IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 8, August 2016

Image Forgery Detection on Digital Images

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Abstract: Image forgery is a manipulation process which hides some key information from the digital image. To avoid the traces of this manipulation, attackers use contrast enhancement. So, contrast enhancement can be used as an identifying feature for detecting an image forgery. In this paper, an algorithm to detect the global contrast enhancement applied to JPEG-compressed images is proposed. The histograms of the images are created and then the peak or gap bins present in the histogram are analyzed theoretically and distinguished by identifying the zero-height gap fingerprints. To verify the efficiency and effectiveness of the proposed technique, extensive experiments have verified.

Keywords: Composite image, contrast enhancement, digital forensics, image forgery.

I. INTRODUCTION

With the help of media editing software's, manipulators can change the content of a digital image. Thus the authenticity and integrity of images becomes questionable. A number of digital forensics techniques have been proposed to handle the scenario.

When manipulators create a forged image, global contrast enhancement is applied to remove the visual clues of an image forgery operation. Global contrast enhancement is an image manipulation operation which is used to adjust the brightness of an image globally by changing the original pixel value. Gamma correction is one of the global contrast enhancement methods. This contrast enhancement operation introduces some noticeable differences in the histogram which can be used to detect the image forgery.

Digital forensics developed a number of global contrast enhancement detection algorithms with the assumption that the gray level histogram of an unchanged image posses smooth contour. It is well-known that in mobile phones and internet applications, digital images are stored in JPEG format and heavily compressed with a middle or low quality factor. Usually the digital images with low quality JPEG compression forms blocking artifacts. These blocking artifacts create unsmoothness and locally dense peak bins in the histogram. The existing global contrast enhancement detection algorithm with the assumption of histogram's smooth contour fails to detect the applied contrast enhancement in JPEG compressed images. As a solution to this problem, a new global contrast enhancement detection algorithm is proposed.

II. PREVIOUS WORKS

In [1], a method to detect image-processing operations like scaling, rotation, contrast shift and smoothing in digital images is proposed. This method fails to detect very small levels of manipulations.

In [2], a method to recreate the gamma mapping by the identification of peak-gap fingerprints in the histogram is proposed. The different peak-gap pattern for different gamma mapping can be pre-computed theoretically. The peak-gap feature pattern extracted from test images are matched with those pre-computed ones to estimate the amount of gamma correction. In [3], a method to find the histogram of the original image and operation used to modify the original image is proposed. This method is based on probabilistic model. Contrast enhancement is detected by noticing the smoothness of the histogram. The method gives accurate result only for the non-standard enhancement.

In [4], two forensic techniques for the reverse engineering of a chain composed by a double JPEG compression interleaved by a linear contrast enhancement are compared. Only linear pixel value stretching can be detected using this method. In [5], a method to detect both global and local contrast enhancement is proposed. Contrast enhancement operation is applied to images to avoid the traces of image forgery. This method works with the assumption that the gray level histogram of an unchanged image posses smooth contour. It fails to detect contrast enhancement in the case of JPEG compressed images.

III.PROPOSED METHOD

In the proposed method, global contrast enhancement detection is based on the identification of zero-height gap bins present in the histogram.

Fig. 1(c) shows that the zero-height gap bins where no pixel values are mapped to, always appear in enhanced images and they are absent in compressed images. Therefore, the blind identification of zero-height gap bins can be used as the main strategy to detect global contrast enhancement both in compressed and uncompressed images.

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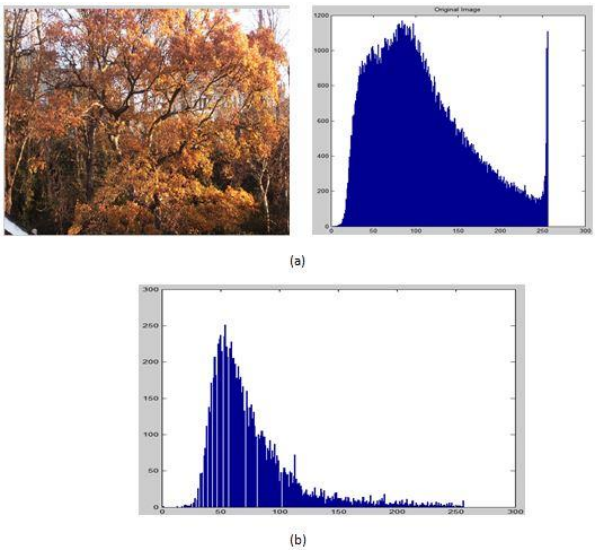

Fig. 1. Histogram of an image. (a) Original image and its histogram. (b) Histogram of the enhanced image.

The proposed global contrast enhancement detection algorithm is as follows. First, obtain the normalized gray level histogram of the image. Then, a zero-height gap bin is detected, if it satisfies the following conditions.

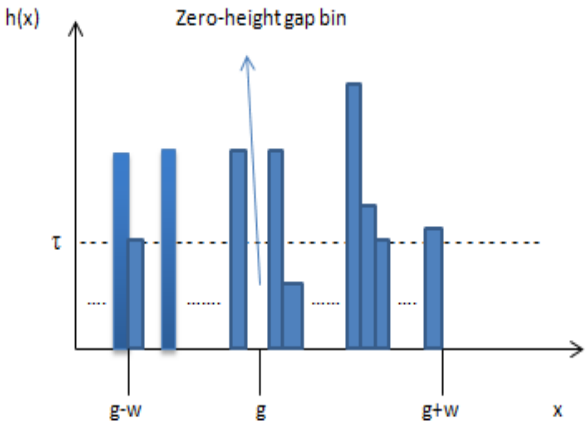

Fig. 2. A zero-height gap bin at g

a) The current bin should be null.
b) The two neighboring bins should be larger than the threshold τ.
c) The average of the neighboring (2w+1) bin should be larger than the threshold τ.

The number of detected zero-height gap bins is counted and it is denoted by N. If the value of N is larger than the decision threshold, then contrast enhancement is detected, otherwise not.

IV. EXPERIMENTAL RESULTS

To evaluate the efficiency of the proposed global contrast enhancement detection algorithm, experiments should be conducted on test images. The contrast enhancement operation called gamma correction is applied to images to remove the traces of image forgery.

The value of N for an enhanced image is always greater than 0 and for unenhanced image N = 0.

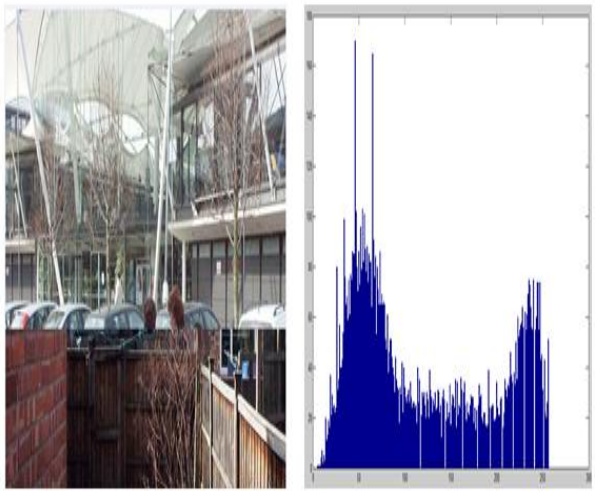

Fig. 3. Forged image and its histogram

In Fig. 3, contrast enhancement is detected since the value of N is greater than 0. That means the image is forged.

TABLE I COMPARISON BETWEEN PREVIOUS METHOD [5] AND PROPOSED METHOD.

Method	Samples	Correct prediction	Incorrect Prediction
Previous method(original images)	221	207	14
Proposed method(original images)	221	221	0
Previous method(contrast enhanced images)	221	13	208
Proposed method(contrast enhanced images)	221	221	0

TABLE I shows the comparison between previous method [5] and proposed global contrast enhancement detection method.

These results shows that our proposed global contrast enhancement detection algorithm attains 100% detection rate in the case of contrast enhanced images while the previous method [5] attains only 5.90%.

Similarly, in the case of original images, proposed detection method attains 100% detection rates while previous method [5] has only 93.6% accuracy. By using our proposed detection algorithm, images which undergo forgery can be detected accurately.

DOI 10.17148/IJARCCE.2016.5863

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V. CONCLUSION

In this paper, a new global contrast enhancement detection algorithm is proposed to detect the global contrast enhancement in both uncompressed and JPEG-compressed images. The identifying feature used for detection is zero-height gap bins present in the histogram. Experiments on large number of images shows that the proposed contrast enhancement detection algorithm attains 100% accuracy in the case of original and enhanced images.

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