Image Compression Using Pixel Correlation & Image Decomposition

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Abstract

Digital images contain large amount of information that need evolving effective techniques for storing and transmitting the ever increasing volumes of data. Image compression addresses the problem by reducing the amount of data required to represent a digital image. The uncompressed image data requires a large storage capacity and transmission bandwidth. The purpose of the image compression algorithm is to reduce the amount of data required to represent the image with less degradation in the visual quality and without any information loss. In a monochrome image, the neighboring pixels are more correlated. The discrete cosine transform (DCT) and wavelet transform are commonly used to reduce the redundancy between the pixels and for energy compaction. The JPEG standard uses the DCT and the JPEG2000 standard uses the wavelet Inter Color Correlation Based Enhanced Color In a color image, correlation exists between the neighboring pixels of each color channel and as well as between the color channels But pixels beyond the neighbor matrix will not match so we will introduce a new method that is based on the image byte streaming and color correlation.

Keywords:- Discrete cosine transform (DCT), wavelet transform, JPEG2000

1. Introduction
1.1 Image Compression

Image compression addresses the problem of reducing the amount of data required to represent a digital image. It is a process intended to yield a compact representation of an image, thereby reducing the image storage/transmission requirements. Compression is achieved by the removal of one or more of the three basic data redundancies:
1. Coding Redundancy
2. Interpixel Redundancy
3. Psychovisual Redundancy

Coding redundancy is present when less than optimal code words are used. Inter pixel redundancy results from correlations between the pixels of an image. Psychovisual redundancy is due to data that is ignored by the human visual system (i.e. visually non essential information). 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 the reconstructed 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.

\[
f(x,y) \xrightarrow{\text{Mapper}} \text{Encoder} \xrightarrow{\text{Quantizer}} \text{Compressed image} \xrightarrow{\text{Symbol Decoder}} \text{Decoder} \xrightarrow{\text{Inverse Mapper}} F(x,y)
\]

\( f(x,y) \) Encoder Compressed image \( F(x,y) \) Decoder Image \( f(x,y) \) is fed into the encoder, which creates a set of symbols from the input data and uses them to represent the image. If we let \( n_1 \) and \( n_2 \) denote the number of information carrying units (usually bits) in the original and encoded images respectively, the compression that is achieved can be quantified numerically via the compression ratio,

\[ CR = \frac{n_1}{n_2} \]

As shown in the figure, the encoder is responsible for reducing the coding, interpixel and psychovisual redundancies of input image. In first stage, the mapper transforms the input image into a format designed to reduce interpixel redundancies. The second stage, quantizer block reduces the accuracy of mapper’s output in accordance with a predefined criterion. In third and final stage, a symbol decoder creates a code for quantizer output and maps the output in accordance with the code. These blocks perform, in reverse order, the inverse operations of the encoder’s symbol coder and mapper block. As quantization is irreversible, an inverse quantization is not included.

2. Image Compression Techniques

The image compression techniques are broadly classified into two categories depending whether or not an exact replica of the original image could be reconstructed using the compressed image.

These are:
1. Lossless technique
2. Lossy technique

2.1 Lossless compression technique

In lossless compression techniques, the original image can be perfectly recovered from the compressed (encoded) image. These are also called noiseless since they do not add noise to the signal (image). It is also known as entropy coding since it uses statistics/decomposition techniques to eliminate/minimize redundancy. Lossless compression is used only for a few applications with stringent requirements such as medical imaging.

Following techniques are included in lossless compression:
1. Run length encoding
2. Huffman encoding
3. LZW coding
4. Area coding

2.2 Lossy compression technique

Lossy schemes provide much higher compression ratios than lossless schemes. Lossy schemes are widely used since the quality of the reconstructed images is adequate for most applications. By this scheme, the decompressed image is not identical to the original image, but reasonably close to it.

Figure: Outline of lossy image compression
As shown above the outline of lossy compression techniques. In this prediction – transformation – decomposition process is completely reversible. The quantization process results in loss of information. The entropy coding after the quantization step, however, is lossless. The decoding is a reverse process. Firstly, entropy decoding is applied to compressed data to get the quantized data. Secondly, dequantization is applied to it & finally the inverse transformation to get the reconstructed image.

Major performance considerations of a lossy compression scheme include:
1. Compression ratio
2. Signal - to – noise ratio
3. Speed of encoding & decoding.

Lossy compression techniques includes following schemes:
1. Transformation coding
2. Vector quantization
3. Fractal coding
4. Block Truncation Coding
5. Subband coding

3. Purposed method :- Image is firstly converted into byte[] stream and match the values of color by using binary tree to sort the values of color and mark the reference of the location of stream index. This index will fill the color of the reference location. This helps to no reduction of value to achieve the lossless image. There is no neighbor color co relation by which more efficient image compression will achieved.

4. Conclusion and Future work:-

In our image compression technique, we user bit reference so there is no way to effect to image for any type of generation of image artifacts. We use array of generic structure for the access the reference of bits which is cost effective and performance effective. So It provides a potential cost savings associated with sending less data over switched telephone network where cost of call is really usually based upon its duration. It not only reduces storage requirements but also overall execution time. In future one can use hash algorithm structure for the reference of the color bytes so that access of color reference may faster than array.

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