy” compression, and a predictive method for “lossless” compression. JPEG features a simple lossy technique known as the Baseline method, a subset of the other DCT-based modes of operation. The Baseline method has been by far the most widely implemented JPEG method to date, and is sufficient in its own right for a large number of applications. This paper provides an overview of the JPEG standard, and focuses in detail on the Baseline method.

Advantages

The proposed standard contains the four “modes of operation” identified previously. For each mode, one or more distinct codes are specified. Codes within a mode differ according to the precision of source image samples they can handle or the entropy coding method they use. Although the word codec (encoder/decoder) is used frequently in this article, there is no requirement that implementations must include both an encoder and a decoder.

Disadvantages

Many applications will have systems or devices which require only one or the other. The four modes of operation and their various codes have resulted from JPEG’s goal of being generic and from the diversity of image formats across applications. The multiple pieces can give the impression of undesirable complexity, but they should actually be regarded as a comprehensive “toolkit” which can span a wide range of continuous-tone image applications.

3. Lossless and Lossy Image Compression Based on Data Folding

Image compression plays a very important role in image processing especially when they have to send the image on the internet. Since imaging techniques produce prohibitive amounts of data, compression is necessary for storage and communication purposes. Many current compression schemes provide a very high compression rates but with considerable loss of quality. On the other hand, in some areas in medicine, it may be sufficient to maintain high image quality only in the region of interest, i.e., in diagnostically important regions called region of interest.

In the proposed work images are compressed using Data folding technique which uses the property of adjacent neighbour redundancy for prediction. In this method first column folding is applied followed by the row folding iteratively till the image size reduces to predefined value, then arithmetic encoding is applied which results the compressed image at the end before transmitting the data. In this paper lossless compression is achieved only at the region of interest and it is mainly suitable for medical images. A Region of Interest, often abbreviated ROI, is a selected subset of samples within a dataset identified for a particular purpose. The concept of an ROI is commonly used in medical imaging. Medical imaging has a great impact on medicine, especially in the fields of diagnosis and surgical planning. However, imaging devices continue to generate large amounts of data per patient, which require long-term storage and efficient transmission. Current compression schemes produce high compression rates if loss of quality is affordable. An approach that brings a high compression rate with good quality in the ROI is thus necessary. The general theme is to preserve quality in diagnostically critical regions while allowing lossy encoding of the other regions For example; the boundaries of a tumour may be defined on an image or in a volume, for the purpose of measuring its size. So in case of ROI they separate the region of interest from the complete image in which the user is interested. In the proposed method the compression idea is based on spatial resolution for lossless image compression called corrugation/ data folding. The idea is to subtract even pixels from odd pixels and store the difference data in a buffer. Odd pixels are stored in another buffer for further iterations. In this Image compression method first column folding is applied followed by the row folding iteratively till the image size reduces to predefined value. In column folding, pixels used for subtraction are column adjacent whereas in row folding, the pixels are row adjacent. The pixel redundancies are rearranged in a tile format and Arithmetic encoding technique is applied which results the compressed image at the end before transmitting the data. The idea is to reduce the image size iteratively in terms of dimensions rows or columns by 2. At the decoder, Arithmetic decoding is applied followed by data unfolding which is similar to data folding. Difference data thus obtained through all iterations is stored in the tile format. Data Folding is an algorithm for lossless image compression at the region of interest and lossy compression means quality of image degrades in the rest part of the image. It is simple and faster method which gives good bpp (bits per pixel) value, high PSNR and lower computational complexity. Arithmetic coding is better than the Huffman coding because it gives fewer bits as level of folding increases. It works comparatively better for smooth images. The proposed work is mainly suitable for medical images. The proposed data folding algorithm can be implemented using transformation technique such as DCT, DWT etc where the computation complexity is affordable. This results high compression ratio and achieves lossless compression for complete image.

4. Modified Run Length Encoding Scheme for High Data Compression Rate

Now a day's communication plays a vital role and it is the main aspect in the present world. Due to of this rapid changes are occurred and to transmit the data effectively and efficiently and it takes large time and power conception to transmit it. So it needs to decrease the data rate, the data can be compressed and it would be transmitted in an efficient manner. The efficient manner of compression data is to use Run Length Encoding (RLE) method. In this paper data compression uses Run Length Encoding (RLE) because the compression is very ability and would be having an exact output and an easy way to understand to implement. This algorithm is implemented by writing VHDL description and is simulated using Xilinx ISE software simulation tools. The paper deals mainly about data compression. There are two types of compressions - one is loss less data compression and other is lossy data compression. In this paper loss less data compression technique is used. Both techniques have their own advantages. Advantage of lossless compression is that it can send the data efficiently. It has low power consumption, reduced time delay. This includes audio, video, images and detailed graphics for screen design (computers, TVs, projector screens). One of the disadvantages of loss less compression is that if the data has less repentance bytes then it takes more bits than the original data. Run-length encoding (RLE) is a very simple form of data compression in which runs of data (that is, sequences in which the same data value occurs in many consecutive data elements) are stored as a single data value and count, rather than as the original run. This is most useful on data that contains many such runs: for example, simple graphic images such as icons, line drawings, and animations. It is not useful with files that don't have many runs as it could greatly increase the file size.

RLE may also be used to refer to an early graphics file format supported by CompuServe for compressing black and white images, but was widely supplanted by their later Graphics Interchange Format. RLE also refers to a little-used image format in Windows 3.x, with the extension rle‟, which is a Run Length Encoded Bitmap, used to compress the Windows 3.x startup screen. Run-length encoding is used in fax machines (combined with other techniques into Modified Huffman coding). It is relatively efficient because most faxed documents are mostly white space, with occasional interruptions of black. This technique is very useful to transmit the data having redundancy but this technique is fails to transmit the which is having less redundancy, it requires to send more compressed input bits than original data. This is the main limitation of this method. Lossy data compression has of course a strong negative connotation and sometimes it is doubted quite emotionally that it is at all applicable in medical imaging. In Transform encoding one performs for each image, run a mathematical transformation that is similar to the Fourier Transform thus separating image information on gradual spatial variation of brightness (regions of essentially constant brightness) from information with faster variation of brightness at edges of the image (compare: the grouping by the editor of news according to the classes of contents). In the next step, the information on slower changes is transmitted essentially lossless (compare: careful reading of highly relevant pages in the newspaper), but information on faster local changes is communicated with lower accuracy compare: looking only at the large headings on the less relevant pages). In image data reduction, this second step is called quantization. Since this quantization step cannot be reversed when decompressing the data, the overall compression is lossy‟ or irreversible‟. Run-length encoding performs lossless data compression and it is well suited to the digital data which is having more redundancy. This loss less data compression technique is very useful for efficient data transmission in less duration of time. So it takes less power conception and reduces the time delay. These Common formats for run-length encoded data include True vision TGA, Pack Bits, PCX and ILBM.

Most lossless compression programs do two things in sequence: the first step generates a statistical model for the input data, and the second step uses this model to map input data to bit sequences in such a way that "probable" (e.g. frequently encountered) data will produce shorter output than "improbable" data. The primary encoding algorithms used to produce bit sequences are Huffman coding (also used by DEFLATE) and arithmetic coding. Arithmetic coding achieves compression rates close to the best possible for a particular statistical model, which is given by the information entropy, whereas Huffman compression is simpler and faster but produces poor results for models that deal with symbol probabilities.

EXISTING SYSTEM

Data folding is a way for lossless image compression. The compression idea is based on spatial resolution for lossless image compression called corrugation/ data folding. The Data folding exploit pixel redundancy in 2-D images in either consecutive rows or columns. The idea is to subtract even pixels from odd pixels and store the difference data in a buffer. Odd pixels are stored in another buffer for further iterations. In data folding column folding followed by row folding is applied. In column folding, pixels used for subtraction are column adjacent whereas in row folding, the pixels are row adjacent.

The pixel redundancies are rearranged in a tile format and source encoding technique is applied at the end before transmitting the data. The difference matrix can be entropy encoded by using the Huffman Coding (HC) algorithm. The histogram and the probability distribution is calculated for helping the Huffman table calculation. The final results are obtained after encoding the data of each level would be compressed data for the input image. The dictionary is used for entropy encoding which is a mapping between pixel value and corresponding bit value is also transferred along with the encoded bit file.

The decoder will perform the Huffman decoding followed by the data unfolding. The decoding is done by using the Huffman table. Data unfolding is an iterative procedure similar to data folding. Row unfolding by column unfolding that is repeated at each image level. This data unfolding is starts with the bottom right elements of the image.

Drawbacks of Existing System

- It divides images into regular square image block only.
- The data folding Increases the encoding time and reduce compression ratio.
- It has the high computational complexity
- It gives the good results for the textual images only not for the photographic images
- The data folding has the problem of higher magnitudes while calculating the difference data
- It has the more pixel distance in higher levels
- The efficiency of compression is flooded after certain level of data folding
- Huffman coding always produces rounding errors, because its code length is restricted to multiples of a bit.

PROPOSED SYSTEM

Equivalently to the Huffman coding, the arithmetical coding tries to evaluate the probability with which certain symbols appear and to optimize the length of the required code. The arithmetic coding (AC) achieves an optimum which exactly corresponds to the theoretical specifications of the information theory. A slight degradation results from inaccuracies, which are caused by correction mechanisms for the interval division.

When all symbols have been encoded, the resulting interval unambiguously identifies the sequence of symbols that produced it. Anyone who has the same final interval and model that is being used can reconstruct the symbol sequence that must have entered the encoder to result in that final interval. The interval of the symbol is low and high based on the cumulative probabilities.

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