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DETECTION OF IMAGE FORGERY BASED ON RIPPLET WAVELET TRANSFORM

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Abstract: With the increasing popularity of electronic gadgets, image capturing is very simple and convenient mannerly done by any person. Because image performs a major role in the most job. With the availability of image editing's software like Adobe Photoshop and CorelDraw, the portions of the image or entire image can be modified without any obvious sign. This leads to discarding image authenticity. These modifications are not visible to the naked eye. Modification of image is a common image manipulations operation. The modification can be performed within the same image or another image. This copy paste operation is called as doctored. During image capturing every region of the image is stored with its unique features. Many researchers have already been carried out on doctored image detection. In this paper, we propose a method to detect image forgery based on ripplet transform.

***Index Terms* - Image Source, Image Forgery, Image Features, Ripplet Transform.**

I. INTRODUCTION

In the digital world, every day highly performed digital devices like camera and mobiles are available in the market. Also, due to the advancement of digital image processing softwares and tools, the image can be easily edited and manipulated. These modifications are not visible to the naked eye. Forgery is not new to the world (Mohd Dilshad ansari et. al). In ancient days it was limited to art and literature but did not affect any human life. Nowadays, digital images are a major source, which covers newspapers, cover image of magazine, proof of court evidence. S.Murali et al(2012). Digital Image forgery is classified into two ways like active and passive. In which, the passive approach is also classified into four categories like Pixel based forgery, Format based forgery, Source device based forgery, and geometry based techniques (Mohd Dilshad ansari et. al). Doctored image is pixel based technique. This type of forgery can be done by any person very easily either in the same image or other images. Amerini, L et. al (2011). Researchers have proposed many techniques to detect image forgery. This paper is organized as follows: Overview of different methods of detecting Image forgery detection of research method in section 2, section 3 illustrate the proposed method of doctored image detection using ripplet transform, experiment results are discussed in section 4, section 5 concludes this paper.

II. RESEARCH METHOD

In the internet world, image modification is very common, until it does not affect any human. I. T. Ahmed et al (2021). proposed a method to detect the copy move forgery using spatial feature domain, in which the edge features could not be detected perfectly. L. Kang et al (2010) proposed a technique to detect the forgery with the help of block matching features. Rodriguez-Ortega et al (2021) proposed two approaches that use deep learning a model using custom architecture and another model with transfer learning. The depth of the network is analyzed in each approach. AKPCA with sift based forgery detection proposed by Jeyalakshmi and Dr.Ramyachitra(2019). In which the region of tampering is detected with two step approaches.

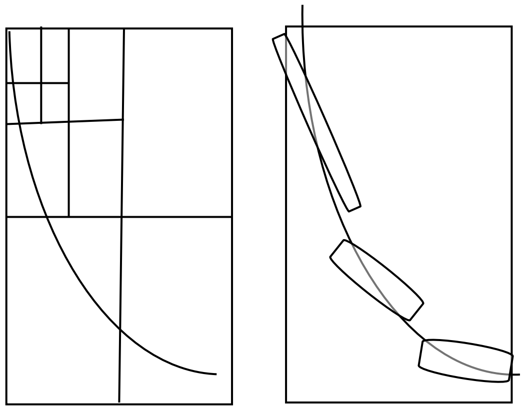
2.1 Curvelet Transform: Curvelet transform is powerful tool for Image denoising , feature extraction in digital images. Traditional wavelet transforms are not able to represent the edge discontinuities along the curves perfectly. To overcome this negative aspect, researchers simply use curvelet transform to represent the two dimensional singularities along the curves. Hence, curvelets will be superior to wavelets. K. Siva Nagi Reddy (2012). This is a multiscale directional transform that allows an almost optimal non-adaptive sparse representation of objects with edges.

The curvelet transform of function f can be represented by, $c(j,l,k) := < f \quad \varphi_{j,l,k} >$ (2.1)

Where $\varphi_{j,l,k}$ is the curvelet, j,l,k is scale, direction and position parameter respectively[8]. The digital curvelet transform is defined by $c^D(j,l,k) := \sum_{0 \le t1,t2 < n} f[t1,t2]\overline{\varphi^D_{j,l,k}[t1,t2]}$ (2.2)

The figure 1 represents the edge singularities of wavelet and curvelet approximations. The curvelet requires least number of coefficients to compute the edge features along with curves.

2.2 Ripplet Transform: The 2D singularities are resolved by parabolic scaling using curvelet transform. Jun Xu et.al(2010). But it does not have any evidence in scaling law. Riplet transform is a generalization of curvelet transform. This has all properties of curvelet except the parabolic scaling.Multi-resolutin analysis of data can be perfectly done by ripplet transform. Ripplets are also highly directional to capture the orientations of singularities in an image data because of; ripplets have different compact support for localizing the singularities more accurately.



Wavelet approximation of edge singularities

Curvelet transform of edge singularities

Fig.1

2.3 Discrete Ripplet Transform: Digital image processing needs discrete transform instead of continuous transform. The discretization of parameters of continuous ripplet transform is performed like discrete curvelet transform. The image can be decomposed by the discrete ripplet transform (DRT) of M x N image $f(n_1 n_2)$ will be in the form of Jun Xu et.al(2010).

$$R_{j,\bar{k},l} = \sum_{n1=0}^{M-1} \sum_{n2=0}^{N-1} f(n_1 n_2) \overline{\rho_{j,\bar{k},l(n_1 n_2)}} \qquad (2.3)$$

where $R_{j,\bar{k},l}$ are the ripplet coefficients. The decomposed image can be reconstructed through inverse discrete ripplet transform (IDRT) $\bar{f}_{(n_1,n_2)} = \sum_j \sum_{\bar{k}} \sum_l R_{j,\bar{k},l}\ \rho_{j\bar{k}l}(n_1, n_2)$ (2.4)

III. IMAGE FORGERY DETECTION

Every day millions of digital images are captured or generated by various digital devices; which are also easily modified by different multimedia software's. Hence, Digital image modification is not a new thing. This process is good, until it does not affected any human or living things. In this proposed method the image forgery has been detected by ripplet transform. Initially, the source image has been divided into four level of sub band like LH, HL, HH and LL. Discrete ripplet transform is applied on LH, HL, and HH sub band and extract features from high resolution coefficients..

The extracted features have been arranged in lexicographical order. This is also known as dictionary order. Block based classification is performed on one another. The mismatched features region is marked by different color.

3.1 GLCM Features: **G**ray **L**evel **C**oocurrence **M**atrix method is a way of extracting second order statistical features.

Energy: This is second moment in GLCM. High energy values occur when the gray level distribution has a constant or periodic form. Energy has a normalized range

Entropy: This measures the disorder or complexity of an image. The entropy is large when the image is not texturally uniform and many GLCM elements have very small values.

Variance: This is a measure of heterogeneity and is strongly correlated to first order statistical variable such as standard deviation. Variance increases when the gray level values differ from their mean.

Homogeneity: This is also called as Inverse Difference Moment. It measures image homogeneity; it is more sensitive to the presence of near diagonal elements in the GLCM.

Correlation: This feature is a measure of gray tone linear dependencies in the image.

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Algorithm of calculating GLCM Features:

1. Quantize the image data.

   Each sample on the echogram is treated as a single image pixel and the value of the sample is the intensity of that pixel
2. Create the GLCM Matrix
3. Calculate the statistical features
4. Sample S in the resulting variable is replaced by the value of this calculated feature.

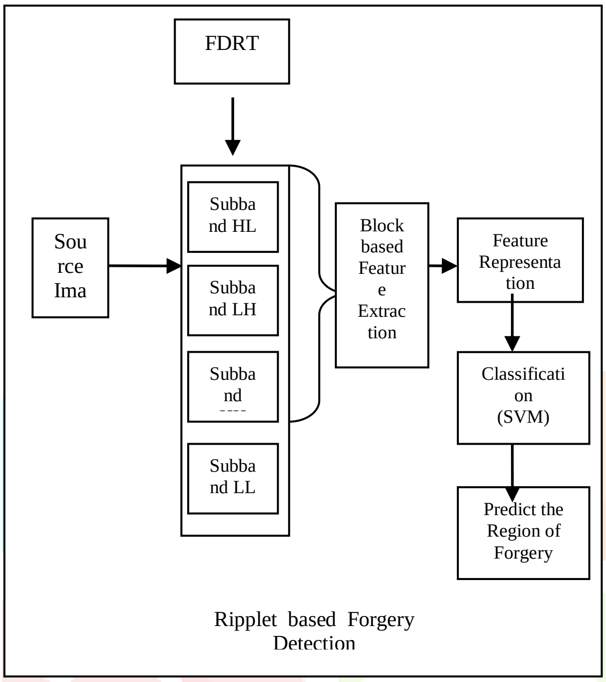

Fig: 2 proposed method of Forgery Detection

Algorithm for Copy-Move Forgery Detection

1. Get the Source Image f(x,y)
2. Divide the image into four subband HH,LL,HL,LH
3. Apply the Discrete Ripplet transform
4. $R_{j,\bar{k},l}= \sum_{n1=0}^{M-1}\sum_{n2=0}^{N-1} f(n_1 n_2)\,\overline{\rho_{j,\bar{k},l(n_1 n_2)}}$ Extract the GLCM Features from the Sub band HH,HL,LH
5. Sort the extracted features in lexicographical order(Dictionary)
6. Classify the extracted features.
7. Spot out the uneven region as forgery.

3.2 Support Vector Machine (SVM)

Support Vector Machine (SVM) is a famous classification tool in image processing and pattern recognition. C.Chang and C.J.Lin.(2011).which has been widely used in supervised learning techniques. SVMs are based on the idea of minimizing training set error by constructing a hyper plane as the decision surface in such a way that the margins of separation between different classes are maximized. Consider a two-class classification problem with linearly separable data and training feature sets [mi, yi] (i =1,… K), where yi is the label of the feature vector mi with a value of either +1 or -1. The feature vector m lies on a hyper plane given by wT.m+b=0 where w is the normal to the hyper plane.

IV. EXPERIMENTS AND RESULTS

In the Experiment and testing image data base has been download from CoMoFoD - Image Database for Copy-Move Forgery Detection. Tralic D. et.al(2013). More than 200 sample pre-processed images are available in this CoMoFoD database. In this paper nearly 10 images have been used for experiment. Extract the GLCM features using discrete wavelet and ripplet transform. Based on the simulation result, the ripplet wavelet transform returns much better outcome than wavelet transform

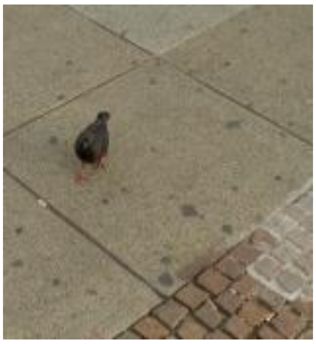

Fig 3 a Original Image

3.bForgery Image

3.c Doctored Image region Detected

Table 1tabulate the extracted Features of digital image using wavelet and curvelet transform define in the form of precision and recall rate. Figure 3.a and 3.b are original and copy move forgery image; which are downloaded from CoMoFoD database. These are standard testing image for copy-move forgery process. Figure3.c is the Ripplet based forgery detected image.

Table 1: Simulation Results of Forgery Detection using wavelet and Ripplet transform

Methods	No.of Images Detected as forged out of 10 Images				Precision(p)	Recall(r)
	T_P	T_N	F_P	F_N		
Discrete Wavelet	8	7	5	4	61.5%	66.6%
Ripplet wavelet	9	6	2	1	81.8%	90%

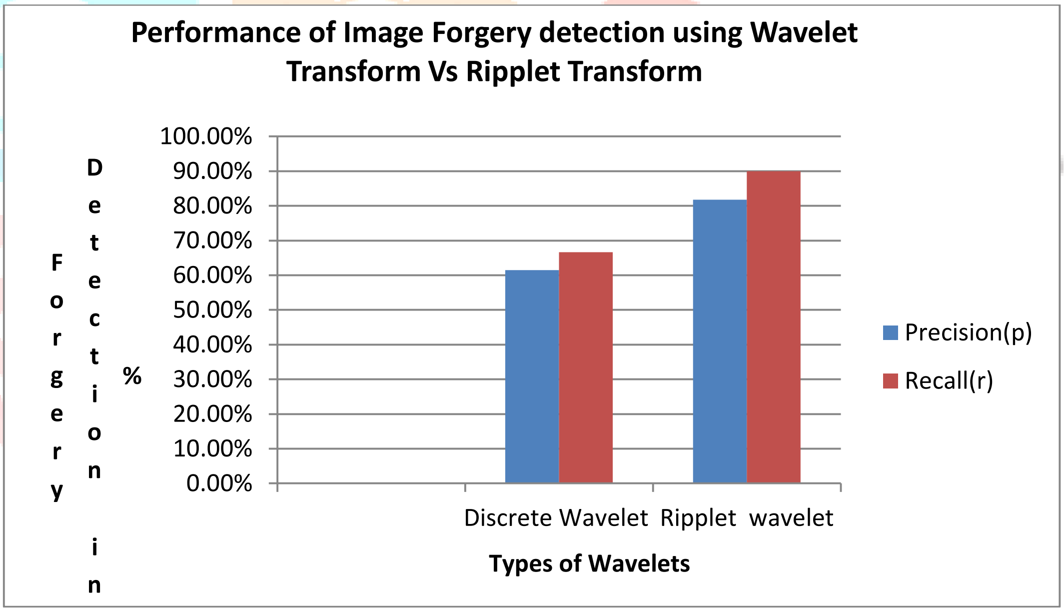

Fig 4: Performance of Image Forgery Detection Rate

Figure 4 describes the Image modification detection based on precision and recall rate in percentage wise. With the simulation results and graphical representation; the ripplet transform performance rate is better than traditional discrete wavelet transform, because the edge discountinuties along with local singularities representation are absolutely computed than traditional wavelet transform

V. CONCLUSION

For Copy-Move forgery detection, many real-world applications are existing in the market. However, they are providing some static solution. Most of the methods are used to point out the forgery region only. They could not be detected the edge discontinuities along with curves. Nowadays, ripplet transform performs to detect the edge features along with curves perfectly. In this paper, the proposed method implemented with ripplet transform based forgery detection. The simulation results via; the proposed method gives better performance than traditional wavelet transform

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