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Steganalysis in Estimation of Spatial ± 1 Steganography Using JPEG 2000 Standards

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ABSTRACT: Image compression addresses the problem of reducing the amount of data required to represent a digital image called the redundant data. The underlying basis of the reduction process is the removal of redundant data. The redundancy used here is psycho visual redundancy. In this letter, we firstly propose an effective method to detect the quantization table from the contaminated digital images which are originally stored as JPEG format based on our recently developed work about JPEG compression error analysis, and then we present a quantitative method to reliably estimate the length of spatial modifications in those gray-scale JPEG stegos by using data fitting technology. In Proposed method using 3D-DCT Image compression algorithm takes a full-motion digital video stream and divides it into groups of 8 frames. In the image is divided into 8x8 blocks (like JPEG), forming 8x8x8 cubes. Each 8x8x8 cube is then independently encoded using the 3D-DCT algorithm: 3D-DCT, Quantize, and Entropy encoder. A 3D DCT is made up of set of Image at a time. Image compression is one of the processes in image processing which minimizes the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level. The reduction in file size allows more images to be stored in a given amount of disk or memory space.

KEYWORDS: Image compression, Digital Image, psycho visual redundancy, 3D-DCT Image compression, Water Marking.

I. INTRODUCTION

Interest in image processing methods stems from two principal application areas, improvement of pictorial information for human interpretation for autonomous machine perception. An image may be defined as a two-dimensional function, $f(x,y)$ where x and y are spatial coordinates and (x,y) is called the intensity of f are all finite, discrete quantities, the image is called a digital image. Transform theory plays a fundamental role in image processing, as working with the transform of an image instead of the image itself may give us more insight into the properties of the image. Two dimensional transforms are applied to image enhancement, restoration, encoding and description and also vitally contributes for image compression.

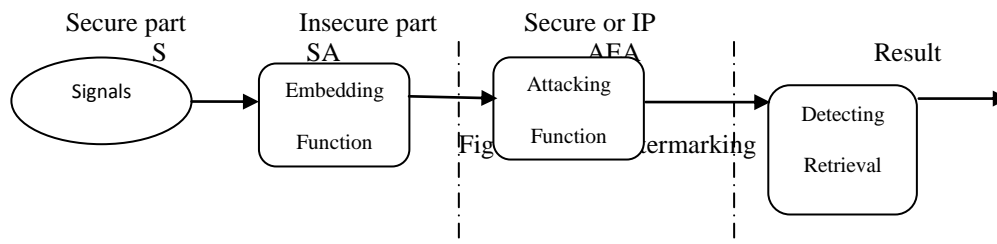
There are several different ways in which image files can be compressed. For Internet use, the two most common compressed graphic image formats are the JPEG format and the GIF format. The JPEG method is more often used for photographs, while the GIF method is commonly used for line art and other images in which geometric shapes are relatively simple. A digital watermark is a kind of marker covertly embedded in a noise-tolerant signal such as audio or image data. It is typically used to identify ownership of the copyright of such signal. "Watermarking" is the process of hiding digital information in a carrier signal; the hidden information should, but does not need to contain a relation to the carrier signal.

Digital watermarks may be used to verify the authenticity or integrity of the carrier signal or to show the identity of its owners. It is prominently used for tracing copyright infringements and for banknote authentication. Like traditional watermarks, digital watermarks are only perceptible under certain conditions, i.e. after using some algorithm, and imperceptible anytime else. If a digital watermark distorts the carrier signal in a way that it becomes perceivable, it is of no use. Traditional Watermarks may be applied to visible media (like images or video), whereas in digital watermarking, the signal may be audio, pictures, video, texts or 3D models.

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II. IMAGE COMPRESSION

Compressing an image is significantly different than compressing raw binary data. Of course, general purpose compression programs can be used to compress images, but the result is less than optimal. This is because images have certain statistical properties which can be exploited by encoders specifically designed for them. Also, some of the finer details in the image can be sacrificed for the sake of saving a little more bandwidth or storage space. The objective of image compression is to reduce irrelevance and redundancy of the image data in order to be able to store or transmit data in an efficient form.

Image compression may be lossy or lossless. Lossless compression involves with compressing data which, when decompressed, will be an exact replica of the original data. This is the case when binary data such as executable, documents etc. are compressed. They need to be exactly reproduced when decompressed. On the other hand, images need not be reproduced 'exactly'.

An approximation of the original image is enough for most purposes, as long as the error between the original and the compressed image is tolerable. Lossless compression is preferred for archival purposes and often for medical imaging, technical drawings, clip art, or comics. This is because lossy compression methods, especially when used at low bit rates, introduce compression artefacts. Lossy methods are especially suitable for natural images such as photographs 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 may be called visually lossless.

III. 3D- DISCRETE COSINE TRANSFORM (DCT)

The image in RGB format is first converted to YCbCr format to separate the luminance from the chrominance information. After the conversion, each colour component is partitioned into blocks of 8x8 pixels. The intensity values of pixels in each block are normalized to [-128, +127]. Each block is then processed in the following order.

- 1) 3D Data Cube Formation: Starting with the top-left corner of the image, every eight adjacent two-dimensional pixel blocks are taken to construct a three-dimensional data cube.
- 2) 3D FDCT Transformation: The three-dimensional forward discrete cosine transformation is performed on each three-dimensional data cube. The purpose is to reduce the redundancy of similar pixel blocks. After the 3D DCT transformation, only a small number of low-frequency coefficients are significant. Most high-frequency coefficients are near zeros.
- 3) Quantization: All DCT coefficients in the same data cube are quantized using the following formula:

$$F_q(u,v,w) = \text{round}\left(\frac{F(u,v,w)}{Q(u,v,w)}\right) \quad 1)$$

Where u, v, w are the spatial indices $F(u, v, w)$ refers to the coefficient value before the quantization $Q(u, v, w)$ denotes the element in the quantization table F_q represents the quantized coefficient.

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4) Zigzag and Entropy Coding: Each 2-D block in a 3D cube is zigzagged into a vector. The difference between the DC values in the adjacent 3D cubes is computed and Huffman encoded. The run-length of zero AC coefficients and the non-zero AC coefficients in each 2-D block in the same data cube are also Huffman encoded. The decoding procedure is the reverse of the encoding procedure. The compressed image is first Huffman decoded. All 2-D blocks of quantized coefficients in the same data cube are identified and dequantized. The 3D inverse DCT is then applied to each data cube.

5) Streaming: The streaming process converts the 3D data structure of the video cube into a linear data stream. The stream order is essential for the subsequent zero run-length encoder. To optimize its efficiency the stream order has to maximize the average number of subsequent zero's. As the statistical properties of each component within a cube are known, the optimum sequence can be determined by sorting the components with their zero probability in ascending or descending order. If latency is not an issue, the streaming process can be delayed until all cubes of the sequence are compressed. The optimized stream order can then be applied to the whole sequence.

Encoder 3D DCT

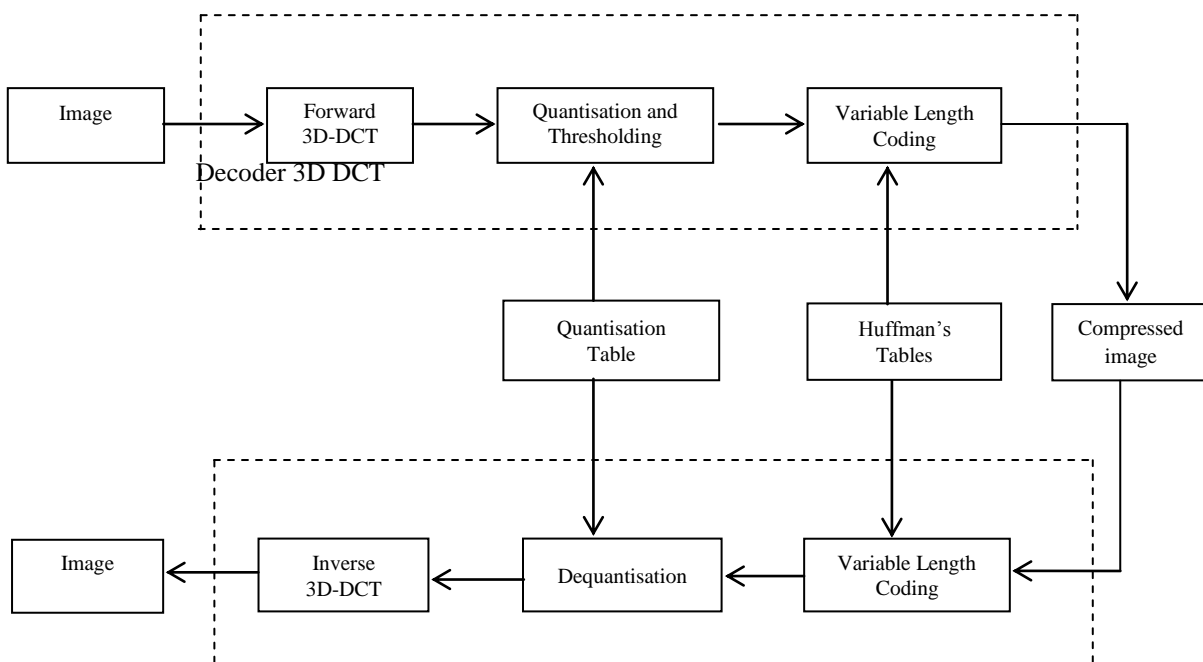


Fig. 2 Block diagram of 3D DCT

- a. 3D System Description: This section gives a more detailed description of the parts of the system outlined above. It also describes some extensions of the basic algorithm that lead to improved compression results. Trade-off is presented that greatly simplify an efficient implementation while only slightly degrading the overall performance.
- b. Colour-Space Conversion: As the human visual system is less sensitive to colour (chrominance) than to contrast (luminance), the original RGB image is initially converted into the Y Cb Cr colour space, separating the luminance component (Y) of the signal from the two chrominance components (Cb and Cr). This separation allows applying a more aggressive quantization to the less sensitive colour components of the image sequence.
- c. Differential Prediction: Maintaining differential encoding is the simplest possible prediction scheme. It proves especially efficient for scenes with highly detailed static backgrounds. Since the 3D-DCT intrinsically decorrelates successive frames within individual video cubes, differential encoding within cubes is inappropriate. However, since the transform does not operate across cube boundaries, differential prediction may be used to

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remove some of the redundant information in subsequent cubes. Hereto we employ the last frame of the known cube as a predictor for each frame in the following cube. As the same predictor is used for every frame, this process only affects the temporal DC-component in the frequency domain. Especially in relatively static scenes these components carry the highest amount of information.

- d. DC-Prediction: After the transformation into the frequency domain, the information is concentrated in the low frequency coefficients. Looking across cube boundaries in the spatial domain, it becomes obvious that the DC components of adjacent cubes can be highly correlated; especially in scenes with large monotonous areas. This correlation is again not exploited by the 3D-DCT due to its limited scope. A good prediction of the DC-component of some cube could be obtained from a combination of the DC-components of all its neighbouring cubes. However, with respect to the implementation, only the previous cube to the left is used as a predictor, with the DC-component of the first cube in every row being encoded with its absolute value. This corresponds to the feed-back prediction scheme. Thus, error propagation is avoided for the DC-components. In this case the introduced overhead is marginal.

IV. SIMULATION RESULT

Fig. 3 a) Original image b) The inverse DCT image c) Output window d) Original image 3D-DCT e) Output of de compressed image f) Output window



a)

b)

```

Command Window
Displaying DCT decompressed image details
PSNR for Embedded Image 37.132120

info_INPUT =
    Filename: [1x79 char]
    FileModDate: '16-Apr-2015 12:30:03'
    FileSize: 11177
    Format: 'jpg'
    FormatVersion: ''
    Width: 256
    Height: 256
    BitDepth: 24
    ColorType: 'truecolor'
    FormatSignature: ''
    NumberOfSamples: 3
    CodingMethod: 'Huffman'
    CodingProcess: 'Sequential'
    Comment: {}

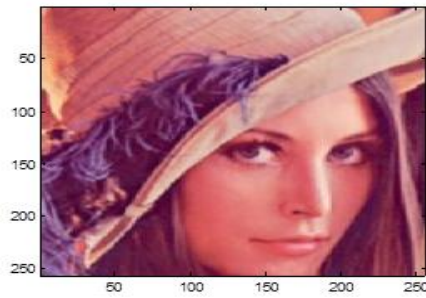
File Size of input image : | 11177 bytes
fx File Size of compressed image: 1100 bytes>>
    
```

c)

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d)



e)

```

Command Window

PSNR for Embedded Image 57.132120

info_INPUT =

    Filename: [1x81 char]
    FileModDate: '16-Apr-2015 12:33:42'
    FileSize: 11177
    Format: 'jpg'
    FormatVersion: ''
    Width: 256
    Height: 256
    BitDepth: 24
    ColorType: 'truecolor'
    FormatSignature: ''
    NumberOfSamples: 3
    CodingMethod: 'Huffman'
    CodingProcess: 'Sequential'
    Comment: {}

File Size of input image : 11177 bytes
File Size of compressed image: 524 bytes>>

```

f)

V. CONCLUSION

An efficient routing strategy to control the routing path and to identify the malicious nodes. A new steganographic encoding scheme which separates the colour channels of the windows bitmap images and then hides messages randomly in the LSB of one colour component of a chosen pixel where the colour components of the other two are found to be equal to the key selected. In addition to this we apply 3D-DCT based Steganography which embeds the text message in LSB of the Discrete Cosine (DC) coefficient of digital picture. Then Huffman encoding is also performed on the secret messages/images before embedding and each bit of Huffman code of secret message/image is embedded in the frequency domain by altering the LSB of each of the DCT coefficients of cover image blocks. The algorithm has a high capacity and a good invisibility. Moreover PSNR of cover image with stego-image shows better results in comparison with other existing steganography approaches.

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