COPY MOVE FORGERY DETECTION AND ESTIMATION OF DIGITAL IMAGES: A SURVEY

Ms. Swati S. Kamthekar

EXTC/PHCET, Mumbai University, (India)

ABSTACT

In recent times image authentication or forgery detection is emerging as one of the new research topics in the area of image forensics. Many techniques have been suggested to detect such type of tampering with the original image, but the problem is far from being solved. Some issues still remained either unsolved or there is a lot of scope for performance improvement. Discrete cosine transform (DCT) and principal component analysis (PCA)-based techniques exhibit high computational complexity and do not possess reliable accuracy rate. Moreover, the DCT-based techniques are inapplicable when considering highly textured and small forged regions. There are techniques exhibiting improved detection accuracy, but having high computational complexity. Moreover, most of the methods may not be that responsive to the geometric transformations, such as rotation and scaling of small variations. If the intensity of the forged part is changed and then image is compressed and blurred such images are the challenges for authenticity detection. Here it is overview of the existing techniques and discussion on the parameters to increase accuracy, reduction of time complexity and reliability of forged part of image.

Keywords: Copy Move, Computational Complexity, Dyadic Wavelet, Interest Point, SIFT

I. INTRODUCTION

Smart phones digital cameras producing huge amount of images. Image editing software like photo shop paint are available on mobile and pc in addition to that use of internet makes the exchange of information in the form of very easy. Images can be used as evidence for criminal cases, in journalism, insurance claim and medical imaging. So it is necessity to have robust authentication techniques for digital images. Authentication techniques are mainly of two types active and passive. Active techniques are the images containing digital watermarks or digital signatures. Before it is sent through the social channel authentication mark is added to it. It may be visible or invisible; authentication is made by comparing the code and the original images. In passive methods the received image is sufficient to prove the authenticity. The image forgery detection processes involve preprocessing of image then feature extraction, classification and post processing. This paper focus on type of copy move detection methods and their merits, demerits. This paper will act as a guide for researcher from copy move forgery detection area to find new research directions.

II. BLOCK BASED METHODS

The literature survey conducted brought out several techniques which were researched from the year 2003 to 2014 and are published in IEEE transactions and Science Direct. The forgery detection methods are the initial methods, which are very simple in which the image is divided into equal sized blocks. Features of each block

are extracted and each block is compared and matched with each remaining block. In 2003 Fridrich et al proposed a method to detect copy, move forgery using discrete wavelet transform [1]. This technique uses overlapping blocks and then lexicographic sorting to reduce time complexity. In 2004 best balance between performance and time complexity was proposed by Popuscu et al [2] Principal component analysis based detection reduces the computational time the computations required are $O(N_t N \log N)$ here N_t is dimensionality constant of truncated PCA representation and N is number of pixels in image. Here the accuracy decreases for small size block and low JPEG quality. In 2006 Langille et al proposed a method searching for block on similar intensity pattern using matching technique [3]. The resulting algorithm has time complexity of $O(N_b N_s)$ where N_b is the total number of blocks and N_s is neighborhood search sizes. Zero normalized cross correlation was used for similarity measures. In the same year Leo et al presented an algorithm having lower computation complexity and robust for various attacks such as lossy compression, noise contamination, blurring. In 2007 Mahadian and Saic proposed a method for detecting near duplicate region by using blur moment invariants [4]. This algorithm uses 24 blur invariants up to the 7^{th} orders resulting in accurate region duplication detection. But it takes large computational time like 30 min for 640 × 480 RGB image when block size is 24. In the same year Myna presented a technique which uses log polar coordinates and wavelet transform to detect and localized forgery [5]. Reduced dimension image is obtained by wavelet transform and log polar co ordinates of each block are taken as feature and the blocks are searched for similarity by using phase correlation technique. In 2011 Qiumin et al [6] proposed log- polar fast Fourier transform. This algorithm is invariant to rotation and scaling.It reduces the computational complexity to $O(N^2 \log N)$ where N is size of block.

In 2007 Li et al [7] present a method for forgery detection in highly compressed and boundary processed images. Singular value decomposition is used for getting reduced dimension image and then wavelet to find forgery. Duplicated regions are sorted lexicographically and neighborhood detection for all blocks. In 2009 Zhang et al proposed SVD Based method for copy move detection. It was found that the SVD algorithm along with counting bloom filters result into improvement in time complexity [8]. In 2010 Christlein et al presented is dimensionality constant rotation invariant selection method called same affine transformation selection. It detects rotated and scaled region [9]. In 2010 Xu Bo et al proposed copy move forgery based on speed of robust descriptor [10]. In the same year Weihai et al proposed an algorithm based on Fourier Melina transform. In this method the features are extracted along the radius to improve time complexity. Link processes is introduced in counting bloom filter [11]. This algorithm shows that it is robust for large rotation of copy move region. In 2011 Bravo et al presented [12] a method which detects duplicated region, even if the duplicated region undergoes reflection, rotation and scaling. In this paper overlapping block pixels are mapped to log polar coordinates and then summed along the angle axis, to produce one dimensional descriptor invariant to reflection and rotation. For scaled region detection the reduced dimension representation of each block has great impact on computational cost. Here very few images are tested. False alarm can be minimized by using more number of features. In 2011 copy, move detection by using different type of moment was initiated.

Guangji et al [13] present a method where image is decomposed in Gaussian pyramid and produce sub image in low frequency is selected to overcome distortions by JPEG compression and presence of noise. Sub image is divided into overlapping circular blocks, as features hu moment of each block is are extracted and used for matching the blocks. Hu moments are not able to find slight rotation that is rotation from 15 to 30 degree is not detected. In 2012 Hao Chiang et al proposed a method which used a Gabor filter with different scaling factor, rotation angle and frequencies for feature extraction [14]. This method reduced time complexity and work for

small copy and move areas. In the same year Hussain et al presented a method using the Weber law descriptor. It extracted features from prominent components which could give more information. SVM was used for classification [15] which gave 91% efficiency. The length of the feature vector was found to affect the time complexity, so in 2013, Ulutas et al proposed a local binary pattern to represent an image block [16]. It was used to get the reduced dimension image. This could detect a JPEG compression or Gaussian blurring. In the same year Le Zhong et al presented a method based on mixed moments. Lower frequency overlapping blocks are used for block matching [17] and an eigenvector of blocks is composed. In the same year Mulammad et al presented a method which combined steerable pyramid transform and local binary patterns [18]. SPT is applied to gray scale or one of the Y, CB, CR channels and LBT is applied to describe the texture in each SPT sub band for classifying forged or authentic image.

In 2014 Lydia et al proposed a copy, move detection method under affine transform for image forensics [19]. In this technique polar harmonic transforms is used and the blocks are sorted lexicographically. Euclidian distance and some morphological operations were used for final decision making. Here instead of square blocks circular overlapping blocks are used for focusing to the interested area and due to overlapping blocks which are differ by single row and single column accuracy of detection increases. Similar blocks are arranged in neighboring rows which decrease in computational complexity. In 2013 G.lynch et al proposed an expanding block algorithm [20]. Here the method can detect size of the duplicated region even if the copied regions are made intensity variation JPEG compression or with Gaussian blurring. Here dominant features of the block are considered like average gray value from all pixels in the block. Blocks are grouped together according to dominant features. Buckets concept is taken to make a group of 3 blocks of similar feature, 1st blocks are compared in the bucket itself and then it is compare with previous and next bucket blocks only so in this way computational complexity is reduced, till 8 seconds. fig.1 shows the method of block expanding and bucket formation.

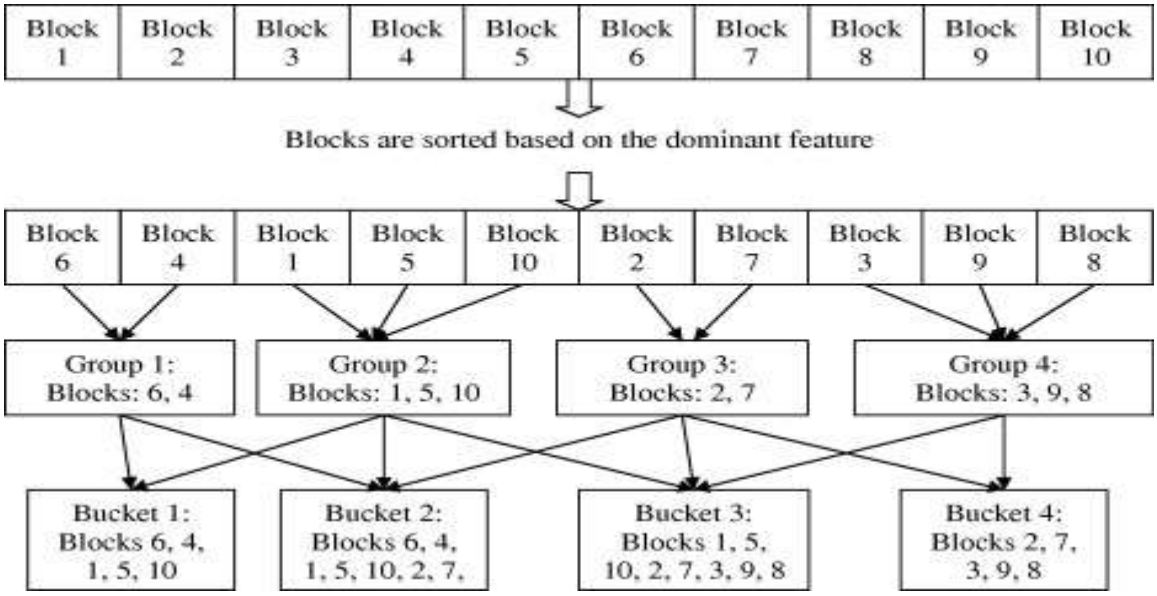

Figure1. An Example of How Blocks Are Sorted and Placed Into Bucket [20]

II. VISUAL FEATURE BASED METHODS

In this type of techniques interest points are detected and then they are clustered or grouped to find a duplicated region. SFIT features are used to find duplicated area, it is robust to rotation, scaling, reflection and compressed and edge processed images also. In 2013, as stated in [21] J-Linkage clustering is used instead of spatial clustering, due to inability to separate duplicated region that are close to each other and the difficulty to identify

a patch as a single when it contains key points with non-uniform spatial distribution and localization of forged region. This method use SFIT and feature matching, to improve previous work clustering phase based on the J-Linkage algorithm is used. It reduces computational complexity from 295 and 71 seconds to 8 seconds and very challenging database MICC-F600 is derived from MICC-F2000 and SATS-130 for testing the results. The 81.6 percent accuracy is achieved for database MICC-F600.in the same year Likai et al [22] proposed a method in which Harris corner points are selected to find edge points and then window is shifted in the direction of edge points. Harries detector used 2^{nd} order moments matrix for detecting corner. Here feature vector consist of 72 features so this is not time efficient but this method decreased from 18.84% to 12.40% percentage. SIFT and speed up methods is also come under visual feature based methods.

Mohammad Hashmi et al [23] proposed a method to detect copy move by combining dyadic wavelet and SIFT to give reliable result. Here in this method we apply dyadic wavelet on the given image which decompose the given image in four part LL,LH, HL, HH most of the information is concentrated in LL part. Then SIFT transform was applied to find features of LL part and feature descriptor vectors are matched to find forged region.

IV. CONCLUSION

Passive methods are more convenient to detect forgery as it does not require prior information. From the information about copy move detection techniques, block methods requires more time for matching blocks. But block expanding method compares previous and next buckets, significant time complexity reduction is possible. Again interest point matching and use of wavelet is also improving for reducing false alarm rate. Feature selection and length or dimensions are very important. If feature dimensions is short accuracy suffers and if larger the dimension of feature vector computational time increases. Interest point matching is time efficient but clustering methods are not able to distinguish small copy move regions. So there is scope for small forged regions, scaling range has to be enlarge, and detection of multiple cloning of regions which are scaled, rotated, compressed or addition of noise. Accuracy, time complexity reduction for all type of attacks together is the biggest challenge.

REFERECES

[1] J. Fridrich, D.Soukal, J.Lukàs, forgery in digital images, Detection of copy-move *Digital Forensic Research Workshop, 2003*. Available http://www.ws2.binghamton.edu/fridrich/Research/copymove.pdf

[2] A.C. Popescu, H. Farid, Exposing digital forgeries by detecting duplicated image regions, *technical report, Dartmouth College, Computer Science, Hanover, NH*, 2004, 515

[3] Langille A, Gong M, An efficient match-based duplication detection algorithm, *The 3rd Canadian conference on computer and robot vision*, 2006. 64.

[4] B. Mahdian,S. Saic, Detecting double compressed JPEG images, *3rd International conference on imaging for crime detection and prevention (ICDP-09)*, 2009, 12.

[5] A.Myna, M.Venkateshmurthy ,C. Patil, Detection of region duplication forgery in digital images using wavelets and log-polar mapping, *The International conference on computational intelligence and multimedia applications (ICCIMA 2007)*, 2007, 371–7.

[6] Qiumin W, Shuozhong W, Xinpeng Z., Log-polar based scheme for revealing duplicated regions in digital images, *IEEE Signal Process, 18(10)*, 2011, 559–62.

[7] G. Li,Q.Wu, D. Tu,S. Sun, A sorted neighborhood approach for detecting duplicated regions in image forgeries based on DWT and SVD, *International conference on multimedia & Expo*, 2007, 1750–3.

[8] Zhang Ting ,Wang Rang-ding , Copy-Move Forgery Detection Based on SVD in Digital Image, *Image and Signal Processing, CISP*, 2009 , 1 – 5.

[9] V. Christlein,C, Riess, E. Angelopoulou, On rotation invariance in copy-move forgery detection Proc. *Second IEEE Workshop on Information Forensics and Security (WIFS),* 2010, 1–6.

[10] B.Xu, Wang Junwen , Liu Guangjie , Dai Yuewei, Image Move Forgery Detection Based on SURF, *Multimedia Information Networking and Security (MINES),* 2010 , 889 – 892.

[11] Weihai,Y.Nenghai ,Rotation robust detection of copy-move forgery,*ICIP 2010,* 2113 – 2116.

[12] B.Sergio,K. Asoke, Automated detection and localization of duplicated regions affected by reflection, rotation and scaling in image forensics, *Elsevier journal, signal processing 91,* 2011, 1759-1770.

[13] Guangjie Liu ,JunwenWanga,ShiguoLian, ZhiquanWang,, A passive image authentication scheme for detecting region-duplication forgery with rotation, Elsevier Journal of Network and Computer Applications, 34, 2011, 1557–1565

[14] H. Hao-Chiang,W. Min-Shi,Detection of copy-move forgery image using Gabor descriptor, *IEEE transaction on Anti-Counterfeiting, Security and Identification (ASID), 2012,* 1 – 4.

[15] M. Hussain,G Muhammad, S.Saleh, A. Mirza,G. Bebis,Move Image Forgery Detection Using Multi-Resolution Weber Descriptors, *IEEE transaction on Signal Image Technology and Internet Based Systems (SITIS),2012,*395 – 401.

[16] G. Ulutas, M. Ulutas, V.Nabiyev ,Copy move forgery detection based on LBP,*IEEE transaction on Signal Processing and Communications Applications Conference (SIU),* 2013, 1 - 4

[17] L.Zhong , Weihong Xu, A robust image copy-move forgery detection based on mixed moments, *IEEE pro Software Engineering and Service Science (ICSESS),* 2013, 381 – 384

[18] G.Muhammad, Al-Hammadi,M. Hussain,M. Mirza, A.M. Bebis, G., Copy move image forgery detection method using steerable pyramid transform and texture descriptor ,*IEEE transaction EUROCON,* 2013,1586 – 1592.

[19] Leida Li, Shushang Li, Hancheng Zhu, Xiaoyue Wu, Detecting copy move forgery under affi transform for image forensic Elsevier Computer and electrical Engineearing , 2013.

[19] Langille A, Gong M. An efficient match-based duplication detection algorithm, *The 3rd Canadian conference on computer and robot vision, 2006.* 64.

[20] Gavin Lynch a, Frank Y.Shih a,⇑, Hong-Yuan Mark Liao, An efficient expanding block algorithm for image copy-move forgery detection, *Elsevier Information Sciences, 239 ,2013, 253–265*

[21] Amerini, Irene, Lamberto Ballan, Roberto Caldelli, Alberto Del Bimbo, Luca Del Tongo, and Giuseppe Serra, Copy-move forgery detection and localization by means of robust clustering with J-linkage, *Signal Processing: Image Communication, 28(6), 2013,* 659–669.

[22] Likai Chen, Wei Lu, Jiangqun Ni, Wei Sun, Jiwu Huang, Region duplication detection based on Harris corner points and step sector statistics, *J. Vis. Commun. Image R, 24, 2013,* 244–254.

[23] Mohammad Farukh Hashmi ,Vijay Anand , Avinas G. Keskar, Copy-move Image Forgery Detection Using an Efficient and Robust Method Combining Un-decimated Wavelet Transform and Scale Invariant Feature Transform, *AASRI Conference on Circuit and Signal Processing, 9, 2014, 84 – 91.*