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Image splicing detection based on surf with ripplet Transform-ii

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Abstract: ***With the increasing popularity of digital devices, human being's get collaged with the usage of digital devices and images in their daily life. Hence, Crimes also increased in many forms. Nowadays image splicing, image forgery is becoming a common way; the anti-social people are using to create the fake photographs and misusing them. So many researchers have already been carried out on image splicing. But the existing methods of detecting image splicing undergo the following challenge: original image is essential for revealing tampering. In this paper, we propose an efficient method to detect image splicing. In which, Ripplet-II transform based scheme outperforms for feature extraction in representing edges and textures of an image; also SURF is good at handling images with blurring and rotation.***

Keywords: Image Splicing, Forgery Detection, SURF, Ripplet Transform-II

I. INTRODUCTION

In the current digital world, many researchers have concentrated to detect the digital crime. Some statistics state that around 20% of accepted manuscripts are tampered, from that 1% are fraudulent manipulations. By using the tool such as Adobe Photoshop, GIMP, Coral Paint fake images can be created as some of the tools are open source.. In view of this, some negative social impact can be raised. To overcome these types of crime problems, we are in need to implement a cost oriented effective approaches for detecting forgeries in digital data like images, audio or video. This paper focuses on image tampering operation like image splicing, i.e. cut and paste a portion of image from other digital images. This problem focused a lot of attention in the recent past, as witnessed by the several publications available in the literature,

Most of the forgery detection methods are classified into two major streams: active and passive methods.

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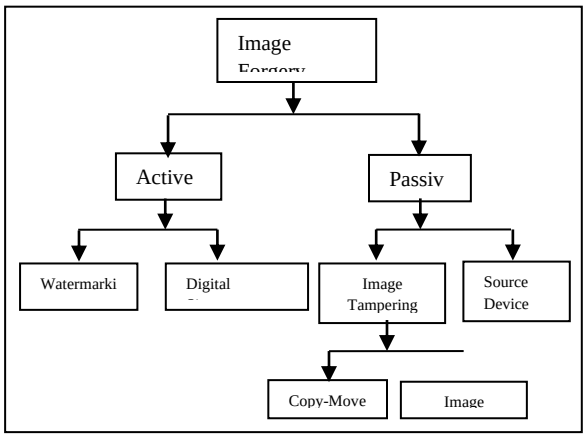

Fig1: Framework of Image Forgery

A. Types of Image Forgery

The image tampering operations involves addition of additional pixel or cutting some pixel intensity levels. Deleting some critical features is also objective associated with image tampering. This is classified into following categories

i. Copy-Move tampering
ii. Image Splicing

B. Copy-Move Tampering: [1,2]

Copy move mechanism is also known as cloning. Some part of the image is cut in any size and pasted on some other region in this case. Critical information either is lost or replicated in this case. As the copied part originated from the same image hence determining forgery becomes very difficult.

C. Image Splicing:

Image splicing uses cut and paste method form one or more images to create a new image. The new image is also known as fake image. This is one of the most common types of forgery mechanism. This mechanism along with the copy moves forged images are difficult to detect since image intensity levels does not differ much from the original image. This paper is planned to provide efficient image forgery localization with a combined ripplet transform based SURF feature extraction, which is used to overcome the limitation of wavelet, Ripplet transform is used for feature extraction due to its efficiency in representing edges and textures.

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Then SURF is used to detect interest points. This is several times faster than other key point based methods.

This paper is organized as follows: Section II gives an overview of Existing methods in image splicing detection. Section III describes the research methodology, an Experimental result of proposed method is discussed in section IV and section V concludes this paper.

II. RELATED WORK ON IMAGE SPLICING

The recently researchers made efforts to detect the image forgery detection, the different methods are proposed for different types of forgeries [1, 2, 3, 4].

III. RESEARCH METHODLOGY IN IMAGE SPLICING

This paper focused to propose an improved method of forgery detection with the combination of Ripplet transform with SURF feature detector.

A. Ripplet Transform:

Efficient representation of imagery is critical for image processing. Wavelet transform has better performance in representing 1D singularity than Fourier transform. The ripplet transform is also a generalization of curve let transform.

Discrete Ripplet-II Transform:

If the Input of the ripplet-II transform is digital image, discrete Ripplet-II transform[10] of function *f* can be obtained by first computing discrete generalized radon transform(DGRT) of *f*, and then computing 1D discrete WT (DWT) of the DGRT of *f* as below

$$f(\rho,\phi) \overset{DGRT}{\Longrightarrow} GR_d[f](r,\theta) \overset{1D-DWT}{\Longrightarrow} \mathcal{R}_f(a,b,d,\theta) \quad \text{-(1)}$$

The discrete orthogonal ripplet-II transform follows the paradigm in (2)

$$f(\rho,\phi) \overset{GRT}{\Longrightarrow} GR_d[f](r,\theta) \overset{2D-WT}{\Longrightarrow} \mathcal{R}_f^{orth}(a,b_1,b_2,d) \quad \text{- (2)}$$

and is obtained by

$$f(\rho,\phi) \overset{DGRT}{\Longrightarrow} GR_d[f](r,\theta) \overset{2D-DWT}{\Longrightarrow} \mathcal{R}_f^{orth}(a,b_1,b_2,d) \quad \text{-(3)}$$

If d=2, the discrete ripplet-II transform simply and effectively computed through generalized radon transform.this is called as parabolic radon transform.

The generalized radon transform along curves can be defined in the polar coordinates(ρ,ϕ) by

$$GR_d(r,\theta) = \int\int \rho f(\rho,\phi)\delta(r-\rho\cos^d((\phi-\theta)/d))d\rho d\phi \quad \text{-[4]}$$

$$\begin{aligned} GR_2(r,\theta) &= 2\sqrt{r}\int\int \rho' f(\rho'^2,2\phi')\delta(\rho'\cos(\phi'-\tfrac{1}{2}\theta)-\sqrt{r})d\phi' d\rho' \\ &= 2\sqrt{r}R[f(\rho'^2,2\phi')](\sqrt{r},\theta/2) \end{aligned} \quad \text{-[5]}$$

Hence, we can compute ripplet coefficients via the equations [1] and [5].

Methods	No.of Images Detected out of 300				Precision (P)	Recall (r)
	T_P	T_N	F_P	F_N		
SURF	231	260	68	50	77.2%	82%
DWT+ SURF	213	264	87	45	71%	83%
DyWT+ SURF	252	253	48	40	84%	86%
Proposed	277	280	23	20	92.3%	93%

Computation of Inverse Ripplet-II transform with degree d=2:

Step 1: Apply 1D inverse wavelet transform to Ripplet-II coefficients w.r.t r,resulting in $GR_2(r, \theta)$.

Step2: substitute (r,θ) in $GR_2(r, \theta)/2\sqrt{r}$ with $(r'^2, 2\theta')$ resulting in $R(r', \theta')$;

Step 3: apply classical inverse radon transform to $R(r', \theta')$,resulting in $f_1(x,y)$.

A. SURF Detector

SURF was first presented by Herbert Bay, et al. It is one of the local feature detector and descriptor. It is partially related with the SIFT descriptor; However, it is faster than SIFT. To ensure the quick process this follows three steps: detection, description and matching. In key point comparison level.

B. Proposed Methodology

In the proposed methodology the image splicing can be detect through the combination of the ripplet transform through surf feature detector. In which the ripplet transform perfectly detect the 2d singularities than other wavelet transform. The curves and edge features are efficiently detected by ripplet transform. Also the computation has to be speed up through surf feature detector

Proposed Algorithm

***Step1**: Input the image I(x.y)*

***Step 2**: Preprocessed the Image*

***Step3**: Divide an image I(x,y) into non-overlapping blocks.*

***Step4**: Decompose the image using ripplet transform and obtain the ripplet coefficients.*

***Step5:** foremost distance of the nearest key points are detected from the interrelated sub channels like LL,HL,and LH.*

***Step6**: arrange all the detected features in lexicographically order.*

***Step7**: match the keypoints with same gradient values.*

***Step 8**: detect the region of the image splicing.*

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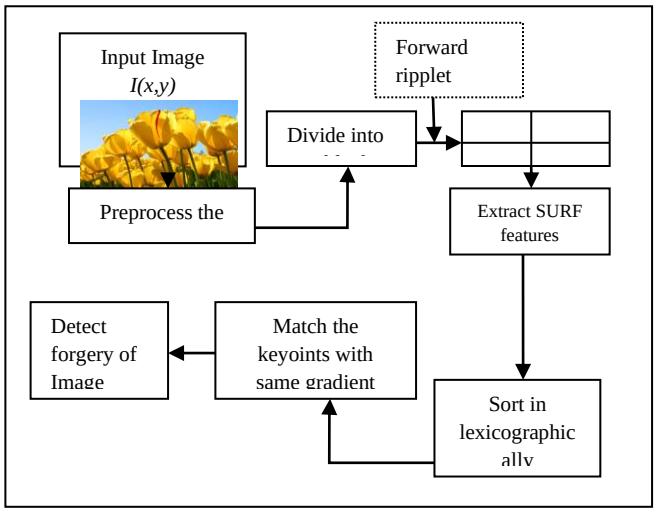

Fig.2 Framework of Image Splicing based on Ripplet Transform with SURF Feature

IV. FINDINGS

In result analysis, Totally (50x3timesx6camera) 900images were taken; from that 300 images have been tampered as image splicing with the help of Photoshop CS3 software.

Table1. Digital cameras used in this experimentation

S.No	Camera Model	Max.Image Size	Image format
C1	Canon PowerShot A495	3648x2048	JPEG
C2	SAMSUNG PL120	4320x2432	JPEG
C3	SONY-DSCW330	4320x3240	JPEG
C4	Canon-DSLR	5184x3456	JPEG
C5	NikonD90	4288x2848	JPEG
C6	NikonD300	4288x2848	JPEG

This paper is focused to find a given image is forged or not. if it is True; then calculate the performance of computation time. The image level fact has to be measured through precision *P* and recall *r* which are defined as:

$$p=T_P/(T_P+F_P) \quad and \quad r=T_P/(T_P+F_N) \qquad (6)$$

Table 2: Evaluation measures Description

Evaluation Measures	Description
True Positive(T_p)	No. of Images that have been correctly detected as forged
False Positive(F_P)	No, of Images that have been falsely detected as forged
False Negative(F_N)	No.of Images that have been falsely missed but they are forged
True Negative(T_N)	No.of Images that have been correctly detected as not forged(without Tampering)

Table 2 shows the evaluation measures description[12]. Recall is also called as True positive rate(TPR).The simulation results are tabulated in Table 3.

Table 3.Performance Result of Different methods

This can be calculated as

$$F\text{-}Score= 2T_P/(2T_P+F_P+F_N) \qquad (7)$$

Table 4: Performance Accuracy of Various Methods

Methods	TPR	FPR	F1 Score	Total Elapsed Time(ms)
SURF	77.26 %	11%	79.66	13395
DWT+SURF	71.00 %	15%	76.34	15060
DyDWT +SURF	84.00 %	8%	85.14	7090
Proposed	92.33 %	4%	92.8	5083

From the above comparison, the proposed method gives much better results than other existing methods.

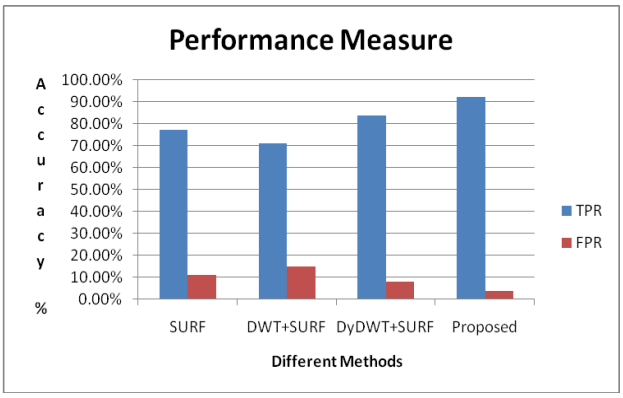

Fig.3 Performance Measure of TPR and FPR in Different methods

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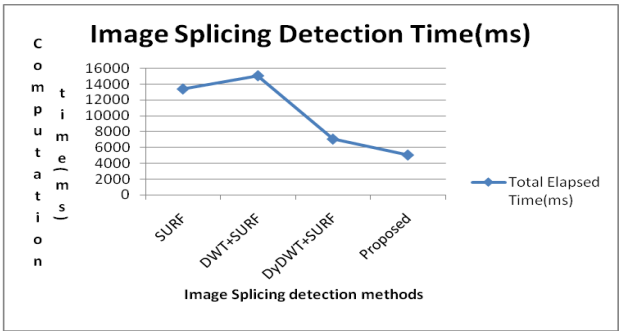

Fig.4 Performance Time taken for Image splicing Detection by various methods

V. FINDINGS

In this paper we found and analye many methods for ripplet transform with SURF feature detector. And also found 2D singularities method.

VI. CONCLUSION

In this paper, image splicing forgery has been detected by a combined method of ripplet transform with SURF feature detector. Which produce an accurate result than other existing methods; also the 2D singularities are effectively detected. With combination of the ripplet with surf gives a very quick response than other existing methods. In the court premises the forged images are easily and effectively detected by this method.

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