A Novel Method for Detecting Triple JPEG Compression with the Same Quantization Matrix

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Abstract - **The detection of JPEG compression plays an important role in digital forensics. The JPEG image can be compressed one, two, three or n times. But if the number of times of the compression of a same JPEG image increases, the process of detection of the JPEG compression will be difficult. If the compression is done using the same quantization matrix the detection is even more difficult. There are mainly two reasons why forensic experts give attention to the detection of JPEG compression. The first one is that due to image forgery compressed JPEG images often resulted. The second one is that some JPEG steganographic schemes such may generate doubly compressed images or triply compressed images if the input cover image is in JPEG format. Detection of JPEG compression ie, how many times a JPEG image is compressed can help to identify the steganographic algorithm or improve the detection accuracy rate of the steganalytic schemes.**

*Keywords***- Colour image, JPEG Compression, Extended Random Perturbation Strategy**

I. INTRODUCTION

JPEG is the one of the hottest topic in the image compression method that is used today. The Joint Photographic Experts Group stands for JPEG, a standards committee that had its origin within the International Standard Organization (ISO). In 1982, the ISO formed the Photographic Experts Group (PEG) to research methods of transmitting video, still images, and text over ISDN (Integrated Services Digital Network) lines. PEG's goal was to produce a set of industry standards for the transmission of graphics and image data over digital communications networks. In 1986, a subgroup of the CCITT (International Telegraph and Telephone Consultative Committee) began to research methods of compressing colour and gray-scale data for facsimile transmission. The compression methods needed for colour facsimile systems were very similar to those being researched by PEG. It was therefore agreed that the two groups should combine their resources and work together toward a single standard. In 1987,

the ISO and CCITT joined their their two groups into a joint committee that would research and produce a single standard of image data compression for both organizations to use. This new committee was named as JPEG.

Triple joint photographic experts group (JPEG) compression means that a JPEG image has been compressed three times by JPEG compression. The detection of Triple JPEG compression plays an important role in the area of digital forensics. Detection of triple JPEG compression can helps to identify the steganographic algorithm or improve the detection accuracy rate of the steganalytic schemes. In this paper we are doing the detection of the various compressions in an experimental form. For that we are first created a test data base that contains three types of compressed images (Ie, singly compressed, doubly compressed and triply compressed.) and of five different quality factors . For creating the test database we need to compress the JPEG images singly, doubly and triply.

II. LITERATURE SURVEY

JPEG can be considered as a algorithm that can be useful for image compression . And also that algorithm can be altered to satisfy the different needs of the users [1]. Using JPEG image compression it can achieve very high compression ratios. If the compression ratios increase, the quality of the image decreases. But those images are still very useful in many applications. For transferring highly compressed image through internet it will consume very little bandwidth. Also JPEG is highly capable of creating compressed images those are of high quality when compared with the original image data.

The method of compression used in JPEG images are usually lossy by nature, ie during the image compression process we are losing some image data. During the encoding process in the image compression it discards the useless data for getting the high compression ratios. The discarded information cannot easily identifiable by the human eyes. So we cannot reconstruct the original image exactly. There are also some lossless image

compression standards known as LZW, CCIT or the RLE standards. These standards do not remove any image data during the compression process and still able to achieve image compression. And also we can reconstruct the original image. When compared with the lossy compression schemes usually the compression ratios of the lossless method are very less.

Detection of double compression of the JPEG images are very useful for applications in steganography[2]. Mainly it is having two uses, firstly it describes an effective method for detecting double compression of the JPEG images with the help of support vector machines. A key attribute of this method is that, it is able to detect double compression of the cover images as well as the images processed with Steganographic algorithms. Secondly it helps to create a maximum probability estimator of the primary quality factor in double-compressed JPEG images.

One of the major problems with the many steganographic systems are the weakness to withstand against various statistical and attacks. Only fairly small capacity for Steganographic messages if the system is without the above weakness. F5- is an novel Steganographic Algorithm which is having elevated capacity and also good Steganalysis. It is also have the ability to resist against various statistical and visual attacks. For improving the efficiency of the F5, it uses matrix encoding.

We all know eye movements are the one of the major components of the human vision the reason of this is due to only some area of our visual scene are fixated and have been processed by our brain at high resolution. The retina samples the other image areas at lower and coarser resolution. But the corresponding image is appeared uniformly clear to our eyes. Study on focussed JPEG compression FJpeg[11] help us to understand this concept clearly. It uses a focused Jpeg encoder, visual compression or FJpeg which is created for operate in a like fashion. The working of FJpeg is depend upon the algorithms for image processing which is able to interpret human regions-of-interst , ROIs, and on a equivalent differentiated quantization of the DCT coefficients.

III. PROPOSED DETECTION METHOD

This detection method is based on a algorithm known as Random Perturbation Strategy [12] for detecting the double compression of the JPEG images using the same quantization matrix. Here we are modifying the current algorithm to Extended Random Perturbation Strategy which is capable of detecting the triple compression of the

JPEG images with the same quantization matrix. And it contains JPEG compression and JPEG decompression process in repeated number of times in some specific order.

A. *Compress the Image Using the Same Quantization Matrix.*

In this step we are compressing the JPEG image singly ie, one time compression, doubly ie,two time compressing and triply, ie three time , the JPEG image with the same quantization matrix for making the input files for our experiment according to the diagram given in fig 1..
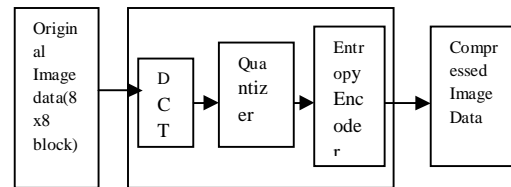

Fig 1. Block diagram of jpeg compression process.

B. *Decompress the Image*

In this step we are decompressing the image using the following step. Ie the reverse process of the JPEG compression process. It is shown in fig 2.
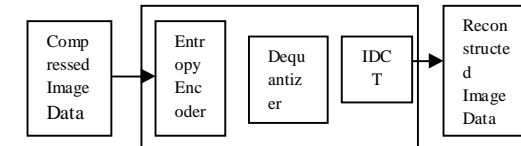

Fig 2. Block diagram of jpeg decompression process

C. *Extended Random Perturbation Strategy*

In this we are implementing the 4 steps in Extended Random Perturbation Strategy. Following steps. The steps are

STEP 1: Take the image which is to be tested as 'I'. First image 'I' is to be decompressed then the resulting Image is to be recompressed with the same quantization matrix. The resulted image is called as I'. And one more time we have to decompress the image I' into spatial domain and again recompress I' with the same quantization matrix. The resulted image is called as I''. S_1 denotes the number of different JPEG coefficients between I and I'. S_2 represents the number of different JPEG coefficients between I' and I''.

STEP 2: For getting the JPEG coefficients of I', entropy decode I' and from the resulted JPEG coefficients, arbitrarily choose a portion for

alteration. Each arbitrarily choosed coefficients are increased or decreased by 1 randomly. For getting the JPEG image I'm, entropy encode the modified JPEG coefficients again. In this step we are doing doing entropy coding only for getting the JPEG coefficients alteration. Entropy coding can be done with the help of JPEG Tool Box.

STEP 3: For getting JPEG image I''m, we have to decompress I'm into spatial domain and using the same quantization matrix the resulting image is to be recompressed. S'm represents the number of different JPEG coefficients between I'm and I''m

STEP 4: Repeat steps 2 and 3 for k times. Note that in each time, the JPEG coefficients of I' to be modified are arbitrarily selected, but the ratio of JPEG coefficients that should be modified remains the same. Each and every time we may have a unlike value S'm, represented by S^1m,, S^2m,….S□m , respectively.

The average value is

$$S_m = (S^1m+S^2m+….+S□m)/k$$

If $S_m > S_2$ is a triply compressed image   (1)

If $S_m < S_2$ and $Sm > S_1$ is a doubly compressed image   (2)

If $S_m < S_1$ is a singly compressed image.   (3)

The key for the success of our detection method is the portion of JPEG coefficients that should be modified. The modified portion being selected too big or too small will not lead to a good detection result.

The images in the test database are as shown in Fig 3. First the uncompressed JPEG colour images is taken and then convert that JPEG image into gray scale image. Then the converted gray scale image is singly compressed, then the singly compressed image is again compressed then that image became doubly compressed. After that the doubly compressed image is again compressed then it became triply compressed. Each of these compressed colour images are stored in the database separately and form a test database. This database is used to determine the detection accuracy of the Extended Random Perturbation Strategy.
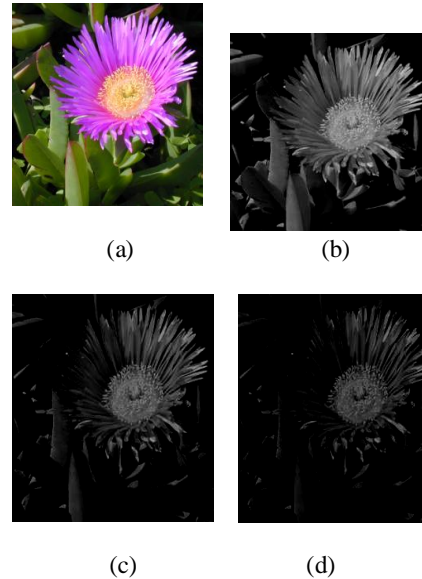

(a)   (b)

(c)   (d)

Fig 3. (a)Uncompressed colour image (b) Singly compressed image (c) Doubly compressed image (d) Triply compressed image.

After implementing the Random Perturbation Strategy, a test database is given to the implemented program for detecting the various compressions. The test database contains three images each ie, singly compressed, doubly compressed and triply compressed and of different Quality Factors ranging from 60, 70, 80, 90, 100. And total of 60 images. The output of the detection accuracy of the program is shown in the table 1. The equation for calculating the accuracy rate is given equation 4.

TABLE 1.

DETECTION ACCURACY.

QUALITY FACTOR	NUMBER OF SINGLY COMPRESSED IMAGES	NUMBER OF DOUBLY COMPRESSED IMAGES	NUMBER OF TRIPLY COMPRESSED IMAGES	DETECTED NUMBER OF SINGLY COMPRESSED	DETECTED NUMBER OF DOUBLY COMPRESSED	DETECTED NUMBER OF TRIPLY COMPRESSED	DETECTION ACCURACY RATE
60	4	4	4	2	4	4	83.3333
70	4	4	4	2	2	3	58.3333
80	4	4	4	2	3	4	75
90	4	4	4	3	3	4	83.3333
100	4	4	4	4	3	4	91.6667

$$Accuracy\ rate = \frac{(Detected\ no\ images)}{Total\ no\ of\ images}*100 \qquad (4)$$

Accuracy rate indicates that how many images from the database is detected correctly according to its quality factors, i.e. singly compressed, doubly compressed and triply compressed.

IV. CONCLUSION

Because the difference between the singly compressed JPEG image, doubly compressed JPEG image and a triply compressed JPEG image with

the same quantization matrix is small, detection of double JPEG compression and triple JPEG compression with the same quantization matrix is a challenging problem. Through a extended random perturbation strategy, the difference between a singly compressed image, a doubly compressed image and a triply compressed image can be discriminated, especially when the image is compressed with relatively high Quality Factor . A novel method for Detection of Double and Triple JPEG Compression with Random Perturbation Strategy is an efficient method for Detecting for Double JPEG Compression as well as Triple JPEG compression with the same quantization matrix. This method has very much importance in the area of digital forensics.

V.   REFERENCES

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