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Mirror Reflected Cloning Detection

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ABSTRACT— *Cloning is one of the manipulation techniques in image forgery. Cloning is the process of creating a forged image by copying a region of the image and pasting it into another region in the same image. Mirror reflected cloning is copying a region and flip it horizontally then pasting in the same image. A novel cloning detection scheme using SLIC and MIFT is proposed to detect this kind of forgery. The proposed scheme integrates block and keypoint-based cloning detection methods. First, by using Simple Linear iterative Clustering (SLIC) the host image is segmented into non-overlapping and irregular blocks. Second, Mirror invariant Feature Transform (MIFT) extracts block features from feature points of each block and then similar feature points are matched and are labeled to detect the forgery. Forgery Region Extraction algorithm shows the suspected region by replacing the feature points with small super pixels as feature blocks. By merging the neighboring similar local color feature blocks merged regions are obtained. Finally, a morphological process is applied on the merged regions to detect forgery regions.*

Index Terms—Feature point matching, SLIC, Block features, MIFT, Forgery region extraction algorithm, Super pixels, Local color features, Merged regions, Morphological operation.

I. INTRODUCTION

Advance in image processing and various computer software availability increases the manipulation on digital images to hide information and makes the forged images. Therefore images will lose its integrity and authenticity. Various image forgery detections such as Block based methods, keypoint based methods are available. In Moment-based technique [2] blur property is used for invariants of image area due to non-effected by means of blur additive noise and degradation but it has high computation time. In Hu moment based technique [3], it decreases dimensions through Gaussian pyramid of image. Image separated into many fixed sized blocks that further coinciding and calculate the reign values through Hu moments. This approach is efficient for perceiving copy-move forgery. Scale Invariant Feature Transform (SIFT) algorithm [4] performs normal detection but unable to find out flat copied regions and mirror reflected copy-move forgeries. PCA technique [5] detects even minor variations of noise or lossy compression and it is better for detecting copy-move forgery and gives less number of false positives. SVD method [6] failed to detect copy-move block out of two matched blocks and not vigorous in contradiction of JPEG compression. DWT method [7] fails in detection forgeries like rotation, heavy compression and scaling. DWT & KPCA [8] can detect false findings and it can detect rotation type and flip of forgeries. Intensity based method [9] fails when images are large smooth regions and highly distorted. FMT [10] can detect forgeries rotation up to 10° and scaling of 10% and robust to JPEG compression. MLBP [11] method does not calculate similarity between objects in the image and it does not estimate the weak sensor noise pattern. Existing block based methods increases computational complexity and they unable to identify the forged regions if the copied part is geometrically transformed and pasted. Feature keypoint based methods cannot locate the forgery regions very well. To overcome all these problems if we integrate both the block based and keypoint based methods [1] we will get the better results. In following sections, Section II shows the proposed scheme in detail. In Section III, Experiments are demonstrated. Finally, the conclusions are in Section IV.

II. MIRROR REFLECTED CLONING DETECTION

As shown in the Fig.1, the proposed method in detail. Image segmented into image blocks (IBs) using SLIC algorithm, which segments the image into non-overlapping irregular blocks. Then Mirror Invariant Feature Extraction (MIFT) extracts the features from each block as block features (BFs). These BFs are matched with one another and matched features are labeled for forgery region extraction, these labeled feature points (LFPs) indicates suspected forgery regions. Forgery Region Extraction algorithm detects forgery region from the LEPs by replacing feature points with super pixels and matching neighboring blocks with similar local color features. Finally a morphological operation applied on merged regions to generate the detected forgery regions.

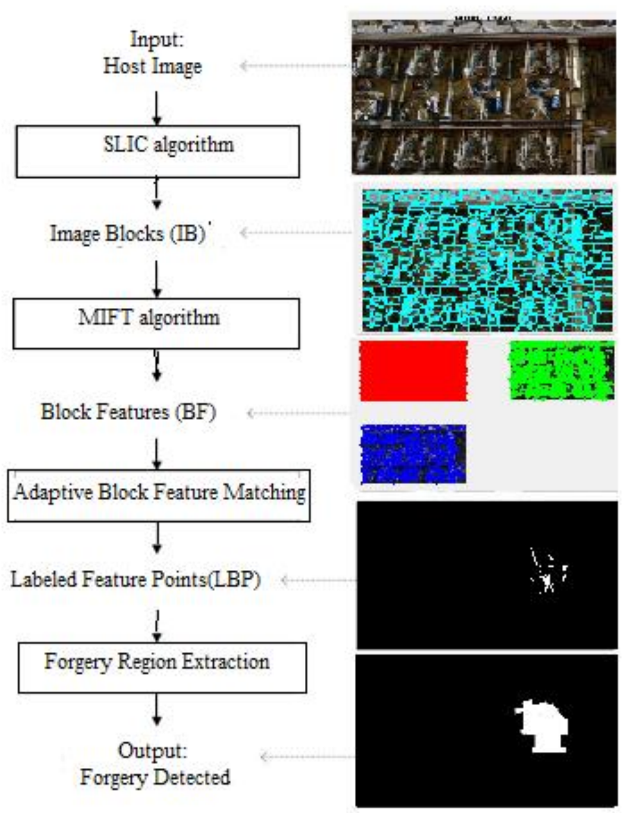

Fig.1.Flowchart of the proposed method

A.SLIC Algorithm

Existing methods, divides the host image into overlapping regular blocks with fixed block size, but this method doesn't represent the forgery region accurately. The main problem involved in this method is as size of image increases the computational complexity increases. To solve it a novel method i.e. SLIC Segmentation is proposed to segment the image into non-overlapping regions of irregular blocks next the features extracted from these irregular blocks and are matched to detect the suspected forgery region. Therefore Simple Linear Iterative Clustering (SLIC) is used to divide host image into irregular superpixels and are treated as individual blocks.

Steps to calculate initial size of the superpixel of given image:

i. Perform 4-level Discrete Wavelet Transform (DWT) using "Haar" Transform

ii. Calculate low level energy (E_{LF}) and high level energy(E_{HF}) as follow

$$E_{LF}=\sum|CA_4| \quad (1)$$

$$E_{HF}=\sum\left(\sum|CD_i| + \sum|CV_i| + \sum|CH_i|\right) \quad i=1,2,3,4. \quad (2)$$

Where CA_4 is approximation component (4th level) of DWT and CD, CV, CH are diagonal, vertical, horizontal components of DWT

iii. Calculate Percentage of low power distribution

$$P_{LF} = \frac{ELF}{ELF+EHF}.100\% \quad (3)$$

iv. Calculate the Initial size of super pixel using

$$S=\begin{cases} 0.02 \times M \times N & PLF > 50\% \\ 0.01 \times M \times N & PLF \leq 50\% \end{cases} \quad (4)$$

Using S as initial size super pixel segmentation is applied on host image.

B.Block Feature Extraction Algorithm

Each block contains the features of the respective block. Here adopted MIFT descriptors that are invariant to mirror reflection transformations as shown in Fig.2. MIFT is local feature extraction method based on SIFT, that is robust to mirror reflection also. A Mirror reflected version of an image can be acquired by reversing the axis of the image, hence, in a horizontally reflected image the row order of pixels remains the same. So in MIFT mirror invariance is achieved by simple descriptor reorganization. This descriptor reorganization first organizes the arrangement of cell order around the interest points. This is done by checking the values of total left pointing (ml) and right pointing (mr) orientations. Based on the winning orientation, column order may change (ml >mr) or not. Second, for each cell, it checks whether the order of

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orientation bins to follow clockwise or anticlockwise direction. Thus MIFT provides a descriptor which is identical in all cases of mirror reflections.

C.Feature Point Matching Algorithm

For this algorithm Block Features (BF) are taken as inputs Labeled Feature Points (LFP) are obtained as outputs. Initially load all the Block Features and then calculate the correlation coefficients CC of each image blocks. Calculate the block matching threshold according to the distribution of correlation coefficients. Locate the matched blocks according to the block matching threshold. Label the matched feature points in the matched blocks MB to indicate the suspected forgery regions.

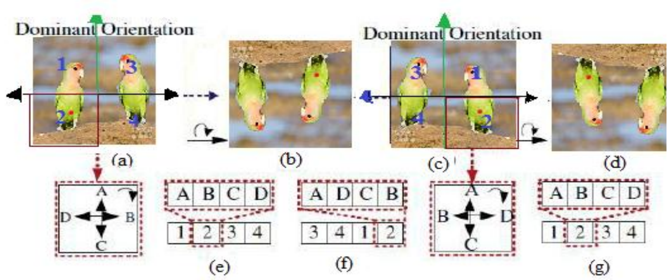


Fig.2. Different mirror reflections and the concept of MIFT. (a) The original image. (b) The combined reflection of (a). (c) The horizontal reflection of (a).(d) The vertical reflection of (a). (e) The original and MIFT descriptor for (a). (f) The descriptor of original version for (c). (g) The MIFT descriptor for (c).

D. Feature Extraction Algorithm

As shown in Fig.3. It will detect the forged region exactly. For this replace the LFP with small superpixels to get suspected regions. By measuring local color feature of superpixel and its neighbors suspected region is identified. If the color features matched with each other merge those to form merged regions (MR). To detect the copy-move forged region a morphological operation is applied for merged regions.

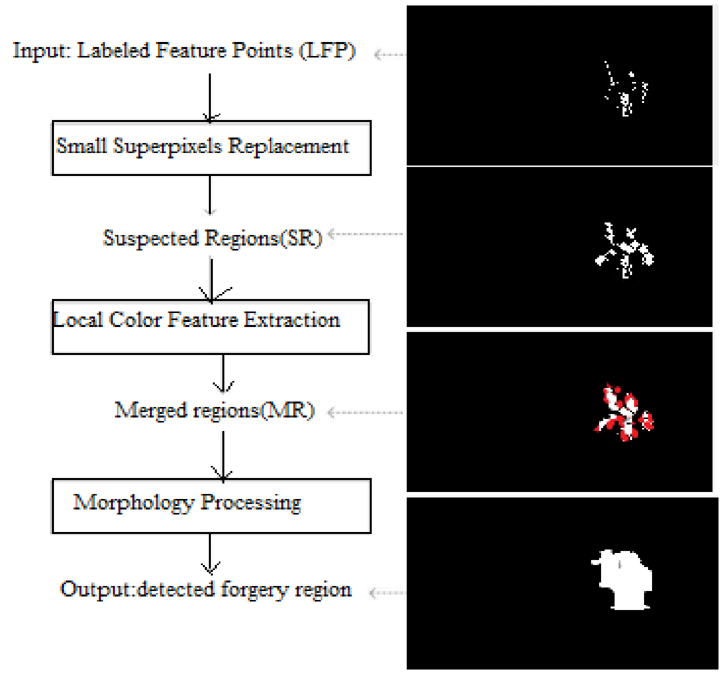
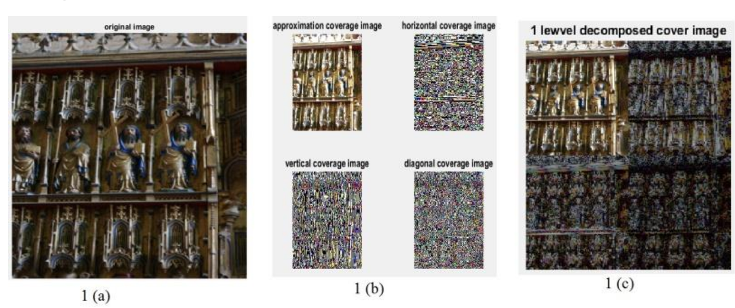


Fig.3. Flowchart of the Forgery Region Extraction Algorithm

III. EXPERIMENTS AND DISCUSSION

In this section, To evaluate the effectiveness of the proposed Mirror reflected cloning detection experiments are conducted. In the following experiments, high-resolution uncompressed PNG true color images are used. Fig. 4 shows the cloning detection results of the proposed scheme. Fig.5. shows the forgery detection on another image. Fig.6. shows the image forgery without reflection and its detection using SIFT. Since SIFT doesn't detect mirror reflections for mirror reflected forged image as shown in Fig.5. is detected by using MIFT as in Fig.7 4(b)



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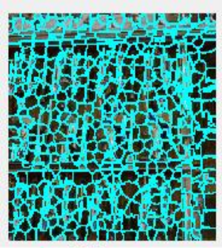
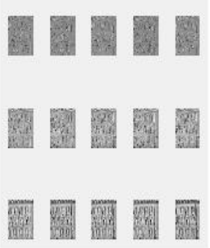

1 (d)


1 (e)

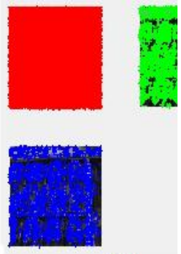
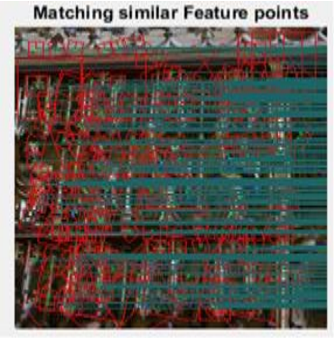
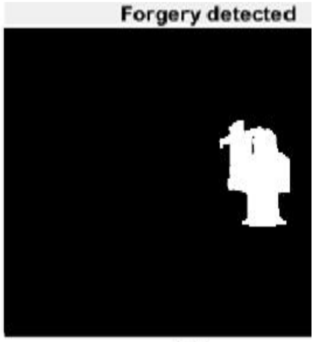

1 (f)

Fig.4: 1(a). Original image, 1(b). Components of DWT, 1(c). DWT 1 level decomposed image, 1(d). SLIC segmented image, 1(e). SIFT descriptors, 1(f). Feature points on image



1 (g)



1 (h)


3 (a)


3 (b)

Fig.6. 3(a) forged image without reflection 3(b) forgery detection using SIFT


4 (a)

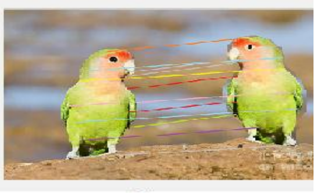

4 (b)

Fig.7. 4(a) forged image with reflection 4(b) forgery detection using MIFT

IV.CONCLUSIONS

In this paper, we have proposed a novel Mirror reflected cloning detection. Initially the image is segmented using SLIC algorithm. To get better accuracy for each given image a new initial size is calculated according to their energy distribution in lower frequencies. Then, from each block, the feature points are extracted as block features, and the Block Feature

Fig.4. 1(g) Matching similar feature points, 1(h) detected forgery

2 (a)

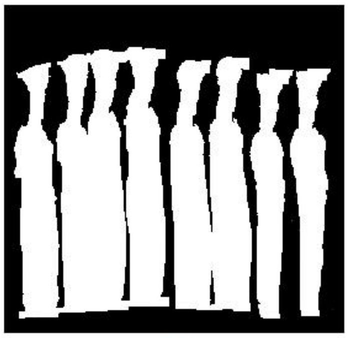

2 (b)

Fig.5. 2(a) original image 2(b) forgery detected image

Matching algorithm is proposed, with which the block features are matched with one another to locate the labeled feature points; it can approximately indicate the suspected forgery regions. Finally, to detect the more accurate forgery regions, we proposed the Forgery Region Extraction algorithm, in which the labeled feature points are replaced with small superpixels as feature blocks, and the neighboring feature blocks with local color features that are similar to the feature blocks are merged to generate the merged regions. Next, the morphological operation is applied to the merged regions to generate the detected forgery regions.

Since in Feature extraction algorithm SIFT unable to detect mirror reflected copy-pasted image a novel method using MIFT is proposed it can detect the mirror reflected forgery accurately. Experimental results show that the proposed scheme can achieve much better detection results for cloning images than the existing copy-move forgery detection methods. Future work could focus on applying the proposed forgery detection scheme based on SLIC and MIFT on other types of forgery, such as splicing or other types of media, for example, video and audio.

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