Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231– 6345 (Online)
An Open Access, Online International Journal Available at www.cibtech.org/sp.ed/jls/2015/04/jls.htm
2015 Vol. 5 (S4), pp. 404-416/Nowroozi
Research Article

IDENTIFICATION OF DOUBLE COMPRESSED MEDICAL IMAGES WITH MANIPULATION

***Ehsan Nowroozi**
Department of Science and Computer Engineering, Shahid Beheshti University, Evin, Tehran, 19839-63113, Iran
**Author for Correspondence*

ABSTRACT
Nowadays a variety of powerful software has been developed to manipulate digital images, that such software has caused the accuracy of digital medical documents undergo questioning. Yet, fortunately some algorithms have developed to diagnose fake medical images that undergo progress. Any change in digital images will raise unconventional statistical features that do not exist in natural images. In this regards, another classification of fake image detection algorithms has developed that detect the fake images without any need to further information and only through detection of artificial phenomena. Such algorithms are called inactive algorithms. Manipulation of images can be classified to a variety of classifications. Double compression with manipulation of image is one of the types of manipulation of images. Through manipulation, the compressed image enters into software called Photoshop and undergoes manipulation and ultimately stores, called with double compression of image with manipulation. In this study, an algorithm is elaborated to detect double compressed medical images with manipulation. The proposed method is extracted through artificial block effects, undergoing detection through statistical features and support vector machine in double compressed fake medical images with manipulation at high accuracy.

Keywords: *Inactive Detection of Double Compressed Images, Criminology of Digital Images, Manipulation of Image,* Image Authentication, *Detection of Manipulated Images*

INTRODUCTION

Nowadays, with advancement of digital world, powerful software tools have been developed to edit digital image. Editing the images which has been assumed so tough in the past has become simpler via such tools; so that a 10 years old child can remove an object from an image that the adults do not understand such object existed in this image previously. Unfortunately these tools are not just employed to beautify the images but are misused more often. Assume two persons are taken to court, one of them represents an image as evidence claimed that it has been taken via his mobile phone, under which a question which is asked is in this way that how it can trust. The response to this question has led in Forensic science. This science represents a series of methods and tools for tracking and investigating the manipulations in the information and specifies the accuracy of information. This science has a wide range, that the present research just considered overview of this science at the area of digital images. This science has two general approaches at the area of digital images: active approach and passive approach (Farid, 2009).

Passive fake image detection algorithms do not require previous information on image and content of image or any other methods such as steganography. With regard to the announcement by Wall Street Journal, 10% of all the all colored photos published in America have been precisely manipulated (Amsberry, 1989). This phenomenon has also affected the scientific medical community of our country and subjected the medical community to the fake images (Farid, 2006). Authenticity of images is of great importance, because the images are generally of a great importance as historical evidences in wide range of applications of criminology research, photojournalism, criminal investigation, lawsuits and medical imaging applications. Image forgery has a long history. Nowadays, it can create, modify or change the information proposed via image, without any trance on these operations. Figure 1 represents high attention to fake image detection; in this figure, the number of articles associated to this area published by

IEEE association, presses and journals during recent 12 years indicates the significant of research at this area.

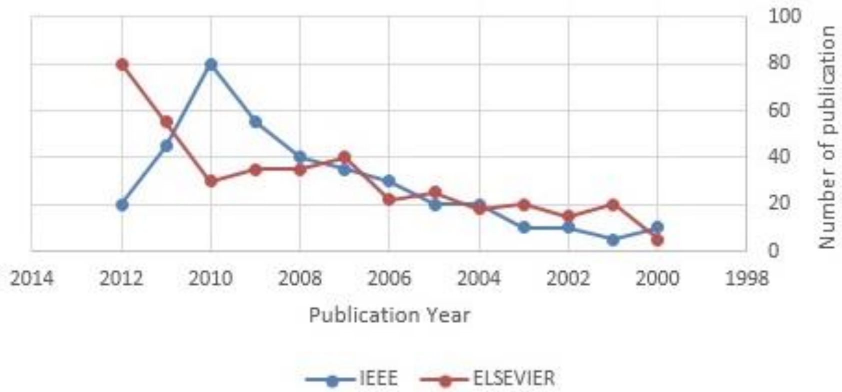


Figure 1: The number of articles published during 12 years (Birjadar *et al.*, 2013)

Passive Approach

In passive approach, without embedding extra information in the image, we seek the effects raised in the image. This is precisely like finding a thief's fingerprint on an object. The assumption of this method lies on this fact that however the change in image is not seen by the man's eye, it will raise change in statistical features of image.

An Overview on Passive Method for Double Compressed Images

When two-dimensional light intensity function is sampled to generate a digital image, numerous data are generated. Indeed, the amount of the generated data might be large to the extent that storing and processing them seem impractical. Under such states, displays except for two-dimensional sampling are required. Image compression engages in reducing the extent of required data to display digital image. Removal of extra data is mentioned as a basis for reducing the extent of required data to display digital image. Mathematically, this process corresponds to transformation of a two-dimensional pixel array to a series of statistical data, that such transformation is generally accomplished before storing or transmitting the image. The compressed image at a period of time disappears with compression state in order that the early image undergoes reconstruction. Manipulation of digital images generally requires use of image editing and photo manipulation package such as Photoshop software. During digital documents forgery, the image is loaded in image editing and photo manipulation package and manipulationsare made and the image is stored again. If most of digital cameras appear as JPEG types, it can say that the image has been compressed. Double compressed images contain special changes that it can consider these changes to differentiate them from once compressed images. Nonetheless, it should be noted that discovery of double compressed images does not prove manipulation, e.g. the user might store the high quality of JPEG images with lower quality for storage of maintenance space. Nonetheless, accuracy of double compressed JPEG image is challenging, required further analysis (Popescu *et al.*, 2004). Compression of image can come to realize with or without waste. Compression without waste is preferred in some images such icons and technical mapping, under which compression damages to the quality of image in compression methods with waste especially when it is used for low bits rate. The compression methods without waste are more likely used for medical images or scanned images for the purposes of archiving. We often need to use a small image for some special purposes, thus losing bits of image will not raise any problem. This method is called compression with waste. JPEG compression method is called to a method with waste, because bits are removed from image in this method.

JPEG Compression

In general, it can state that image compression algorithm has four stages (Gonzalez *et al.*, 2008). At the first step, the image must be divided to 8*8 blocks (Figure 2), and then discrete cosine transform must be applied on each of blocks after the stage of image blocking. After obtaining the discrete cosine transform coefficients, the coefficients must be multiplied such that the coefficients matrix is divided into the standard matrix. Figure 3 indicates standard matrix, that the multiplied matrix coefficients must be encoded in a special order at the last stage via Hoffman method.

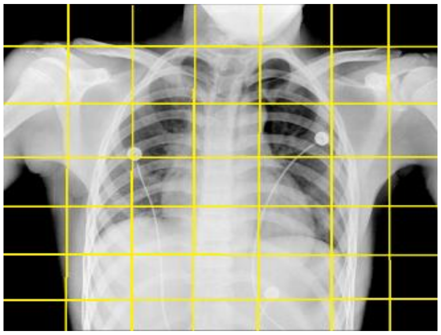


Figure 2: Blocked image

$$\begin{bmatrix} 16 & 11 & 10 & 16 & 24 & 40 & 51 & 61 \\ 12 & 12 & 14 & 19 & 26 & 58 & 60 & 55 \\ 14 & 13 & 16 & 24 & 40 & 57 & 69 & 56 \\ 14 & 17 & 22 & 29 & 51 & 87 & 80 & 62 \\ 18 & 22 & 37 & 56 & 68 & 109 & 103 & 77 \\ 24 & 35 & 55 & 64 & 81 & 104 & 113 & 92 \\ 49 & 64 & 78 & 87 & 103 & 121 & 120 & 101 \\ 72 & 92 & 95 & 98 & 112 & 100 & 103 & 99 \end{bmatrix}$$

Figure 3: Standard multiplied matrix

All the stages are applied on gray scale image, yet if there exists a colored scale image, firstly it must be transferred to the colored space and then the existing stages must be applied on the image. JPEG is an algorithm with waste because a series of data are wasted during the stage of multiplication. Assume Q represents multiplication, the more value of Q is considered with a higher value, numerous wastes will occur in the data. To display JPEG compressed image, the aforementioned stages must be made in an inverse way, then it can observe the image.

Aligned / Non-Aligned Compression

Majority of digital cameras have JPEG format, used in image processing tools. It can expect setting the manipulated image in JPEG format. The existing manipulations can be classified to two classifications. If a network is set on original image and a network is set on compressed image, two states will occur under which it can state that there is adjustment or maladjustment in the networks. Figure 4 indicates a non-aligned double compressed image and Figure 5 indicates an aligned double compressed image (Piva, 2013).

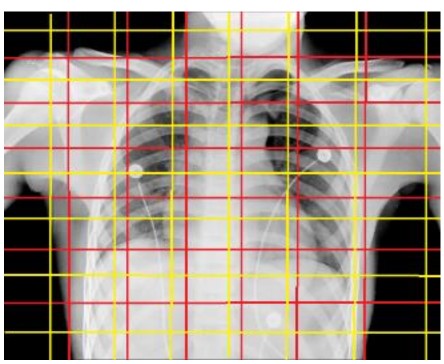


Figure 4: Non-aligned image

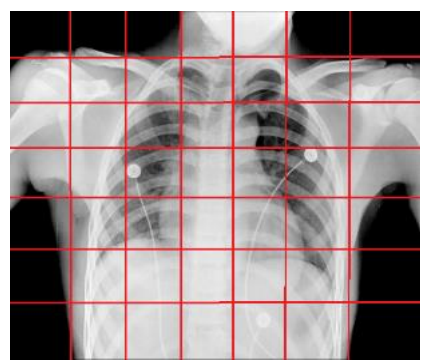


Figure 5: Aligned image

Overview of Aligned and Non-Aligned Compression Method

Recently, Chen and Hsu (Chen *et al.*, 2011) have represented a detection method which enables to detect both aligned and non-aligned compressions via combination of features of place scope and frequency scope and modify them through double compression. Specifically, this pattern calculates a series of features to measure discrete cosine transform coefficients. The proposed pattern works out better for non-aligned double compressed images. The proposed algorithm detects aligned or non-aligned double compressed images based on statistical features. The proposed algorithm automatically develops a similar map, indicating this probability that discrete cosine transform is applied for each 8*8 block. Results

Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231– 6345 (Online)
An Open Access, Online International Journal Available at www.cibtech.org/sp.ed/jls/2015/04/jls.htm
2015 Vol. 5 (S4), pp. 404-416/Nowroozi

indicate that the factors of first quality and second quality as the qualitative factors in first and second compression. The proposed method enables to detect the effects of compression in aligned double compressed image, unless the factor of the first quality equivalents to the factor of the second quality, or the factor of the first quality appears larger than the factor of the second quality, deducing that if the factor of the second quality be larger than the factor of the first quality, compression of the non-aligned double compressed image will be diagnosed. Binachi *et al.,* (2012) analyzes detection of aligned and non-aligned images in case the image is subjected to manipulation via discrete cosine transform, such that the manipulated image enters some effects in histogram of discrete cosine transform coefficients.

An Overview on the Related Works and Challenges

Statistical methods have been considered as the prominent methods in detection of fake images. Popescu has elaborated a method to detect fake images via Statistical Tools (Popescu, 2004). It should be noted that (Ng *et al.*, 2004) and (Li *et al.*, 2007) followed by (Popescu, 2004) and other individuals engaged at this area (Popescu 2004). These individuals detect passive double compressed image via the statistical analysis on histogram of discrete cosine transform coefficients.

Popescu has elaborated his idea to detect double compressed image in this way: if an image is double compressed, firstly discrete cosine transform will be applied on all coefficients of image at similar situations, then Fourier transform will be applied on coefficients, then it can detect whether the considered image is double compressed or not (Popescu, 2004). If the impacts emerge in frequencies in Fourier transform, it can deduce that image has been double compressed. For instance, Figure 6 represents an image which has been compressed once with the factor of quality 85, and then has been compressed with the factor of quality 85. Histogram of discrete cosine transform at status (2, 2) has been considered.

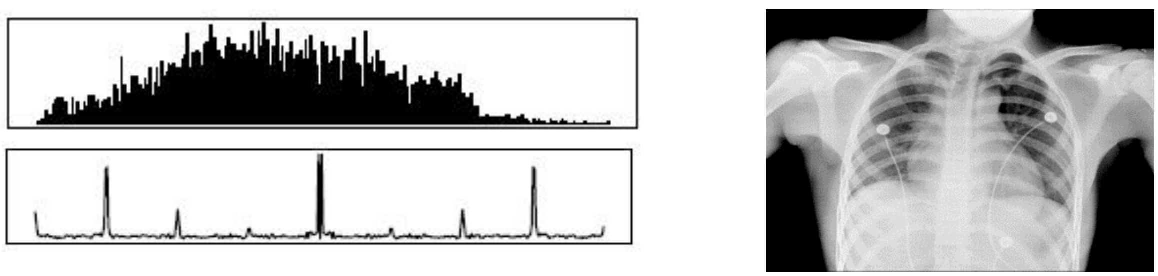


Figure 6: Histogram of discrete cosine transform at status (2, 2) and Fourier transform from histogram of coefficients (Popescu, 2004)

Another simple and reliable algorithm to detect double compressed images has been proposed by Chen *et al.,* (2008). When the image is compressed, the image will enjoy a series of block effects, even if the image with high quality is subjected to compression, these effects will be observed. The proposed method by Chen *et al.,* (2008) can be only used for non-aligned images, using artificial block effects to detect non-aligned double compressed images. Chen *et al.,* (2008) stated that if an image is double compressed in a non-aligned way, it can indicate the artificial blocks via equation 1 and then obtain a pattern in Fourier transform, proving whether the image is non-aligned or not. The main problem of this method lies on its response at flat area.

$$\Pr\{f(x,y)\,|\,within\_block\} = \frac{1}{\sigma\sqrt{2\pi}} * \exp\left(-\frac{\left(f(x,y) - \sum_{u,v} \alpha_{u,v} f(x+u, y+v)\right)^2}{2\sigma^2} \right) \quad (1)$$

A simple and reliable algorithm was proposed to detect aligned and non-aligned double compressed images based on alternative histogram of discrete cosine transform coefficients applied on double compressed image to detect the double compressed images with manipulation by Zhouchen *et al.*, (2009). Firstly, Zhouchen *et al.*, (2009) examines whether histogram of discrete cosine transform coefficients at status (i,j) enjoys frequency or not; yet it must take into notice that histogram of coefficients represents a combination of once and double compressed coefficients. Lin in histogram examines that the peaks which are higher than rest of peaks refer to the areas which have not been subjected to change. Figure 7 indicates a histogram of discrete cosine transform coefficients applied on double compressed images with manipulation. As observed, histogram represents a combination of the coefficients applied on double compressed image with the coefficients applied on double compressed image with compression.

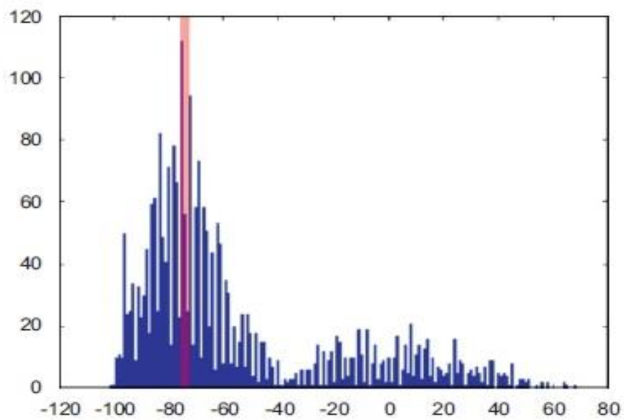


Figure 7: Histogram of discrete cosine transform coefficients applied on double compressed image with manipulation (Zhouchen *et al.*, 2009)

Zhouchen *et al.*, (2009) has proposed an estimation method for periodic histogram. If we intend to obtain periodic histogram at Figure 7, firstly the maximum histogram value must be obtained which has been specified in Figure 7via red color. Equation 2 represents estimation for periodic histogram.

$$H(p)=\frac{1}{i_{\max}-i_{\min}+1}\sum_{i=i_{\min}}^{i_{\max}}\left[h(i.p+s_0)\right]^{x} \tag{2}$$

Then, after calculation of equation 2, it must specify the step for moving forward and backward, thus the movement step is calculated via equation 3.

$$i_{\min}=\lceil (s_{\min}-s_0)/p\rceil$$
$$i_{\max}=\lfloor (s_{\max}-s_0)/p\rfloor \tag{3}$$

Hence, this method has had fundamental challenges that Binachi *et al.*, (2011) enabled to optimize this method for image detection. One of the methods for detection of aligned and non-aligned images was proposed by Chen *et al.*, (2011). The proposed method (Popescu, 2004) has been modeled to detect aligned images, yet he has proposed an optimized method for detection of non-aligned compressed images. Chen *et al.*, (2011) stated that if there exists a non-aligned compressed image applied with two-dimensional Fourier transform, it must enjoy a special pattern shown in Figure 8.

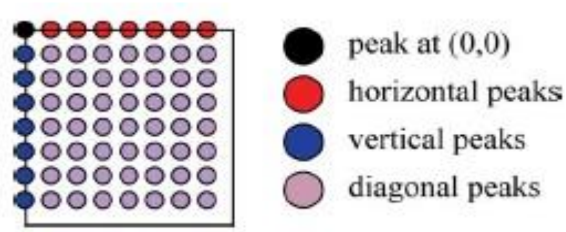


Figure 8: A two-dimensional Fourier transform applied on non-aligned compressed image (Chen *et al.*, 2011)

Binachi *et al.*, (2012) proposed another method to detect double compressed images based on periodic maps to detect aligned and non-aligned images. The proposed method by Binachi *et al.*, (2012) is represented based on equation 4, representing how the image is.

$$D_{ij} I_2 = \begin{cases} Q_2(D_{00} I_1) + D_{00} E_2 & i = 0, j = 0 \\ Q_1(D_{yx} I_0) + D_{yx}(E_1 + R_2) & i = y, j = x \\ D_{ij} D_{00}^{-1} Q_2(D_{00} I_1) + D_{ij} E_2 & elsewhere \end{cases} \quad (4)$$

A periodic map has been considered in the proposed algorithm by Binachi *et al.*, (2012). this map specifies whether the histogram is periodic or not per what values of i and j. it should be noted that the obtained frequencies are normalized in the proposed algorithm. Non-aligned double compressed images are detected in the proposed method, yet it cannot detect the aligned once or double compressed images precisely. A statistical method was proposed based on Benford's law (Fu *et al.*, 2007) by (Hou *et al.*, 2013). Detection of once compressed images based on Benford's law (Fu *et al.*, 2007) has a descending pattern, yet double compressed images do not follow this law. Equation 5 specifies a logarithmic pattern for the first method.

$$p(d) = \log_{10}(1 + \frac{1}{d}) \quad (5)$$

MATERIALS AND METHODS

Proposed Method

Numerous methods have been proposed to detect double compressed images in extensive studies, yet each of these methods faces challenges. Nowadays, about 80% of individuals counterfeit images without having any information for which they used image compression methods. The fundamental challenge in most of methods lies on this fact that if an image is compressed for over once, the elaborated methods can detect the medical images which have subjected to counterfeiting. Hence, it can detect the double compressed images with manipulation in the proposed method. Firstly, the image is compressed one time, then a place of image is manipulated and then the image is compressed, under which the double compressed image develops via manipulation. Figure 9 indicates the place with manipulation in image.

Figure 9: Double compressed image with manipulation

Difference in Pixels

According to what mentioned above, it can say that the compressed images with waste have artificial blocking effects. Fan *et al.*, (2003) used equation 6 to detect artificial blocking effects for the first time. To improve extraction of artificial blocking effects at the first step, we use equation 7 than equation 6.

$$f(R,C) = \left| I(R,C) + I(R+1,C+1) - I(R+1,C) - I(R,C+1) \right| \quad (6)$$

$$f(R,C) = \left| 2I(R,C) - I(R-1,C) - I(R+1,C) \right| \quad (7)$$

In experiments, it is specified that the second derivative equation than the first derivative equation can precisely extract the artificial blocking effects.
It should be noted that since values of artificial blocking effects are represented with low value, thus the values above 50 can be removed, because the values above 50 are improper values, accounted as noise values.
Figure 10 represents applying the second derivative equation on double compressed image with manipulation.

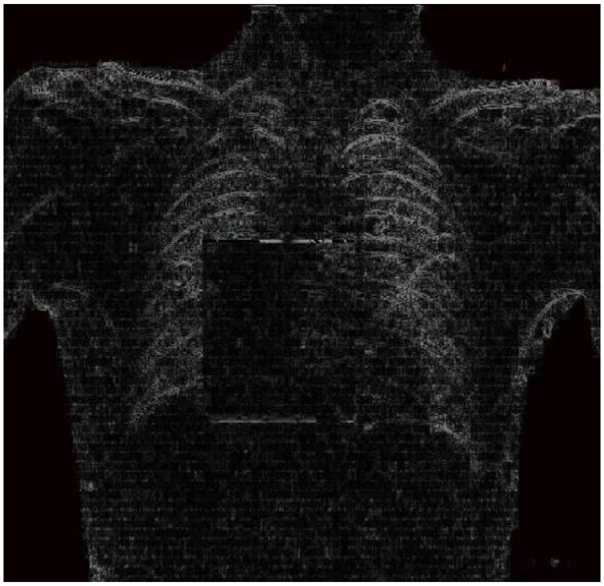


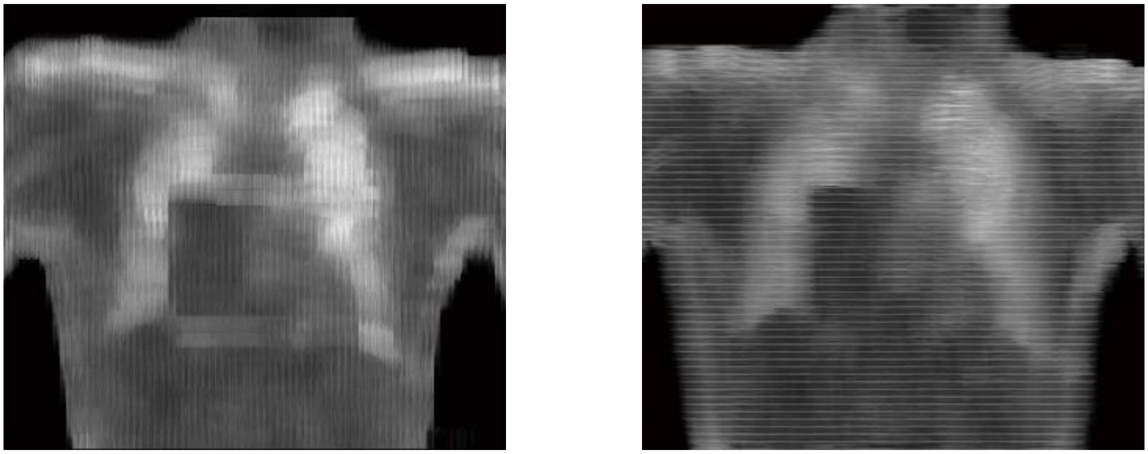
Figure 10: Double compressed image with manipulation together with applying second derivative equation

The reason for why using the second equation lies on this fact that it can detect the artificial effects precisely, yet the first derivative equation cannot detect artificial blocking effects precisely.
Artificial Effects at Vertical and Horizontal States
At the previous stage, we enabled to extract artificial blocking effects, yet as seen in image, the artificial blocking effects have amputations in some points in both vertical and horizontal states, mentioned as a big problem that must undergo optimization, because there is no amputation in artificial blocking effects except in special states.
To improve performance at this stage, the amputation is optimized via an accumulator for horizontal and vertical artificial effects separately. The accumulator is separately is applied for artificial blocking effects under horizontal state and once applied for them under vertical state. Performance of accumulator is in this way that the previous and next 32 values are summed for each pixel transferring the result on the considered pixel, under which artificial blocking effects with amputation or zero value will be substituted with a non-zero value, removing amputation. Equations 8 and 9 represent how to apply accumulator under vertical and horizontal states.

$$f_{AccV} = \sum C - 32 \le i \le C + 32 \quad (8)$$

$$f_{AccH} = \sum R - 32 \le i \le R + 32 \quad (9)$$

Figure 11 represents applying equations 8 and 9 on the image of difference in pixels in turn under vertical and horizontal states.



(a) **(b)**

Figure 11: a-applying accumulator under vertical state, b- applying accumulator under horizontal state

Removal of Error Values in Blocking Effects

At previous steps, we enabled to extract artificial blocking effects under horizontal and vertical states, yet the error values might be set between artificial blocking effects, and this will raise problem in future such as the factors including noise and so on; therefore these values must be removed. To remove error values under horizontal and vertical states, middle filter under horizontal and vertical states is used. The laboratory results indicate removal of error values precisely. Equations 10 and 11 indicate the middle filter equations under horizontal and vertical states.

$$f_v(R,C) = MedianFilter\{i = C-32, C-24, C-16, C-8, C, C+8, C+16, C+24, C+32\} \tag{10}$$

$$f_h(R,C) = MedianFilter\{i = R-32, R-24, R-16, R-8, R, R+8, R+16, R+24, R+32\} \tag{11}$$

Sum of Artificial Blocking Effects under Horizontal and Vertical States

After extraction of artificial blocking effects under horizontal and vertical states, the extracted artificial effects must be summed. To obtained artificial blocking effects under horizontal and vertical states, it suffices to sum the vertical and horizontal matrices so as to obtain the final matrix. Equation 12 represents summing two horizontal and vertical blocks and Figure 12 represents the final matrix for summing horizontal and vertical blocks.

$$f_{VH}(R,C) = f_v(R,C) + f_h(R,C) \tag{12}$$

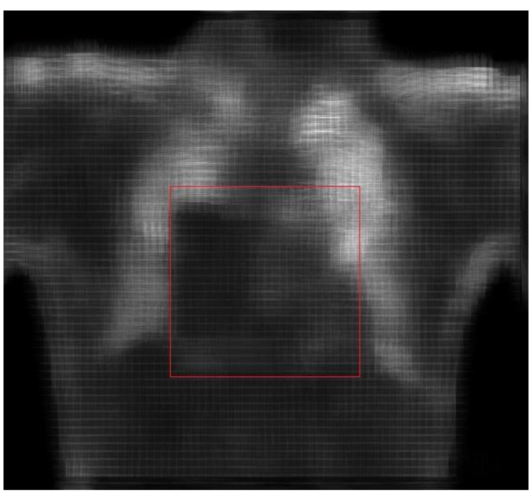


Figure 12: Sum of artificial blocking effects under horizontal and vertical states

Extraction of Feature

At previous stages, artificial blocking effects under horizontal and vertical states have been extracted in an improved state. Now, using Fourier state and extraction of statistical feature from Fourier transform and Support vector machine, the once and double compressed image with manipulation will be detected. Firstly, Fourier transform is applied on the final image with artificial blocking effects. Then matrix 11*11 is extracted from Fourier transform at central status so as to calculate three statistical states. To calculate feature, three parameters of mean, variance and entropy are used to extract feature from the selected matrix. Figure 13 represents the selection places and equations 13, 14 and 15 represent extraction of feature from the selected areas.

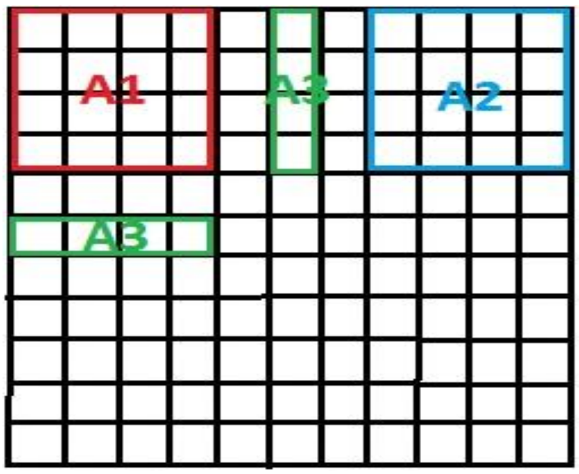


Figure 13: Selection of areas to extract feature

$$F_{Mean} = \frac{M(Ai)}{M(A3)}, A = 1,2 \tag{13}$$

$$F_{Variance} = \frac{V(Ai)}{V(A3)}, A = 1,2 \tag{14}$$

$$F_{Entropy} = \frac{E(Ai)}{E(A3)}, A = 1,2 \tag{15}$$

Detection Algorithm

$input - Picture$

$Start\{$

$Stage1: ForEachPixel$

$\{$

$Difference(R,C) = |2I(R,C) - I(R-1,C) - I(R+1,C)|$

$Then$

$Difference(R,C) > 50 = 0$

$\}$

$Stage\,2: CalculateAccumulatorDifference$

$\{$

$f_{AccV} = \sum C - 32 \le i \le C + 32$

$f_{AccH} = \sum R - 32 \le i \le R + 32$

$\}$

$Stage\,3 : CalculateMedianFilter$

{

$f_V(R,C) = MedianFilter\{i = C-32, C-24, C-16, C-8, C, C+8, C+16, C+24, C+32\}$

$f_H(R,C) = MedianFilter\{i = R-32, R-24, R-16, R-8, R, R+8, R+16, R+24, R+32\}$

}

$Stage\,4 : SummerizeF_v andF_h$

{

$f_{VH}(R,C) = f_V(R,C) + f_H(R,C)$

}

$Stage\,5 : FourierTransformF_{VH}$

$Stage\,6 : SelectCenterMatrix\,11*11 FromFoureir$

$Stage\,7 : CalculateFeatureExtraction$

{

$$F_{Mean} = \frac{M(Ai)}{M(A3)}, i = 1,2$$

$$F_{Variance} = \frac{V(Ai)}{V(A3)}, i = 1,2$$

$$F_{Entropy} = \frac{E(Ai)}{E(A3)}, i = 1,2$$

}

$Stage\,8 : InputSupportVectorMachine$

{

$SVM(F_{Mean}, F_{Variance}, F_{Entropy})$

}

$Finish$

}

RESULTS AND DISCUSSION

Laboratory Results

In experiment applied on the proposed pattern, 31 grey images were selected to train the proposed pattern. Firstly 31 selected images were compressed once with the factor of quality 50, and then 31 selected images were compressed once with the factor of quality 80, and ultimately they are selected as the zero group in training matrix.

Once again, 31 selected images are doubled compressed with manipulation via factors of quality 50-80 and then those 31 images are double compressed via the factor of quality 50-80, and ultimately they are selected as a group in support vector machine. All the selected images in implementation are in bitmapformat (MultiMedia Images).

Software Matlab-2014 has been used for implementation; further all the laboratory results from implementation of this algorithm on computer with five core 2.50 GHz Processor and 6GB RAM have been considered.

Due to long time for implementation, parallelism technique has been used, under which we enabled to improve the implementation time. In experiment, performance and accuracy of the proposed method have been compared with the methods represented in (Li *et al.*, 2007) and (Jin *et al.*, 2013) shown in tables 1 and 2.

Table 3 represents performance and accuracy of the proposed method to detect the double compressed images with manipulation.

Table 1: Accuracy of detection of double compressed images (Li *et al*., 2007)

Factor one / Factor Two	50	60	70	80	90
50	78.1	62.3	20.3	1.5	1.3
60	76.9	82.6	55.9	7.9	1.3
70	88.6	90.5	86.0	34.7	0.8
80	90.4	93.8	94.4	82.3	9.9
90	92.4	95.5	97.1	98.1	71.7

Table 2: Accuracy of detection of double compressed images (Jin *et al*., 2013)

Factor one / Factor Two	50	60	70	80	90
50	76.0	70.8	65.7	59.6	53.6
60	82.0	76.9	70.3	63.4	56.3
70	89.0	83.4	76.6	68.0	58.9
80	96.4	92.8	86.5	75.9	66.5
90	99.0	98.9	97.8	93.9	74.7

Table 3: Accuracy of detection of the proposed pattern to detect double compressed images with manipulation

Factor one / Factor Two	50	60	70	80	90
50	87.5	82.5	73.5	100	76.0
60	92.5	87.5	90.0	85.0	82.0
70	87.5	85.0	90.5	83.9	86.5
80	92.5	75.6	77.5	97.5	92.5
90	95.0	90.0	85.5	100	87.5

Conclusion

The detection tools for fake images are classified to active and passive classifications. The basis in passive methods lies on finding unconventional statistical patterns which do not exist in original images. The fake double compressed images have been mentioned as an attack to counterfeiting images. Researchers have developed numerous passive methods to detect this attack. All these methods strive to detect these images via statistical patterns in image including discrete cosine transform and Fourier transform. Most of the proposed methods face the challenges, e.g. if the image with high quality is compressed and the then it is compressed with low quality, detection will be impossible. In another example, if the image is manipulated, then detection of fake image will face challenge via the statistical methods such as histogram of discrete cosine transform coefficients under special states. The passive method proposed in this research can resolve and detect the challenges in a proper way at high accuracy. The proposed method can detect the once and double compressed images with manipulation at high accuracy.

Future Works

In this research, the proposed method detects double compressed medical images with manipulation precisely, yet the major challenge lies on this fact that if the manipulation be large in detection of double compressed images with manipulation, then the detection will be fulfilled properly, yet detection will face challenge if the place of manipulation be small.

Further, a better detection will come to realize in the double compressed images with manipulation under the suitable image size, yet detection of double compressed medical images will face error under large image size at dimension 2024*2024. In another point, keeping evidences can be the first law in detection of forgery, under which compression algorithms have been mentioned as the worst point at this area, because numerous information might undergo waste under huge compression, resulting in removal of manipulation effects.
Hence, detection of manipulation area in double compressed images is accounted as a challenge. In future, examination of statistical method to detect this challenge to detect the manipulation area at double compressed image will be considered.

REFERENCES
Amsberry C (1989). Alterations of photos raise host of legal, Ethical issues. *The Wall Street Journal.*
Anonymous (No Date). MultiMedia Images: Vector Based Vs. Bitmap graphics (University of Texas) [Web]. Available: https://www.edb.utexas.edu/.../MultiMediaImages/
Binachi T and Piva A (2012). Detection of Non-Aligned Double JPEG Compression Based on Integer Periodicity Maps. *IEEE Transactions on Information Forensics and Security* **7**.
Binachi T and Piva A (2012). Image forgery localization via block graind analysis of jpeg artifacts. *IEEE Transactions on Information Forensics and Security* **7** 1003-1012.
Binachi T, De Rosa A and Piva A (2011). Improved DCT coefficient analysis for forgery localization in jpeg images. *IEEE International Conference on Acoustics Speech and Signal Processing*.
Birjadar K and Mankar H (2013). Digital image forgery detection using passive techniques: A Survey. *Digital Investigation* **10** 226.
Chen Y and Hsu C (2011). Detecting Recompression of JPEG Images Via Periodicity Analysis of Compression Artifacts for Tampering Detection. *IEEE Transaction on Information and Security* **6**(2).
Chen YL and Hsu CT (2008). Image Tampering Detection by Blocking Periodicity Analysis in JPEG Compressed Image. *IEEE 10th Workshop on Multimedia Signal Processing* 803-808.
Chen YL and Hsu CT (2011). Detecting recompression of JPEG images via periodicity analysis of compression artifacts for tampering detection. *IEEE Transactions on Information Forensics and Security* **6**(2) 396-406.
Fan Z and Queiroz R (2003). Identication of Bitmap Compression History: JPEG Detection and Quantizer Estimation. *IEEE Transaction on Image Processing* **12**(2) 230-235.
Farid H (2006). Exposing digital forgeries in scientific images. *ACM Multimedia and Security Workshop* 29-36.
Farid H (2009). Image forgery detection. *IEEE Signal Processing Magazine* **26** 16-25.
Fu D, Shi Y and Su W (2007). A generalized Benford's Law for JPEG coefficients and its applications in image forensics. *Proceedings of SPIE, Security, Steganography and Watermarking of Multimedia Contents IX* **6505** 1-11.
Gonzalez C and Woods E (2008). *Digital Image Processing*, 3rd edition (Prentice Hall) 525-623.
Hou W, Ji Z and Li X (2013). Double JPEG Compression Detection Based on Extended First Digit Features of DCT Coefficients. *IEEE International Journal of Information and Education Technology* **3**(5).
Li WH and Wang B (2007). A Statistical analysis on differential signals for noise level estimation. *Proceeding of the Sixth International Conference on Machine Learning and Cybernetics* 2150-2153.
Ng TT, Chang SF and Sun Q (2004). Blind detection of photomontage using higher order statistics. *IEEE International Symposium on Circuits and Systems* 688-691.
Piva A (2013). *An Overview on Image Forensic* (Hindawi Publishing Corporation).
Popescu A (2004). Statistical Tools for Digital Image Forensics. Ph.D. Thesis, Department of Computer Science, Dartmouth College, Hanover, New Hampshire.
Popescu A and Farid H (2004). Exposing digital forgeries by detecting duplicated image regions. *Technical Report TR 2004* 515.

Yu-Jin Z, Sheng-Hong L and Shi-Lin W (2013). Detecting Shifted Double JPEG Compression Tampering Utilizing Both Intra-Block and Inter-Block Correlations. *Journal of Shanghai Jiaotong University* (Springer-Verlag Berlin Heidelberg) 7-16.

Zhouchen L, Junfeng H, Xiaoou T and Chi-Keung T (2009). Fast, automatic and fine-grained tampered JPEG image detection via DCT coefficient analysis. *Pattern Recognition*.