Exploiting Manipulated Region in an Image using Integrated Convolution Neural Network and LRW Segmentation Features

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Abstract: To locate the manipulated region in digital images, we suggest to use Convolution Neural Networks and the segmentation based analysis. A unified CNN architecture is designed with set of training procedures for sampled training patches. Tampering map can be generated for the above said Convolution Neural Networks with the help of tampering detectors. In the other hand, a segmentation using lazy random walk based method is second-hand to generate the tampering chance map, finally integrate the maps and generate the final decision map. This can help to locate the manipulated region accurately. Experiments are conducted using the various datasets to prove the efficiency of the suggest method.

KEY WORDS: Tampering, Segmentation, Forgery, Convolution Neural Networks.

I. INTRODUCTION

Digital image manipulation is performing of tampering the contents of an image in order to complete some ruinous intention. The Digital Image forensic has appeared as a new research field that aim to disclose tampering operations in digital image. There are two main problems in image forensics are falsification discovery as well as forgery localization. In digital image forensic, forgery localisation is one of the most challenging tasks. Forgery recognition merely differentiates whether a present image is faultless or fake, but the image forgery localization aims to notice the manipulated region accurately. Since forgery localization need to does pixel level scrutinize, so it is far hard than the predictable forgery discovery commission.

Flourishing in computer vision task, Convolution Neural Network (CNNs) is applied in image forensics. There are many research works are carried out on forgery localization by using the features extracted by CNN. CNN based methods are used by researchers because it can get better recital to computerize the commission of feature extraction. Traditional techniques have a restricted ability in image forensics whereas CNN can be useful with good accuracy in locating manipulated region in image forensics.

In [11], the author use Lazy Random Walk (LRW), that algorithm to find initial super pixel and their boundaries. The main advantage of super pixel is to deliver a more natural and perceptually momentous depiction of the image, and also using LRW algorithm finds the exact object boundaries in difficult texture region and concurrently keeps the super pixel uniform is very well.

In [22] author, with the set of multistage tampering detectors based on CNN generate the tampering map, also proposed a segmentation pedestal technique to combine the map and create the ending verdict chart. In this paper, we generate the tampering possibility map by adopting powerful CNN system from our previous work [15] and fuse the CNN map with the map generated by LRW segmentation based hand crafted features. The rest of the paper is structures as Section I deals with Background study, Section II describes the proposed method, and Section III explain the untried result, Section IV explain the product of the future technique among comparison of the other existing technique and finally conclusion are drawn in section V.

SECTION I

II. BACKGROUND STUDY

i) CNN Based Methods

CNNs have made enormous achievements in computer visualization. There are many recent works are carried in tampering region localization using CNNs. Some of the note worthy works which obtained good results is considered. The method [5] authors to use CNN in order to get better the recital and to computerize the commission of feature extraction. The characteristics acquire from the variety of filter images may baffle the CNN model. It has been experiential from the previous work that with a confident characteristic, only a finicky type of forgery is notice [17], and also the new form of convolution layer JPEG compression cause note worthy problem in image forgery region detection.

In [23], the author defined a note worthy features which are unchanged by recompression and a CNN is planned to absorb and classify these characteristics. The Computations difficulty of the technique is lofty, in [13] the authors design the various CNN based methods for image forgery Localization. In our previous work [15] compare the CNN based forgery region detection techniques and prove the CNN method in gives the good accuracy in forgery localization.

ii) Prior Arts In Super Pixel Segmentation

A Recently Researches have introduced various image super pixel segmentation algorithm and we will shortly review these work in this section. Originally Ren and Malik present the Super concept [18] and introduced an image super pixel method to section the given image into a great number of little compressed and uniform regions by regularize cuts. Levinshten et al [12] presented an efficient Turbo pixel super pixel method using the level set based arithmetical stream evaluation from the regularly located seeds in the image. But, it shows relative deprived edge observance since of its arithmetical immovability problem especially with difficult textures. In [20] the author developed an image super pixel method by using the diagram cut optimization, as well as the super pixels were obtain by stitching each pixel that belonged to only one of the overlapping image patches.

The other super pixel methods that have been future are such as the algorithm in [1]. In [29] author describes a trellis similar to formation of super pixel region with same size by discover the Eigen images from the input image, which better the evaluation speed in the Turbo Pixel framework.

In the paper [11] the author presents a novel super pixel segmentation approach using LRW algorithm and derives the result that the introduced method achieves good performance than previous super pixel approaches.

iii) Prior Hybrid CNN Techniques In Image Manipulation Localization.

Nowadays many authors suggest various hybrid methods in which running time of the detection algorithm is low with high accuracy. There are different new techniques are used in hybrid methods. The established key point foundation methods are better by adding some properties of block foundation methods. In author [2] are some example of them. Recent efforts including [6], within the tampering recognition commission, use deep learning foundation models. These contain discovery of generic tampering [5], resembling, splicing [17], and bootleg.

### ARCHITECTURE OF INTRODUCED APPROACH METHOD

In [14] authors use Gaussian-Neuron CNN for stag analysis. In [18] the author introduced a deep learning approach to recognize facial retouch. Image region forgery detection has been performing using heap auto-encoded model in [23]. In [17] author introduced a new type of convolution layer to find out the tampered feature from an image. In a CNN with SLM kernel is adopted for forgery detection. And also with the extensive experiments result and also the methods based on fusion of the two approaches yield better result.

From the above study it is noted that dissimilar approach have their own advantages and shortcomings, so how to reach the final decision by fusion the results are very important issue. Unlike most of the deep learning based image manipulation detection methods which use convolution layer, introduced a unique network exploiting convolution layers along with segmentation feature extraction.

SECTION II

III. PROPOSED METHOD

Copy, clone, splicing and removal are extremely ordinary in Image tampering techniques, similar to as they are extremely complex to identify due to their similarity to its genuine images. The main aim of this job is to recognize these tampering at pixel and patch-level. Localization of tampered regions is a dissimilar problem than object segmentation because manipulated regions are not visually obvious.

We first present the structure for forgery localisation Figure 1. Then introduce two forensic approaches used in the frame work correspondingly, and introduced the fusion method for integrating the detection results of both approaches.

Figure 1 The Structure of Introduced system

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Algorithm of the Introduced System

Step 1: Let I be Input Image(I)

Output : FakeMap

$FakeMap_{HF}$ € Zero(Size of Image)

// HF hand craft feature

FakeResult= Zero(Size of Image)

Step 2: Apply LRW to the given Image (I) and obtain segmented super pixel as I_{supseg}

Step 3: for each seg S_i € (I_{supseg})

// Compute the Texture Feature (TF)

$HSVf_1$ = hsv (seg S_i)

$ICOf_2$= Intergratative co ocurance (seg S_i)

$ICMPf_3$= Co Ocurance matric (seg S_i)

$LBPf_4$=Local Binary Patten (seg S_i)

seg S_i _FV=[$HSVf_1$,$ICOf_2$,$ICMPf_3$,$LBPf_4$)

// FV feature vectors

FakeResult=RF (FV)

If isfake(FakeResult)

Set $FakeMap_{HF}$(seg S_i)= 1

Else

Set $FakeMap_{HF}$(seg S_i)= 0

Step 4: $FakeMap_{CNN}$=$CNN_{PixelLevel}$(I)

// Find the Hand fake map and CNN fake map to obtain final fake map.

Step 5: FakeMap= $FakeMap_{HF}$ U $FakeMap_{CNN}$

i)   *CNN Based Approach*   The outline of the CNN based method is shown in Figure 2.
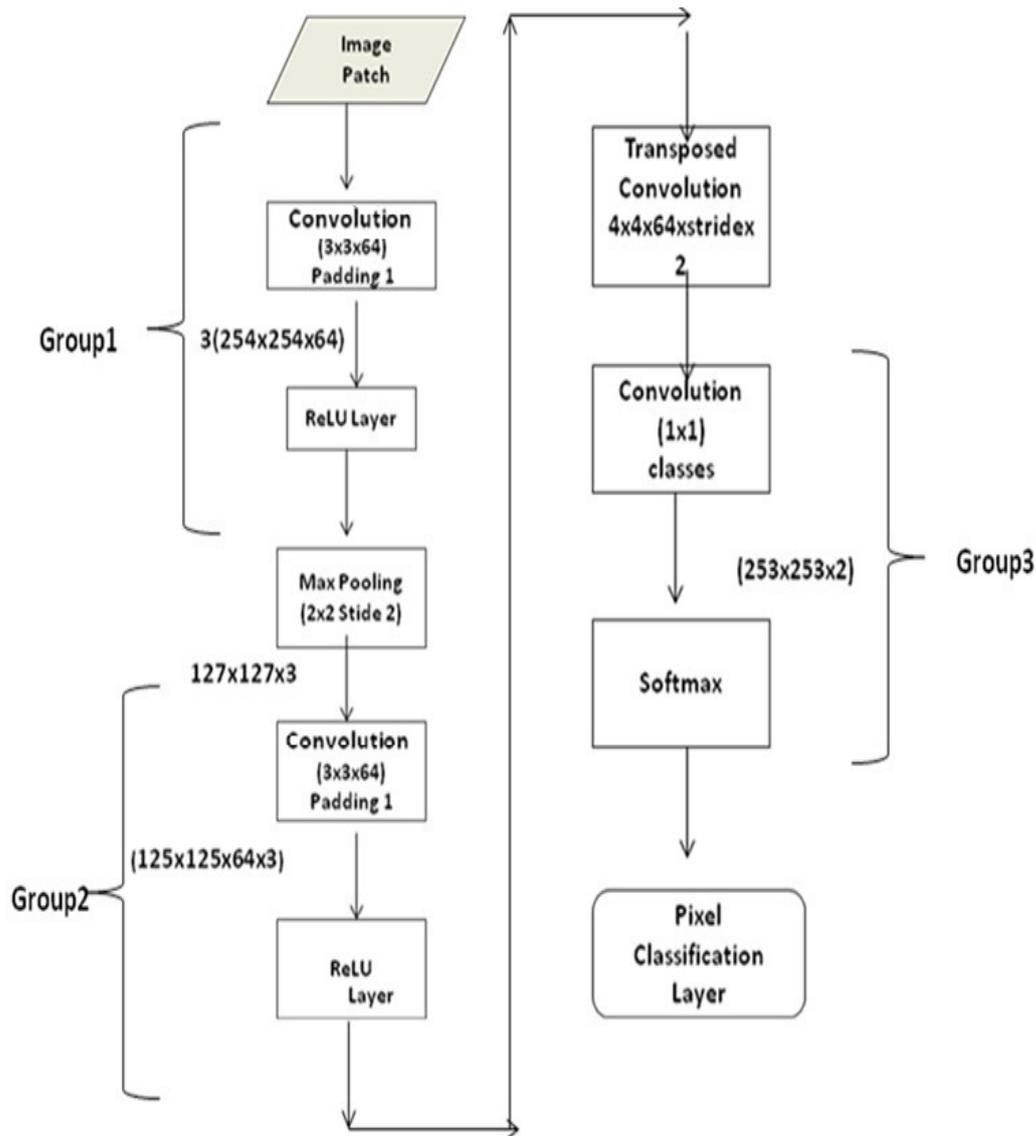
Figure 2 Architecture in CNN based approach [15].

The structure and steps in the introduced CNN architecture are explained on the previous work [15] a two dimensional matrix called an image and a kernel or mask the proposed Convolution in a neural network is a product. The experimental results on the new CNN system outperform the other forgery localization methods. Adjust the result on the CNN based method to get tampering possibility map.

i)   Forgery Detection Using LRW Segmentation Process

Our methods begin by insertion the preliminary super pixel seeds on the input image where the like seed initialization approach. The compute process of forgery detection using LRW segmentation is explained in our previous work [16]. The forgery detection by our LRW algorithm achieve better result in detection compare to other well know approaches. In this paper, compute the texture feature of each segment.

The following texture features of image blocks are considered and taken in to account for image forgery detection. The four features used in this paper are HSV, ICO, ICMP and LBP. Finally the results obtained by these features are fused and generate the map M^{LRW}.

ii)   Synthesis Of Tampering Possibility Maps

Finally we intend to defined a synthesis purpose $\Delta(M_{i,j}^{LRWF}\ M_{i,j}^{CNN})$ to identify whether the test pixel I_{ij} in an image is perfect or fake .In this case, the fusion purpose give output 1 for a pristine pixel and the fusion function used in this paper as follows, $\Delta(M_{i,j}^{LRWF}\ M_{i,j}^{CNN})=I((M_{i,j}^{LRWF}\cdot M_{i,j}^{CNN})\geq T)$ where $T\epsilon(0,1)$ is the threshold. I (.) denote indicator function.

With the introduced fusion strategy, we can exploit the advantages of the CNN based approach and LRW based approach. Let us take in to account the inheritance properties of each kind of maps. Finally to achieve a final decision, we must fuse these maps in to a solitary map.

IV. EXPERIMENTAL PARAMETERS

IFS-TC data set of image forgery challenges is used in our experiment. These data sets have 700 fake images for testing and 442 fake images for training. Their size varies 640x480 to 4752 x 3168 (most of the images are 1024x 768). The image editing software tools are used to create a various kind of forgeries images similar to copy, move, erasing, splicing, and so on. For the training images, their ground truth maps are accessible. The testing images are not disclosed at the ground truth maps. The forgery localization concert is estimated by means of the F1 score as pursue.

$$F_1 = 2 \frac{Precision \cdot Recall}{Precision + Recall} = \frac{2TP}{2TP + FN + FP} \quad \text{----------- (1)}$$

True Positive is representing the number of detected fake pixels TP. False Negative is representing the number of undetected fake pixels FN. False Positive is reprehending the number of wrongly detected pristine pixel FP.

The experimental results are evolutes based on average F1 – score [1] and comparison of the results are shown figure 3. Original Image represents a. **CNN-**TPM **(**Tampering Possibility Map) represents b**.** Super pixel-TPM represents c. Fused-TPM is represents d. Result on the IFS-TC testing set2.

| Original image (a)	CNN-TPM(b)	Super pixel-TPM (c)	Fused TPM (d)
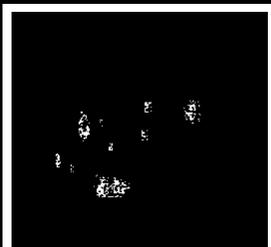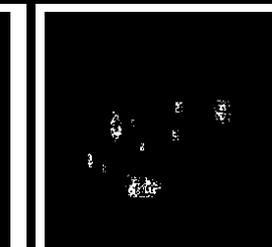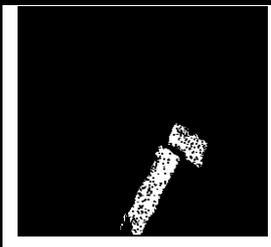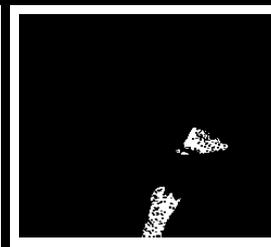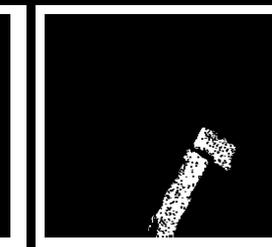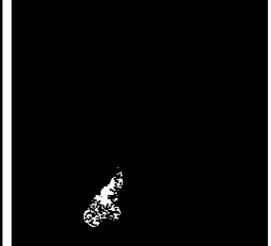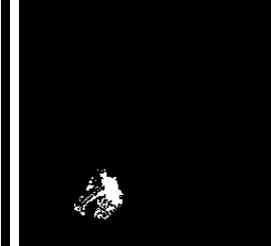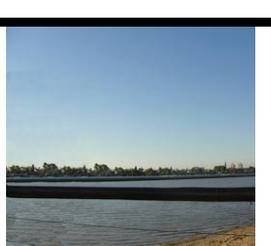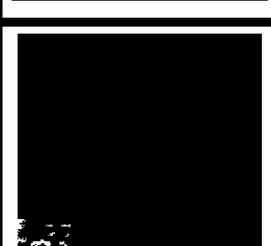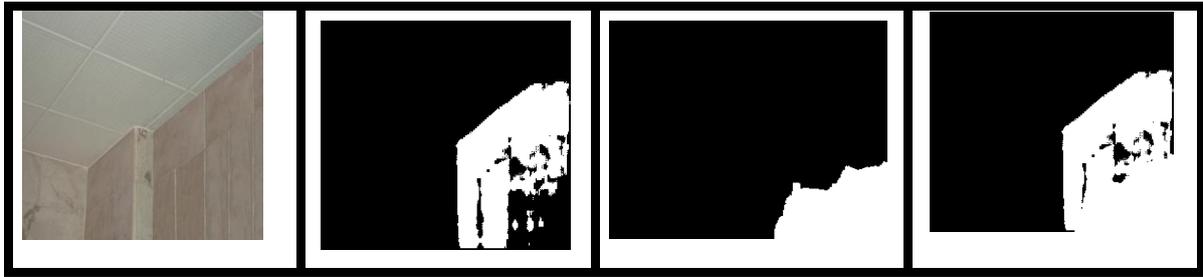
Figure 3. The detection results of images taken from IFS-TC picture forensics dare

a. Images taken from the data set IFS-TC image forensics challenge.

b. tampering possibility map obtained by CNN architecture

c. tampering possibility map obtained by super pixel segmentation.

d. Fusion results of CNN map and super pixel feature map.

V.   EXPERIMENTAL RESULT

Experimental results are representing in Table 1 and Time complexity of the proposed system are representing in Table 2.

|	Avg Accuracy	Avg Sensitivity	Avg Specificity
CNN-TD[15]	73.3122	76.5375	73.4687
CNN+LRW	83.683	89.42	86.79

Table 1 Experimental result
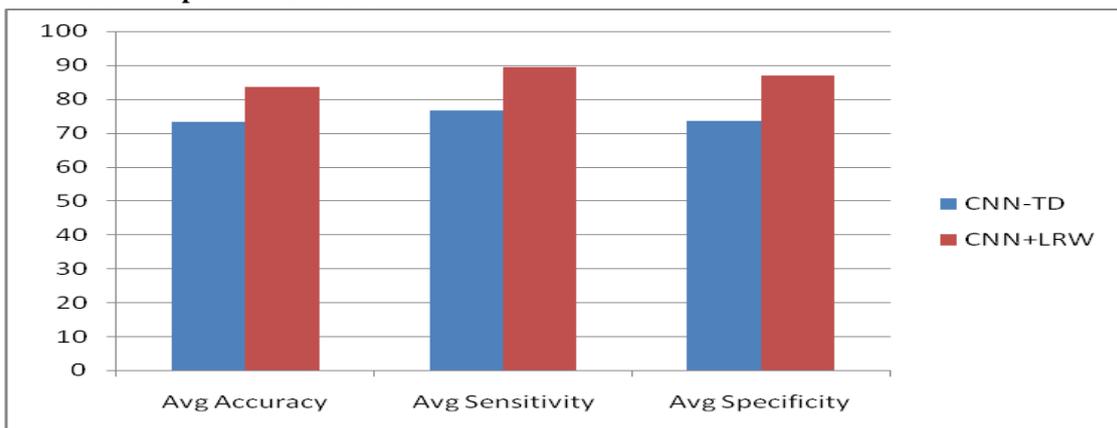
Figure 4. Map of the experimental result.

Table 2. Time complexity

S.No	Average time taken by CNN-TD in seconds	Average time taken by LRW-TD in seconds	Average total time taken by CNN+LRW in seconds
1.	1.1821	13.2585	14.4406

Table 3 Comparisons of proposed methods with existing methods

Methods	F1 Score
S3+SVM[9]	0.1115
S3+LDA[10]	0.1737
PRNU[22]	0.2535
SCRM+LDA[10]	0.3458
CNN-TD[15]	0.3962
GRIP[8]	0.4072
FUS[7]	0.4532
CNN+LRW	0.4763

VI.   COMPARISON WITH EXISTING METHODS

The result of the proposed method is compared with other Manipulation Localization methods in Table 3. Among them, introduced method achieves the highest F1 Score of 0.4763, and outperforms the best existing methods.
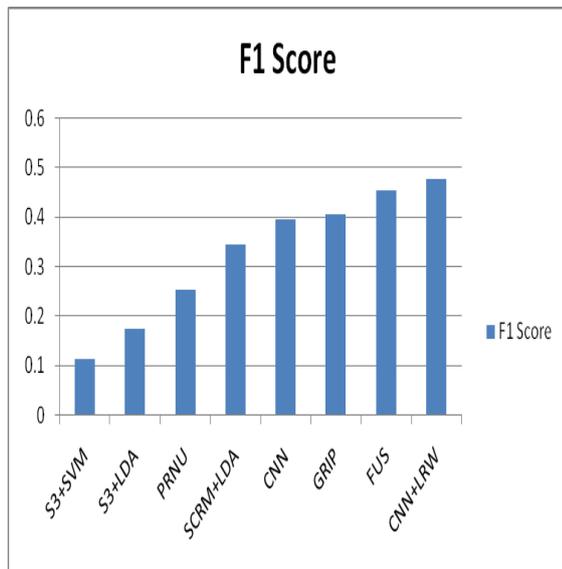
Figure 5 Map for Comparisons of proposed methods with existing methods

VII. CONCLUSION

In this research document we have introduced a new structure for image forgery localization. This introduced new structure, consist of CNN based Tampering localized methods and segmentation based Tampering localized method. The performance of introduced hybrid method has been considerably better by carefully choosing feature, designing the training model, and adjusting the algorithms and parameter.

The result of each forgery approaches are adjusted to obtain a tampering possibility map. The tampering map can conserve more useful transitional information of the forensic approaches, so that they can reduce the false positive and false negatives.

The resulting tampering possibility maps are integrated in the fusion method. We can obtain the pristine curve from analyzed the distribution of values in that maps. We conclude with the experimental result that gives the better compare than proposed strategy, and also achieves the highest tampering localization scores.

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