International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 - 5161

Available at http://inpressco.com/category/ijcet

Research Article

Detecting Region Duplication Forgery in Digital Image using SIFT Features

Pooja S. Kotkar[Å*] and S. S. Shriramwar[Å]

[Å]Electronics and Tele-communication Department, RTMNU University, Priyadarshini College of Engineering, Nagpur, India

Accepted 10 May 2014, Available online 01 June 2014, **Vol.4, No.3 (June 2014)**

Abstract

Digital image are easily manipulated and edited by using photo editing software. Region duplication or copy – move is a special type of forgery that tried to hide the region of the image. By copied and pasted the continuous portion of pixels in an image at the different location in the same image. In this paper, we describing an effective method to detect region duplication or copy- move forgery in digital images. Our method start by first extracting Scale Invariant Feature Transform (SIFT) descriptor of an image, which is invariant to changes illumination, rotation, scaling etc. The proposed method show effective detection on automatically synthesized forgery image database with duplicated and distorted regions. This approach can be drastically reduces the time needed for the detection process and improve the accuracy of detection.

Keywords: *Copy –move or Region duplication detection, Digital image forgery, Illumination, Rotation, SIFT.*

1. Introduction

Digital images are easy to manipulated and edited by using editing software and powerful image processing tools such as Photoshop and Freehand. Nowadays, it is possible add and remove important feature from an image without leaving any visible clue of tampering. With the development of Internet and wide use of it, many numbers of Digital images on the Internet are as sources. As a result, there is rapid increase of digitally manipulated forgeries in mainstream media and on the Internet. Communication plays an important role for the development of society, where digital image serves as medium of communication. In competitive life, everyday Newspaper and Magazine have a closed connection with digital images.

Original Forged

Fig.1. Two original digital images and forgery images created based on them using duplicated and distorted regions.

A continuous portion of pixels are copied and pasted to a different location in the same image is known as region duplication. The duplicated regions can also be created with geometrical or illumination adjustment to make convince for forgery. The following images of Fig. 1. Shows the example of duplicated region in creating forgery images. Example shown in the left case, a rotated duplicated region is used to conceal undesirable contents in the original image where as in another case two duplicated region that are scaled, rotated, and mirrored are used to create contents that are not present in original image. These duplicate regions are very difficult to detect visually because it is well blended into the surrounding at target locations. There are various methods to make forged image are removing, replacement, copy-move, region duplication and computer-generated media. The most common approach to make forged images is copy-move and region duplication which shown in Fig. 1

We will describe the robust method for reliable detection duplicated and distorted region in a digital image, which is based on image keypoint and feature vectors that are robust to typical image transform. The duplicated regions are scaled or rotated shows that the image more natural. Fig. 1. Shows this modification, such modification change pixels value. So methods detect duplicate region without any modification are not possible. To detect such tampered region, there are some approaches that extract interested point i.e. keypoints on the whole image by scale invariant feature transform (SIFT). Such methods extract special points in images which are invariant against changes as scaling or rotation. After extracting SIFT features the transformed between the copied areas are estimated. All parts of image are compared using their transform, by their similarity we will

*Corresponding author: **Pooja S. Kotkar**

be make a mop probable regions with high likelihood to be duplicated from other regions. SIFT method shows effective detection on an automatically synthesized forgery image database with duplicated and distorted regions. It's required less computational times and it is less complex. SIFT is an algorithm in computer vision to detect and describe local feature in image. Our method will be test with a comprehensive quantitative performance evaluation on a database of automatically generated forgery image with duplicated and distorted regions.

The rest of the paper is organized as follows. Section 2, gives details study of related work. Section 3, gives the information about forgery detection by SIFT features. In Section 4 described method.

2. Related Work

Some general techniques in digital image are used to detect region duplication in the forensics. In (Saiqa khan, Arun Kulkarni, 2010) , Arun Kulkarni and Saiqa Khan was proposed a new technique to detect copy-move forgery in digital image based on Discrete Wavelet Transform (DWT), but DWT method suffers from the drawback that it takes lot of computational time and it is computationally complex. Another new work for detecting copy-move forgery in digital image was proposed by Sevinc Bayram and Nasir Memon whos worked on Fourier-Mellin Transform (FMT) (Shinfeng D. Lin and Tszan Wu , 2011) to extract feature from the image blocks. This method would not be only robust to lossy JPEG compression, blurring or noise addition, but also known to be scale and translation invariant. This technique performs well when the degree of rotation is small. Another method has been proposed to detect duplicated regions with a smoothing operation (J.Fridrich, D.Soukal and J. Lukas, 2003). However, the flexibilities provided by this method are limited and cannot be extended for the detection of duplicate regions with general distortions.

Another approach suggested representing each block in log-polar coordinates (E. Ardizzone, A. Bruno,G. Mazzola, 2010). Since the method depends on pixels values, it is sensitive to the change of the pixel values. To solve such type of problems there are some approaches that extract key points on the whole image by SIFT algorithm. J. Fridrich [9] was first proposed a reliable and robust method based on matching Discrete Cosine Transform (DCT) coefficient of the overlapping image blocks, but the computational complexity of this method is too large for practical application. Popescu (J. Lukas, 2003) employs principal component analysis (PCA) to capture the image blocks feature for identifying similar block in the image. The robustness of the method is not good and should be improved. W.Q. Luo described an efficientive and robust method to detecting and locating tempered region (C. Alin,2004). Myna approch a method based on the wavelets and log-polar mapping; here its main advantage is complexity and computational time (W.Q.Luo, 2006). Edge analysis has been considered in (A.N.Myrna, 2007). In this approach variation of edge properties has been used as a signature for forgery detection in digital image. In Johnson and Farid assumed that image forgery would be detected via inconsistency in the light direction of the object into the image. With this assumption, they introduced a new method for estimating direction of a light source and forgery detection (L. Zhou and D.Wang, 2007). Many other existing region duplication detection methods are based on matching blocks of image pixels or transform coefficients. (.Fridrich, D.Soukal and J. Lukas, 2003), (E. Ardizzone and G. Mazzola,, 2009), (X. Kang and S.Wei, 2008), (A. Langille and M. Gong, 2006), (G. Li, Q. Wu, D. Tu, and S. Sun 2007) , (W. Luo, J. Huang, and G. Qiu, 2006), (B. Mahdian and S. Saic, 2007), (A. C. Popescu and H. Farid, 2004) While these methods can detect duplicated regions pasted to the target location without any change, they are largely ineffective to detect duplicate region that are distorted (such as example in fig. 1). To alleviate this problem a variant of the block matching region duplication method is proposed to handle duplicated regions rotated factor with 90^{o}, 180^{o} and 270^{o}.

All this problem will be overcome by using SIFT algorithm, this is an alternative to the block matching based detection methods, several recent method have explored the use of match image features point to identify duplicated regions. Keypoint and feature based on the scale invariant feature transform algorithm will use to count illumination changes in detection of copy-move region duplication. However the robustness of the SIFT keypoint and features to image distortion is not fully exploited which prevent this method from being extended to detect affine transform duplicate regions. SIFT is an algorithm in computer vision to detect and describe the local features in image. This algorithm was first published by David Lowe in 1999. The effective keypoint and feature computational algorithm is known as Scale Invariant Feature Transform.

3. Forgery Detection using SIFT Features

The proposed work based on SIFT algorithm to extract robust features which can allow it to discover if a part of an image but not flat regions, region duplication and furthermore which geometrically transformation will apply. In fact, the copied part has basically same appearance of the original one, thus keypoints extracted in the forged region can be quite similar to the original ones.

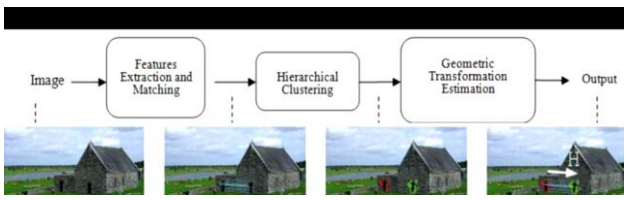

Fig. 2 Overview of proposed system. SIFT matched pair and cluster

Therefore, matching among SIFT features would be adapted to determining tampering. A simple arrangement the whole system which shown in Fig. 2. the first step consist of SIFT feature extraction and keypoint matching,

the second step is devoted to keypoint clustering and forgery detection while the third one estimates the occurred geometric transformation if tampering has been detected.

4. Method

In this paper, we describe the proposed method to detect region duplication forgery in digital image. The main steps of our method for detections of region duplication forgery in digital image are as given below.

A. Feature Extract and Keypoint Detection

The first step in our method is to find image keypoints and extract image features at the detected keypoints. We will detect duplicated regions in the illumination domain, so first we convert RGB image into greyscale image using standard colour space conversion. Location carrying distinct information of the image content are known keypoints. Each keypoint is characterized by a feature vector that consists of a set of digital image statistics collected at the local neighborhood of the corresponding keypoint. Good keypoints and feature vectors should be represent distinct locations in an image , be efficient to compute and robust to local geometrical distortion, illumination variations etc.

Our method is based on an effective keypoint and feature vector computation algorithm is known as SIFT. Fig.3 shows original input image and Fig.4 shows keypoint searching output image where shows the SIFT keypoint, the end of each arrow corresponds to the location of one SIFT keypoint. The direction of arrows shows the dominant orientation of each SIFT keypoint, and the lengths of arrows correspond to the dominant scale. Fig.5 shows performance of algorithm result to find out SIFT keypoint.

Fig.3 Input Image

Fig.4 Matching Region

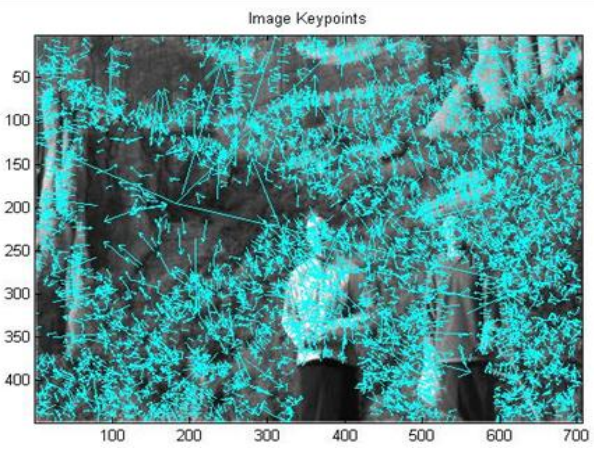

Fig .5 Keypoint searching image

B. Keypoint Matching

The detected SIFT keypoints are then tentatively matched base on their feature using the best-bin-first algorithm. For a keypoint at location **x** with feature **f,** it match with keypoint $\tilde{\mathbf{x}}$ **,** whose corresponding feature vector $\tilde{\mathbf{f}}$ is the nearest neighbor to **f** measured with their Euclidean distance **l2**. Due to the smoothness of the natural images, the good match of a keypoint usually lies within its close spatial adjacency. To avoid searching nearest neighbours keypoint from the same region.

Implementation

Our method will be implemented on the MATLAB version 7.1. on a machine with an Intel core i5.

Conclusions

The region duplication image forgery detection is one of the major problems in the field of digital image forensics. In this paper, we described a robust method to detect region duplication forgery in the digital image by matching feature vector, keypoints, extracted by SIFT. We demonstrate the effectiveness of our detection method of the reliable SIFT keypoints. Due to the strong stability of the SIFT feature vectors, our method has a good performance on different kind of post image processing i.e. image compression, rotation, scaling and illumination. It is also robust to compound image processing.

Acknowledgement

We sincerely like to thank all the people who directly and indirectly encouraged us and helped us in working out our recherché. Also a big thank to P.C.O.E. college from where we got complete support. Our thanks to the experts who have contributed in our work.

References

Saiqa khan, Arun Kulkarni (2010), Robust Method for Detection of Copy-Move Forgery in Digital Images, *International conferences on Signal and Image Processing* .

Hailing Huang, Weiqiang Guo, Yu Zhang (2008), Detection of Copy-Move Forgery in Digital Images Using SIFT Algorithm, *IEEE Pacific-Asia Workshop on Computational Intelligence and Industrial Application* .

Shinfeng D. Lin and Tszan Wu (2011), An Integrated Technique for splicing and Copy-Move Forgery Image Detection, *4th International congress on Image and Signal Processing* .

Sevinc Bayram, Nasir memon (2005), An Efficient and Robust Method for detecting copy-move Forgery, *ICASSP.*

Xunyu Pan, Siwei Lyu (2010) ,Region Duplication Detection Using Image Feature Matching, *IEEE Transaction on Information Forensics and Security, Vol. 5, No 4.*

J.Fridrich, D.Soukal and J. Lukas (2003), Detection of copy-move forgery in digital images, *proceeding of the Digital Forensic Research Workshop .Cleveland OH, USA* .

E. Ardizzone, A. Bruno,G. Mazzola (spet. 2010), Detecting Multiple Copies in Tampered Images, *Proceeding of 2010 IEEE 17th International Conference on Image Processing, Hong Kong*

X.Pan and S.Lyu (2010),Detection image region duplication using SIFT features, *IEEE internation conference on. Acoustics speech and Signal Processing (ICASSP)., pp.1706-1709.*

C.Alin, Popescu, and Hany Farid (2004), Exposing digital forgeries bydetecting duplicated image regions, *Technical Report TR2004-515, Department of Computer Science, Dartmouth College, Hanover, NH,USA.*

W.Q. Luo, J.W. Huang, and G.P. Qiu (2006), Robust Detection of Region-Duplication Forgery in Digital Image, *In Proc. of 18th International Conference on Pattern Recognition, Hong Kong, Vol.4, pp.746-749.*

A.N.Myrna, M.G.Venkateshmurthy (Dec. 2007), Detection of Region Duplication Forgery in Digital Images Using Wavelets and Log-Polar Mapping, *Conference on Computational Intelligence and Multimedia Applications, Vol.3, pp. 371-377.*

L. Zhou and D.Wang (2007), Blur detection of digital forgery using mathematical morphology," *proc. Of first KEC International Symposium Wroclaw, Poland, pp.990-998.*

E. Ardizzone and G. Mazzola(2009), Detection of duplicated regions in tampered digital images by bit-plane analysis, *in Proc. Int. Conf. Image Analysis and Processing, Vietri sul Mare, Italy.*

X. Kang and S.Wei (2008), Identifying tampered regions using singular value decomposition in digital image forensics, *in Proc. Int. Conf. Computer Science and Software Engineering, Wuhan, China.*

A. Langille and M. Gong (2006), An efficient match-based duplication detection algorithm, *in Proc. Canadian Conf. Computer and Robot Vision, Quebec City, Canada.*

G. Li, Q. Wu, D. Tu, and S. Sun (2007), A sorted neighborhood approach for detecting duplicated regions in image forgeries based on DWT and SVD, *in Proc. ICME, Beijing, China.*

W. Luo, J. Huang, and G. Qiu (2006), Robust detection of region-duplication forgery in digital images, *in Proc. ICPR, Hong Kong, China.*

B. Mahdian and S. Saic (2007), Detection of copy-move forgery using a method based on blur moment invariants, *in Proc. Forensic Science Int., pp. 180–189.*

A. C. Popescu and H. Farid (2004), Exposing Digital Forgeries by Detecting Duplicated Image Regions, *Department of Computer Science, Dartmouth College, Tech. Rep. TR 2004-515.*

Bagdanov, A. D., Ballan, L., Bertini, M., and Del Bimbo, A (2007), Trademark Matching and Retrieval in Sports Video Databases, *in Proc. of MIR), pp. 79—86*

Zickler, S., Veloso, M., (2006). Detection and localizationof multiple objects, in *Proc. of 6th IEEE-RAS International Conference on Humanoid Robots*, Genova, Italy, pp. 20-25