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Identification and Verification of Source Camera using DCT Filtering Technique

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Abstract:- **An enormous amount of images or videos are collected from laptops, mobiles, storage devices during the investigation by Police or intelligence agencies or digital forensic team. These collected images/videos to be analyzed to ascertain the source device that was used to capture these during the investigation. An every camera has its fingerprint in the form of Photo Response Non-Uniformity (PRNU) noise. Because it has universality and generality nature, it is unique and hence plays a very vital role in the source camera identification. PRNU is a sensor pattern noise which contains noise components, and other information hence many techniques have been proposed for the extraction of the PRNU. In this paper, a Discrete Cosine Transform (DCT) method is used for extracting the noise, and Weighted Averaging technique for PRNU estimation. Finally, the distance function is used for comparing g the difference between the Query image PRNU and the stored image PRNU. We conducted the experiments its results are verified against the different cameras, and it is giving 93% accuracy.**

Index Terms—**PRNU noise, DCT, Camera, Identification**

1. INTRODUCTION

In mobile ad hoc network (MANET), the NOWADAYS digital cameras are used in a more opportune way to capture the image. In the meantime it is easy to edit or modify the captured image using editing tools or software like photoshop. Through which illegal usage of the images has been increased. The image forensics includes authentication, device linking, integrity verification, anomaly investigation source camera identification, etc [1-2].

PRNU is a sensor pattern noise which is unique for each camera even if it is of same model and hence it is very important in the source camera identification. Fig. 1 represents the image acquisition process. The PRNU is polluted by various types of noise during the stages of image acquisition process. It is the result of manufacturing imperfections of semiconductor wafers. The digital device may contain components like lens aberration noise, Photo Response Non Uniformity noise [2-5].

The PRNU extraction process here is divided into three stages namely in filtering stage Discrete Cosine Transform (DCT) filtering is used, in the estimation stage weighted Averaging technique is used and the post estimation stage consists of concatenating the estimated PRNU's.

Many PRNU based methods are available for source identification of individual camera such as Discrete Wavelet Transform, Discrete Fourier Transform, and Discrete Cosine Transform etc. For the identification of the image origin the most commonly used system was designed by Lukas et al. In [2] the Discrete Wavelet Transform and Principal Component Analysis Eigenvalue Decomposition (DWA-PCAED) are used for cloning forgery detection. The Sharpening method is developed to intensify the PRNU components for better accuracy which is very important in the forensic applications [4]. In [6] an identification method is used which is robust against noise contaminationsince the PRNU is contaminated by the scene content, random noise which inhibits the firm identification. As earlier mentioned the source camera identification based on PRNU estimation consists of three stages. The Discrete Cosine Transform filtering is used in the filtering stage to filter the noise present in the image. In the estimation stage the weighted Averaging method is used and finally in the post estimation stage the estimated PRNU's are concatenated for the better

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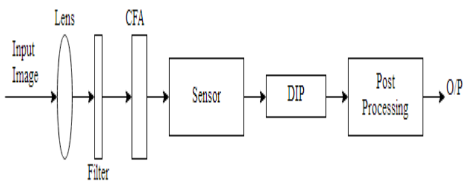

Fig. 1: Image acquisition in a Digital Camera

performance. The rest of the paper is organized as follows. Section II describes the proposed system. Experimental results and analysis are given in the Section III and in Section IV conclusion is given.

II. PROPOSED SYSTEM

Fig. 2showsthe proposed architecture of source camera identification system. Initially three channels are extracted as red, green and blue channel from an image. The channel values are divided into N blocks for applying the DCT filter to extract the noise factor. The extracted noise factor from each blocks are averaged to get only one value and it is called as PRNU for that channel. This process will be repeated for all three channels and calculated the average of channels PRNU and it is called as final PRNU of that image. Finally, this process is repeated for all images and its corresponding PRNU will be stored in the database for feature use. Fig. 3 shows the camera identification system. In this step a query image will be submitted to system for extracting the PRNU from an image and it is compared against the stored PRNU database. The nearest PRNU represents the camera used for capturing the image. In the camera verification step distance function is used as a similarity function between the Test PRNU and the Database PRNU to verify whether the considered image is generated from the camera or not. The remaining will be discussed in the latter subsections in detail.

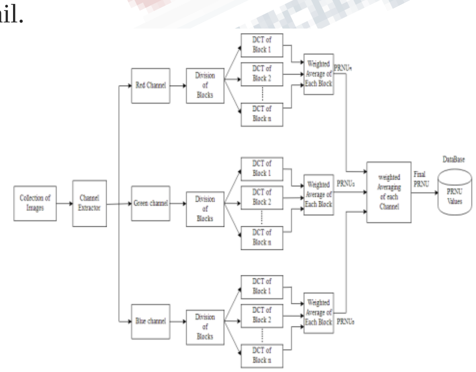

Fig. 2: Block diagram for extracting the PRNU for the images

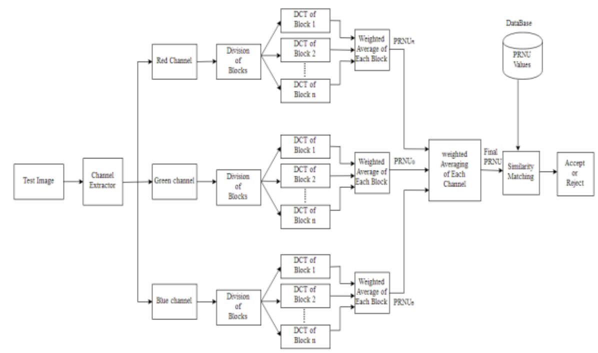

Fig. 3: Block diagram for identification and verification of an image

A. Discrete Cosine Transform (DCT) Filtering

Discrete Cosine Transform can be used in many fields such as compression, filtering, feature extraction. The advantage of DCT over other transforms is that it has the energy compaction property and moreover it operates well on images infected by the multiplicative noise since PRNU is also a type of multiplicative noise DCT is well suited for the PRNU extraction process. The DCT coefficients are computed as follows:

$$F[u,v] = \frac{1}{N^2} \sum_{m=0}^{N-1} \sum_{n=0}^{N-1} f[m,n] \cos\left[\frac{(2m+1)u\pi}{2N}\right] \cos\left[\frac{(2n+1)v\pi}{2N}\right] \quad (1)$$

First the image is divided into 8*8 blocks. Usually DCT operates on one block at a time since it contains 64elements which can be considered as the 64 DCT coefficients. The result of DCT filtering of 64elements is the 1DC coefficient and 63AC coefficients. Average color of 8*8region is represented by a DC coefficient and the color change across the region is represented by the remaining 63AC coefficients. The mean is calculated by summing all the AC coefficients and the variance is calculated by finding square of AC coefficients then performs the sum.

$$Sum_{AC} = \sum_{i=1}^{63} AC_i \qquad (2)$$

$$Mean_{AC} = \frac{Sum_{AC}}{N} \qquad (3)$$

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Where N = 63;

B.Weighted Averaging

Instead of averaging all the pixel values it gives higher weight for closer pixels and lower weight for far away pixels. This type of operation of weighted averaging is known as filtering when all weights are positive it corresponds to weighted average. The weighted average filter retains the low frequency and suppresses high frequency components.

The weighted average of final noise residue from each channel is calculated which is considered as the PRNU and in matching stage it is compared with the database PRNU for the verification of the Source camera. The PRNU can be computed as follows:

$$\mathrm{WA} = \frac{PRNU_R + PRNU_G + PRNU_B}{3} \qquad (4)$$

C. Euclidian Distance Function

The Euclidian Distance is the distance between two points which is defined as the square root of the sum of the squares of the differences between the corresponding coordinates of the points.

Here it is the distance between the Test PRNU and the Database PRNU which is used in the identification process.

III. EXPERIMENTAL RESULTS

In this paper, the results for images from different cameras are taken which are of size 256*256 and analyzed for the source camera identification and verification. The PRNU values from each camera is extracted and stored in the database. Next the image is splitted into three primary color channels namely Red, Green and Blue. Then DCT Filtering is applied for each channel to reduce the noise present in the image. For each individual 8*8block, the noise and variance is calculated depending on the DCT coefficients. Then Weighted Averaging method is applied for final noise residue from each channel which is nothing but the PRNU of the test image. The threshold value for each camera is fixed. The extracted PRNU of the test image is compared with the stored database PRNU in the verification step and if it comes in the specific threshold value of the particular camera then it is considered as taken from the particular camera.

IV. CONCLUSION

In this paper, a source camera identification and verification system has been proposed which attains two goals First it identifies the source camera used to capture the image by using DCT filtering method which is used to denoise the image and also uses the Weighted Average method to average the final noise residue of each channel and to get the PRNU. Second the proposed technique is able to verify the source camera after identifying it by using the Distance function which is the distance between the Test PRNU and the Database PRNU. Finally the proposed system outperforms the state-of-art techniques.

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