Improving Segmentation-based image copy-move forgery detection

Supervisor,

Rizoan Toufiq

Assistant Professor

Department of CSE, RUET.

Presented By,

Arun kundu

Roll No : 143045

Department of CSE, RUET.

Outlines

- Objectives
- Introduction
- Related works
- Background study
- Proposed methodology
- Implementation
- Result
- Conclusion
- Future work
- Reference

Objectives

- Detection of copy-move image forgery more accurately than the existing methods
- Improving the forgery detection speed and accuracy.

Introduction

- Copy-Move is a special type of image manipulation technique in which a part of the image itself is copied and pasted into another part of the same image.
- A copy-move image forgery is done either for hiding some image entity, or adding more minutiae resulting in forgery.

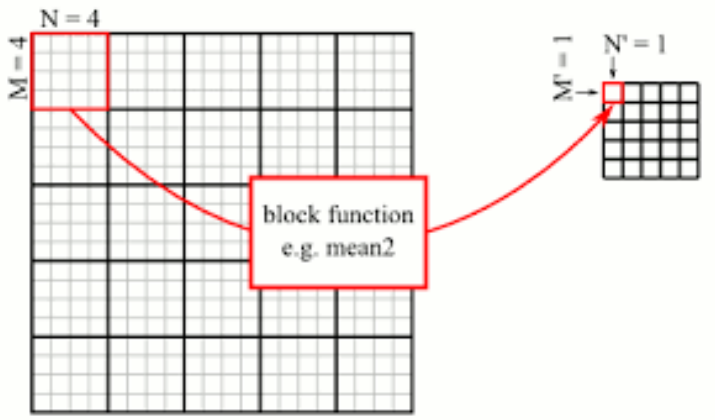
Actual image

Forged image

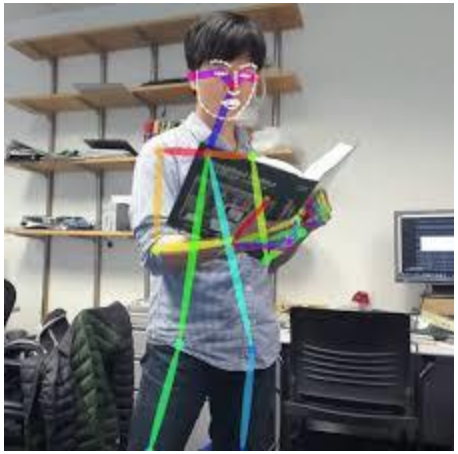
Related works

The works already done in this field are divided into two categories.

Block based



Keypoint based



Related works
(Block based)

- The former first divides the image into overlapping blocks and then finds the CMF by looking for the similar blocks.

There are Several block based technique :

- Discrete cosine transform(DCT)
- Discrete wavelet transform(DWT)
- zernike moments

Related works

(Block based(Contd.))

M. Bashar, K. Noda, N. Ohnishi, and K. Mori, "**Exploring duplicated regions in natural images**," *IEEE Trans. Image Process.*, accepted for publication.

Advantages:

- Discrete wavelength transform (DWT) and Karnel principle component analysis (KPCA) both method used to detect copy move in this paper.
- Preserve high and low frequency features during the signal decomposition due to use DWT.
- Noisy and compressed data handling because of denoiseing performance of KPCA.

Drawback:

- High computational time and complexity.

Related works

(Block based(Contd.))

J. Zhang, Z. Feng, and Y. Su, "**A new approach for detecting copymove forgery in digital images**," in *Proc. Int. Conf. Communication Systems*, Nov. 2008, pp. 362–366.

Advantages:

- Gaussian pyramid decomposition is used to Divide the tampered image into Sub-image To get the smoothest level of the image then block tiling process is performed togenerate overlapping blocks of pixels.

Drawbacks:

- High computational complexity and time consuming.

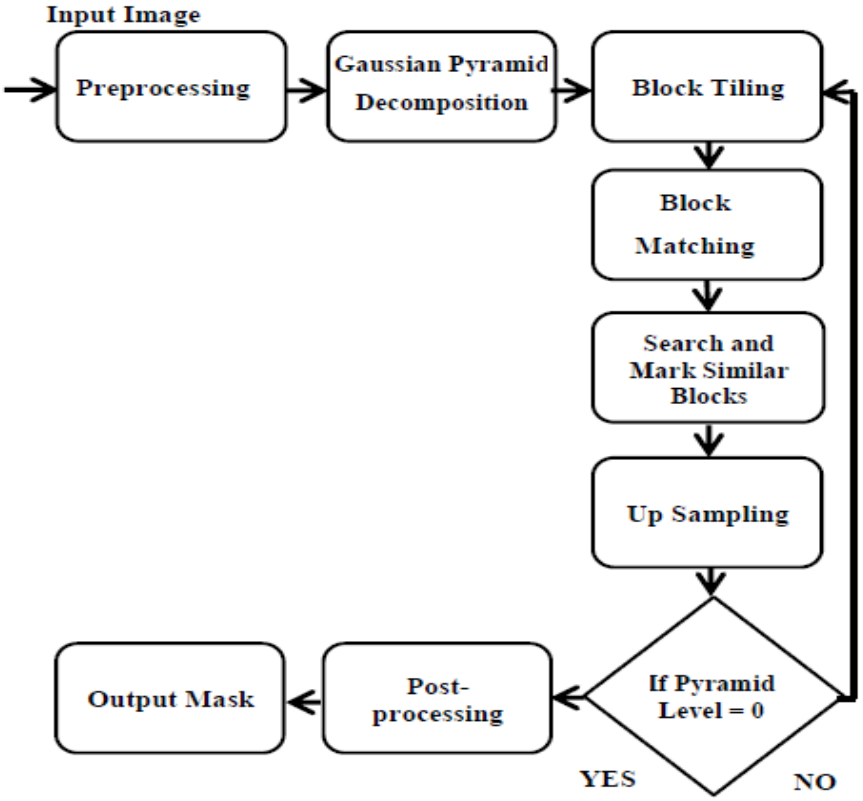


Fig. 3: Block diagram of proposed algorithm.

Related works
(Block based(Contd.))

S. Ryu, M. Lee, and H. Lee, "**Detection of copy-rotate-move forgery using Zernikemoments**," in *Proc. InformationHiding Conf.*, Jun. 2010, pp. 51–65.

Advantages:

- Magnitude of Zernike moments are algebraically invariant against rotation. So any paste region which is geometrically rotated can be successfully detected.

Drawback:

- Cannot handle other geometric transform accurately.

Related works

(Block based(Contd.))

S. Ju, J. Zhou, and K. He, "**An authentication method for copy areas of images**," in *Proc. Int. Conf. Image and Graphics*, Aug. 2007, pp. 303–306.

Advantage :

- Principle component analysis (PCA) used for feature detection which make it less complex.
- Gives better performance during additional noise

Drawback :

- This is not better in detection when geometric transformation like scaling, rotating etc done with paste region.

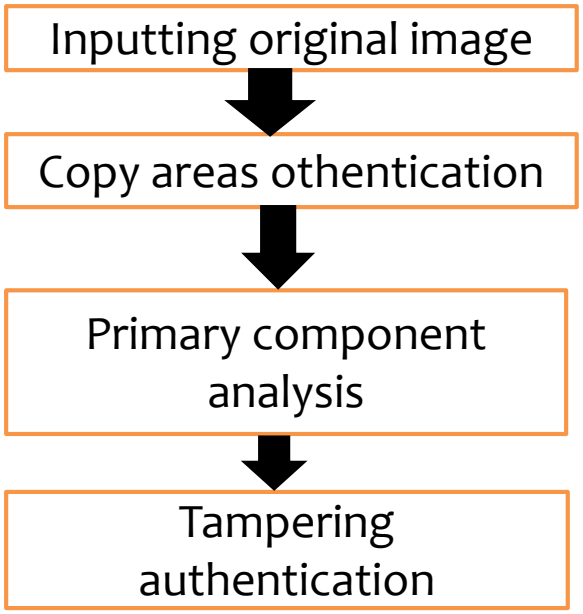


fig: the authentication flow

Related works
(Keypoint Based)

Keypoint based methods mainly uses the scale and rotation-invariant interest point detector and descriptor algorithm.

Two such algorithms are:

- **Scale invariant feature transform(SIFT)**
- **Speeded up robust features(SURF)**

Fig 1: Training phase of CSOM.[1]

Fig 2: Recognition phase of CSOM.[1]

Related works

(Keypoint Based (contd.))

I. Amerini, L. Ballan, R. Caldelli, A. D. Bimbo, and G. Serra, "**A SIFT-based forensic method for copy-move attack detection and transformation recovery**," *IEEE Trans. Inf. Forensics Security*, vol. 6, no. 3,pp. 1099–1110, Sep. 2011.

Advantages:

- Use SIFT algorithm to extract keypoints.
- Can detect multiple pasted region.
- Can detect any geometrical transformation.

drawbacks:

- Detection of small region is difficult because of the absent of enough keypoints.

Related works
(Keypoint Based (contd.))

X. Pan and S. Lyu, "**Region duplication detection using image feature matching**," *IEEE Trans. Inf. Forensics Security*, vol. 5, no. 4, pp. 857–867, Dec. 2010.

Advantages:

- Use SIFT algorithm for keypoint extraction.
- Use Random Sample Consensus(RANSAC) for robust keypoint estimation.

Drawback:

- Detect repeated region as copy-move region.
- Depends on only SIFT for keypoint extraction.

Background study

Several techniques are invented to detect copy-move image forgeries. All these technique follow this common processing pipeline.

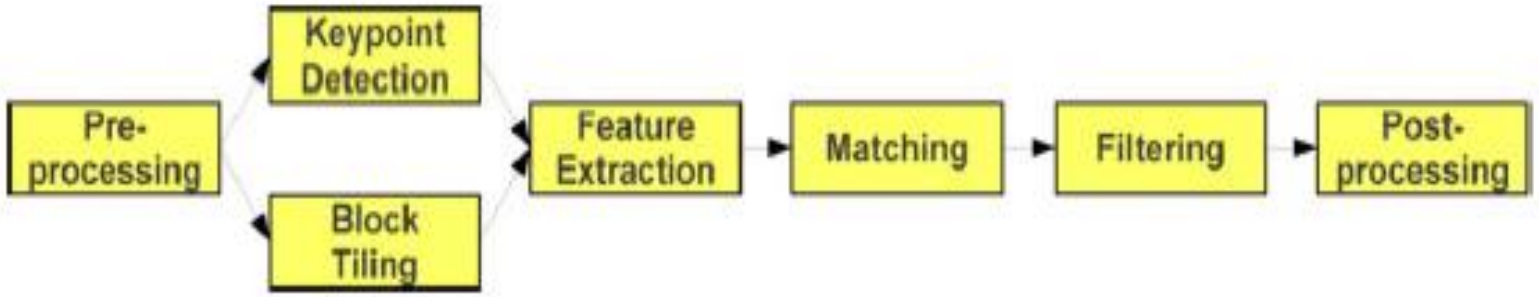


Fig: Common processing pipeline for the detection of copy-move forgeries.

Keypoint extraction is better. because

- it gives better result when there is transformation in paste region
- Takes less computational time than block based methods.

Background study(Contd.)

Scale invariant feature transform (SIFT)

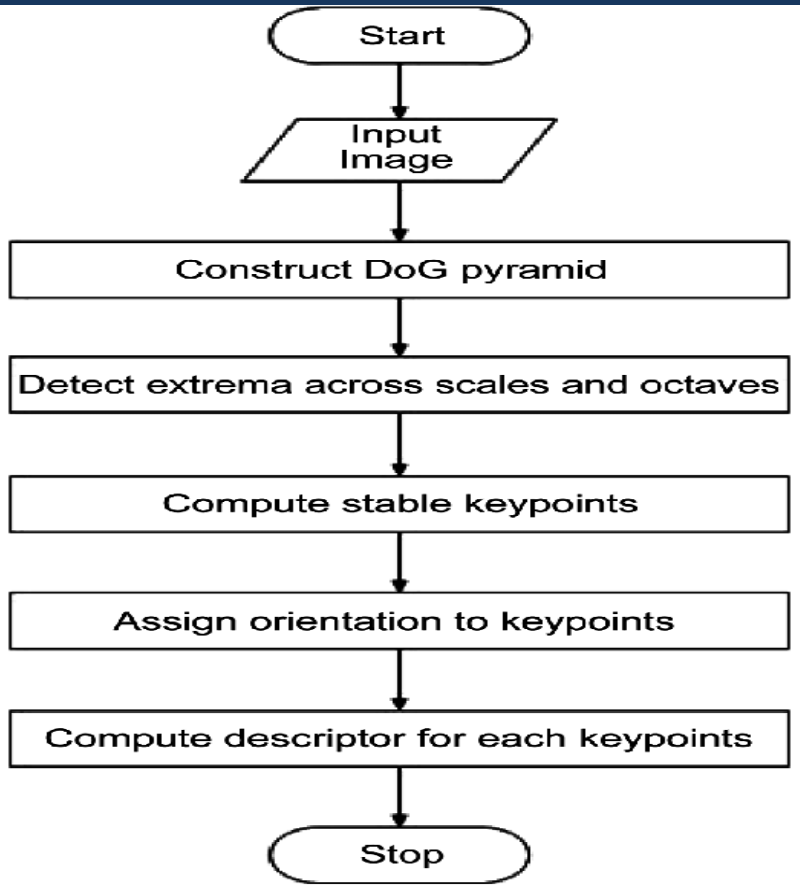


Fig : SIFT method processing pipeline

Background study(Contd.)

SPEEDED UP ROBUST FEATURES (SURF)

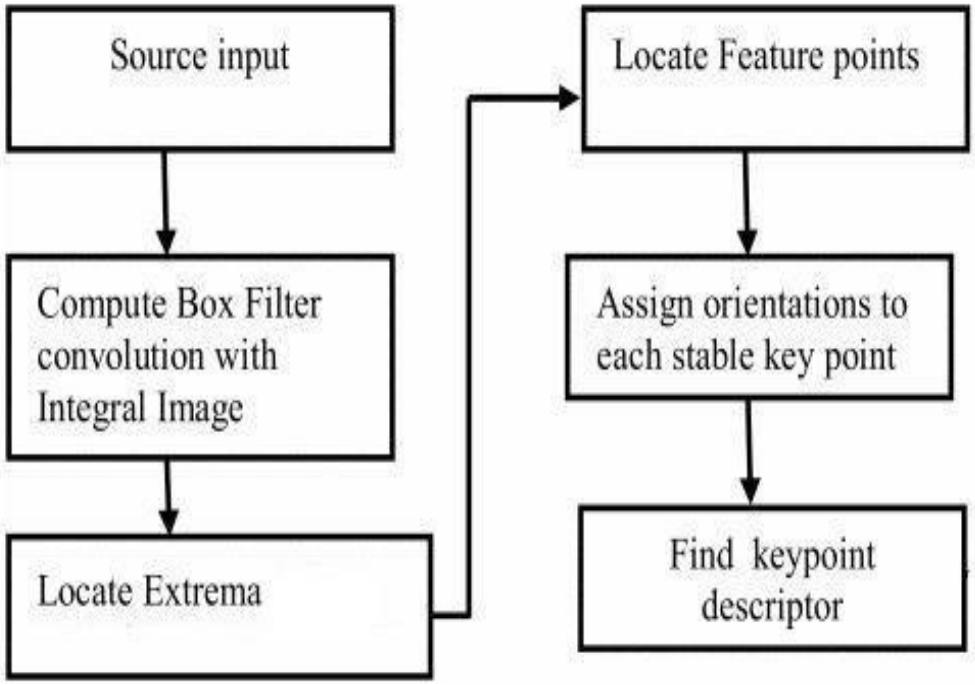


Fig : SURF method processing pipeline

Background study(Contd.)

The workflow of the base paper. [2]

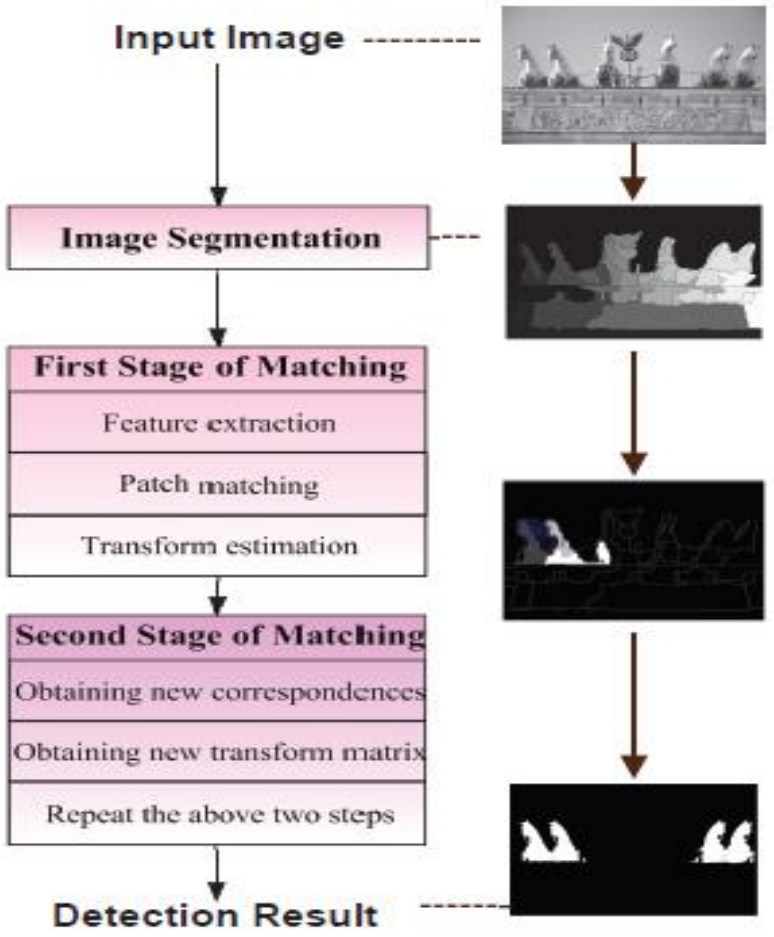


Fig. 2: Flowchart of the proposed CMFD framework

Proposed methodology

In the keypoint detection section Surf will be used Because it gives the same Result as SIFT but the Algorithm is faster than SIFT.

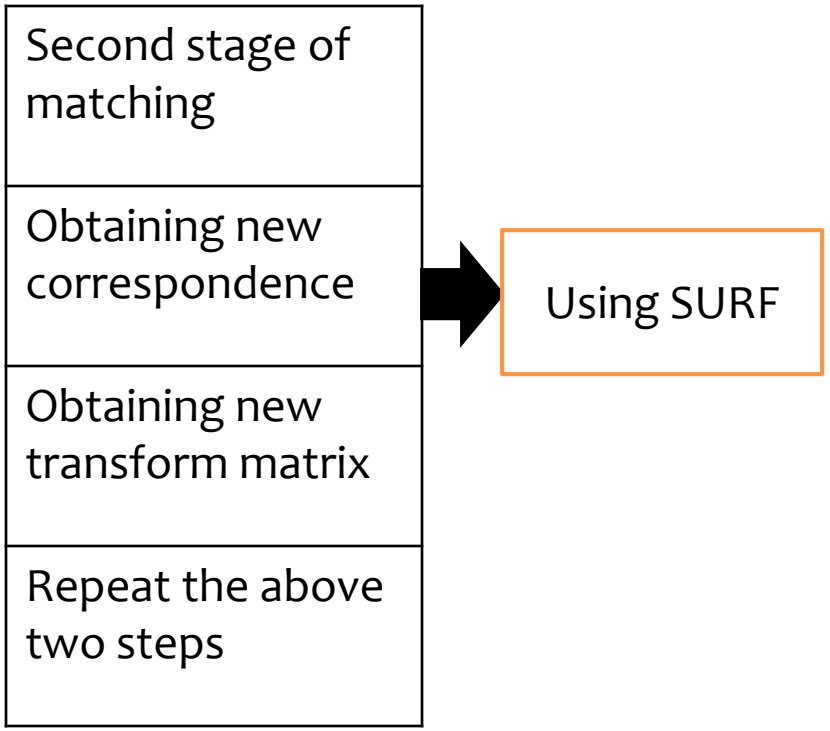


Fig: Proposed workflow

Implementation

Implementing the work of base paper, Has not finish yet.

Result

the performance of theCMFD scheme is tested by detection error at two different.

Image level:

$$FP = \frac{Original\ images\ identified\ as\ tempered}{Original\ images}$$

$$FN = \frac{Tempered\ images\ detected\ as\ original}{Tempered\ images}$$

Result(Contd.)

Pixel level :

- Precision $= \frac{\{\{\text{CMF pixelsg} \prod \text{ retrieved pixels}\}\}}{\{\{\text{retrieved pixels}\}\}}$

- Recall $= \frac{\{\{\text{CMF pixels} \prod \text{retrieved pixels}\}\}}{\{\{\text{CMF pixels}\}\}}$

Result(Contd.)

Result of plain CMF detection at image level:

methods	Fn	Fp
SIFT	26/48	9/48
SURF	27/48	8/48
Base paper	8/48	17/48

Table 1 : Image level comparison

Result(Contd.)

- Result of plain CMF detection at Pixel level in several methods:

Method	Precision	Recall	F_1
BLUR	98.07	78.81	86.19
BRAVO	98.81	82.98	89.34
CIRCLE	98.69	85.44	90.92
DCT	92.90	82.85	84.95
DWT	90.55	88.78	88.86
FMT	98.29	82.33	88.79
HU	97.08	74.89	82.92
KPCA	94.38	88.36	90.24
LIN	99.21	78.87	86.69
LUO	97.75	82.31	88.41
PCA	95.88	86.51	89.82
SIFT	60.80	71.48	63.10
SURF	68.13	76.43	69.54
SVD	97.53	76.53	83.71
ZERNIKE	95.07	87.72	90.29
Average	92.21	81.62	84.92

Table 2 : Pixel level comparison

Conclusion

- The two stage segmentation will increase the accuracy of forgery detection. But it will affect the forgery detection speed. Better performance could be achieved by using SURF algorithm.

Future works

- In this method we need to depend on SIFT/SURF algorithm. This is a drawback because these algorithm doesn't work well in small region where there is a few keypoints.

- So new algorithm can be made which works well in small region and save computational time also.

Reference

- J. Fridrich, D. Soukal, and J. Lukáš, "Detection of copy-move forgery in digital images," in *Proc. Digital Forensic Research Workshop*, Cleveland, OH, Aug. 2003.
- 2. Jian Li ; Xiaolong Li ; Bin Yang ; Xingming Sun "Segmentation-based Image Copy-move Forgery Detection Scheme" *IEEE Transactions on Information Forensics and Security,* Volume: 10 , Issue: 3 Page s: 507 – 518, Year: 2015.
- M. Bashar, K. Noda, N. Ohnishi, and K. Mori, "Exploring duplicated regions in natural images," *IEEE Trans. Image Process.*, accepted for publication.
- J. Zhang, Z. Feng, and Y. Su, "A new approach for detecting copymove forgery in digital images," in *Proc. Int. Conf. Communication Systems*, Nov. 2008, pp. 362–366.
- S. Ryu, M. Lee, and H. Lee, "Detection of copy-rotate-move forgery using Zernikemoments," in *Proc. InformationHiding Conf.*, Jun. 2010, pp. 51–65.

Reference(Contd.)

- S. Ju, J. Zhou, and K. He, "An authentication method for copy areas of images," in *Proc. Int. Conf. Image and Graphics*, Aug. 2007, pp. 303–306.
- I. Amerini, L. Ballan, R. Caldelli, A. D. Bimbo, and G. Serra, "A SIFT-based forensic method for copy-move attack detection and transformation recovery," *IEEE Trans. Inf. Forensics Security*, vol. 6, no. 3,pp. 1099–1110, Sep. 2011.
- X. Pan and S. Lyu, "Region duplication detection using image feature matching," *IEEE Trans. Inf. Forensics Security*, vol. 5, no. 4, pp. 857–867, Dec. 2010.
- https://www.google.com/search?q=SURF+algorithm+flowchart&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjdrrD87eLgAhXET30KHZ3CDCcQ_AUIDigB&biw=1366&bih=586#imgrc=kdNSq6Gthq_leM:
- https://www.google.com/search?q=sift+algorithm+flowchart&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiDosOb7eLgAhUBfX0KHcLiBWAQ_AUIDigB&biw=1366&bih=586#imgrc=-ux4snX2bYybJM: