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Implementation on Compressed Fingerprint Matching and Camera Identification based on Random Projections Techniques

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Abstract : Gender Sensor imperfections in the form of photo response no uniformity(PRNU)patterns are a well-established fingerprinting technique to link pictures to the camera sensors that acquired them. The noise-like characteristics of the PRNU pattern make it a difficult object to compress. So this proposed system uses real-valued or binary random projections to effectively compress the fingerprints at a small cost in terms of matching accuracy. The performance of randomly projected fingerprints is analyzed from a theoretical standpoint and experimentally verified on databases of real photographs.

Index Terms - PRNU; photo response non-uniformity; source camera identification; videos; compression; resolution.

I. INTRODUCTION

Each camera creates a highly characteristic pattern: The Photo Response Non-Uniformity pattern (PRNU-pattern). The PRNU-pattern is caused by differences in material properties and due to proximity effects during the production process of the image sensor. This pattern can be compared with various software in order to answer the following questions: 'which camera is the source of a specific photo or video' and 'are certain photos or videos taken with the same camera'. After this comparison, a correlation value is linked to it, which describes the degree of similarity. In some cases, inexplicable low correlation values were measured when comparing videos. Several initiatives have already been taken by the Netherlands Forensic Institute (NFI) to determine the causes of these low correlation values. This was done by conducting small studies and proficiency tests in which international organizations participated. Since the size of these studies was limited, in most cases this matter has not been published. This study therefore made an overview of the factors already investigated. Based on this list of more than 50 different factors, three factors were chosen that could contribute to the broadening of knowledge regarding the factors that influence the PRNU-pattern.

In this paper, Photo Response Noise Uniformity is used for source device identification purpose. PRNU is very unique and identical feature which is unique for every device like camera phones, cam recorders, digital cameras etc.

II. LITERATURE SURVEY

Protection PRNU extraction using digital filtering operation, by taking average of all PRNU factors, a PRNU fingerprint is obtained [1]. Wavelet denoising filter is used to remove scene contents which are treated as external noise. PRNU of device is affected due to scene contents of image. Hence, these scene contents are needed to be removed from image so that only device noise can be obtained. Dataset used in this work, videos were originally recorded by Smartphone, uploaded to social networks, downloaded from Twitter and Facebook [1].

Camera identification based on joint decision of SPN and peak to correlation energy ratio(PCE) is another method proposed by[2], in which PRNU extraction is performed using Wavelet denoising filter[2], firstly frames are extracted from video then PRNU is calculated. PRNU is extracted using wavelet denoising filter which deletes all the noise and remains with only original frame, then the noise free frame is subtracted from obtained frame to extract PRNU. Then clustered PRNU is calculated for each frame. When reference frame and query frame gives high correlation value then they both are considered as from same device and when the correlation value is low then they show different camera devices. Hence, by calculating peak to correlation energy ratio for each frame, detection of source device is performed. Dataset used in this paper is created by taking videos from 10 camera device [2].

Video source identification is performed by using a sensor pattern noise and wavelet transform taking out from key frames of video [3]. The proposed technique in [3] includes key frame extraction, sensor noise extraction, feature extraction, training of classifier and prediction. Algorithm used includes, video split into individual frames then first frame is considered as a key frame then difference between current frame and the reference frame is calculated then to select frame with a change in scene, color histogram correlation is calculated. When difference between key frame and a selected frame is equal to or greater than user defined threshold value then that particular frame is selected as next key frame. Histogram correlation is compared to compare and find similarities between two frames. The feature used for identification is sensor pattern noise (SPN). This SPN is separated into RGB channels, reference sensor pattern noise is obtained from constant brightness and uniform dispersion images and then average is calculated [3].

SVM classifier is used for classification process. Scene contents of image results into contamination of sensor noise, therefore, Sensor pattern noise enhancement is performed in [4] by assigning less weights to strong components of signal, in order to attenuate scene details of image. Dataset used in this work contains wide variety of indoor and outdoor scenes. 1200 photos of 6 different camera devices are taken. Techniques considering device identification of audio and visual data includes, multi-modal approach in which microphone recognition is using blind estimation of frequency response and video camera detection is using video features related to CFA (color filter array) interpolation. Features used for microphone detection are, average of normalized log power spectrum of microphone frequency response and blind estimation of amplitude of microphone frequency response [5].

Center portion of particular size of image/frame is considered for calculating fingerprints and support vector machine algorithm is used for classification. To identify source of particular image, certain features are to be obtained considering camera characteristics. Color features, quality features, image characteristics of frequency domain are various features considered for source device identification [6].

SVM based classification is performed among different camera make and also different models with the same make. Source camera identification using sensor pattern noise is calculated by obtaining reference pattern noise of the device which is estimated by taking average of noise extracted from number of images using denoising filter. By calculating correlation factor between reference and query images, identification is performed [7].

Correlation value helps to distinguish among the images of same or different camera device. Identification of source device of transmitted videos or images by extracting PRNU patterns of camera [8]. By computing Peak to correlation energy, the PRNU pattern of original videos and videos transmitted from one device to another are compared, also the PRNU patterns of original videos are compared with each other to check the likelihood to discover if the videos create from the same device or not [8]. Using generalized noise model, source device identification can be performed on natural images. A statistical test approach is proposed in [9], likelihood ratio test (LRT) is used for identification. The generalized noise model gives better accuracy to distinguish a natural image got by different digital camera device.

III. BLOCK DIAGRAM

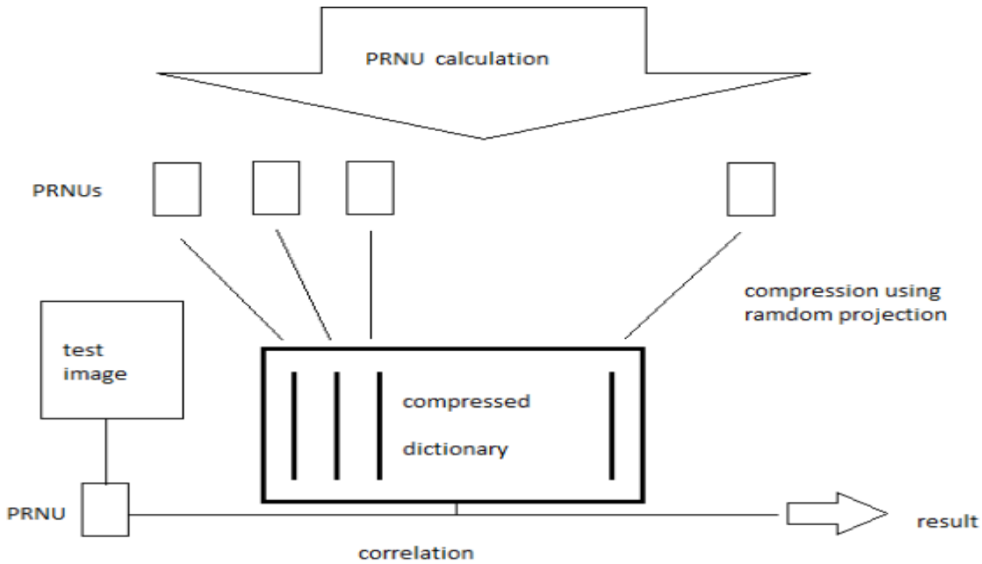

Figure 1. Proposed Block Diagram

In this paper, we propose to use random projections to effectively compress the fingerprints at a small cost in terms of matching accuracy. The performance of randomly projected fingerprints is analyzed from a theoretical standpoint and experimentally verified on databases of real photographs. Practical issues concerning the complexity of implementing random projections are also addressed using circulate matrices.

IV. WORKING CONCEPT

1. Crop images of same size from different cameras
2. Calculate PRNUs for each camera
3. Compress PRNUs using random projection to make fingerprint dictionary
4. Calculate PRNU of test image
5. Find correlation with dictionary for fix threshold value to find matching
6. ROC plot using different threshold values.

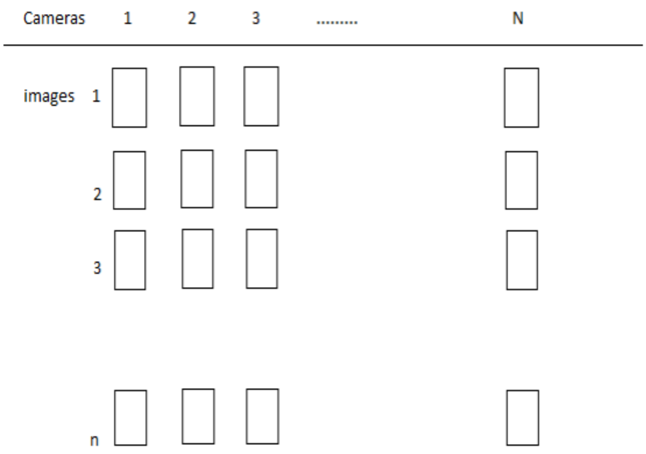

Figure 2. Structure of general image database

As shown in above figure we have number of images from N number of cameras. From those images of individual cameras, we have to calculate PRNU noise / fingerprint. So that we can form database D.

Fingerprint Calculation:

PRNU ESTIMATION : The first step in the proposed framework for camera identification and integrity verification, which is the estimation of the PRNU factor .

PRNU Estimation : Estimate K from a set of N images taken by the camera. To improve the signal-to noise ratio (SNR) between the signal of interest I(0)K and observed data I , we perform host signal rejection and suppress the noiseless image I(0). By substracting from both sides of the denoised version of I, I(0) =F(I), obtained using a denoising filter F.

W = I-I(0) = IK + E ....(1) Let,

I1, I2, I3,........IN be a set of images acquired by a same camera C Let, W(1),W(2),W(3),...........W(N) be their noise residuals (from a certain filter F) When E(i) is modeled as an i.i.d. Gaussian, the maximum likelihood estimator of the PRNU fingerprint of C has the form.

$$\hat{K} = \frac{\sum_{i=1}^{N} W^{(i)} I^{(i)}}{\sum_{i=1}^{N} (I^{(i)})^2}$$

Where I is sensor output image , I(0) is the ideal sensor output , IK is the PRNU factor E is the sum of additional noises.

For getting a good estimate K of the PRNU fingerprint K

- The estimate is done on flat-field images
- The luminance of the images should be as high as possible but not saturated
- About 20 flat field images suffice to have a good estimate of K

V. RESULT

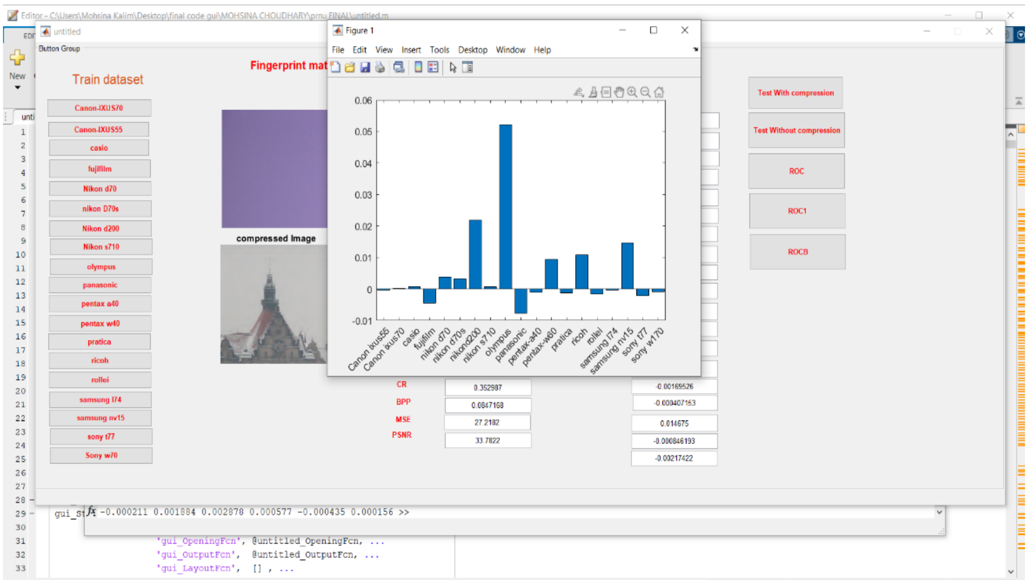

Fig 3. Test image taken from Olympus camera showing pick(max) value with Olympus camera fingerprint

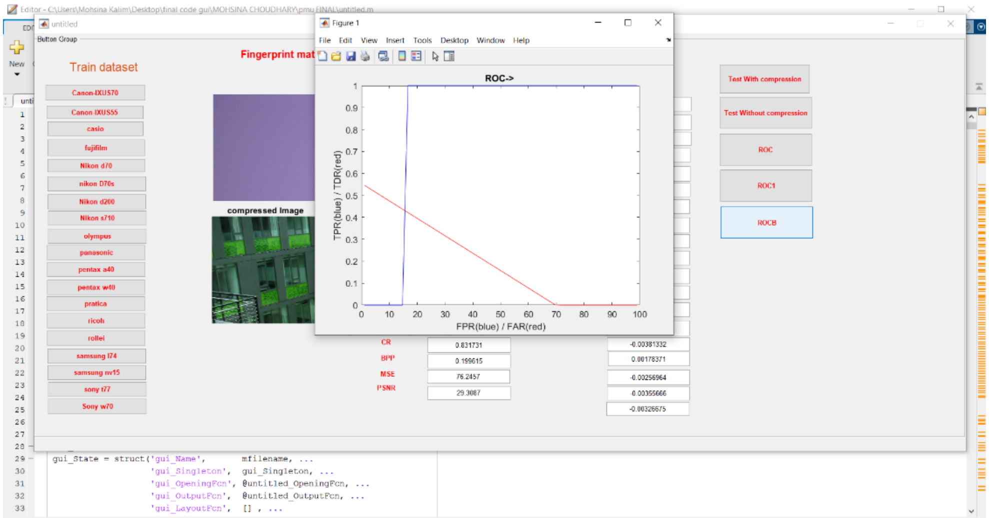

Fig 4. ROC B

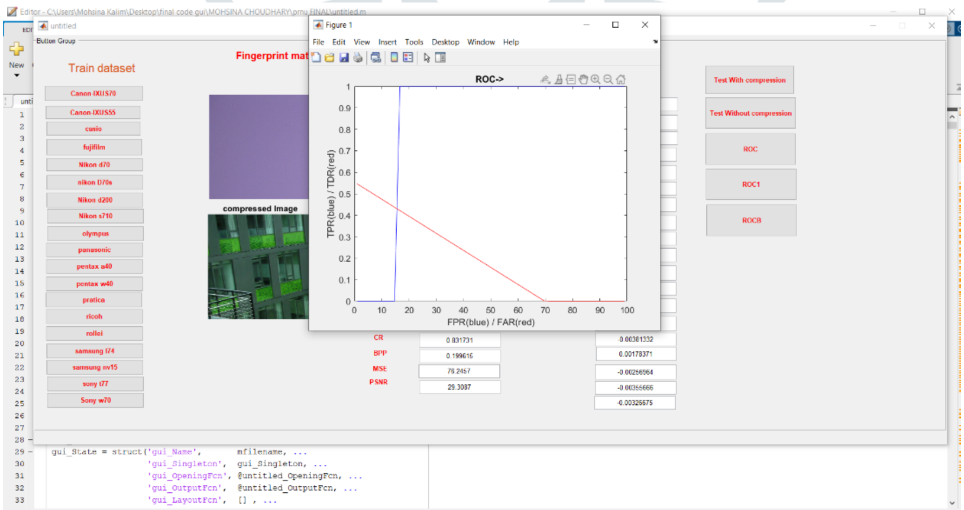

Fig 5. ROC

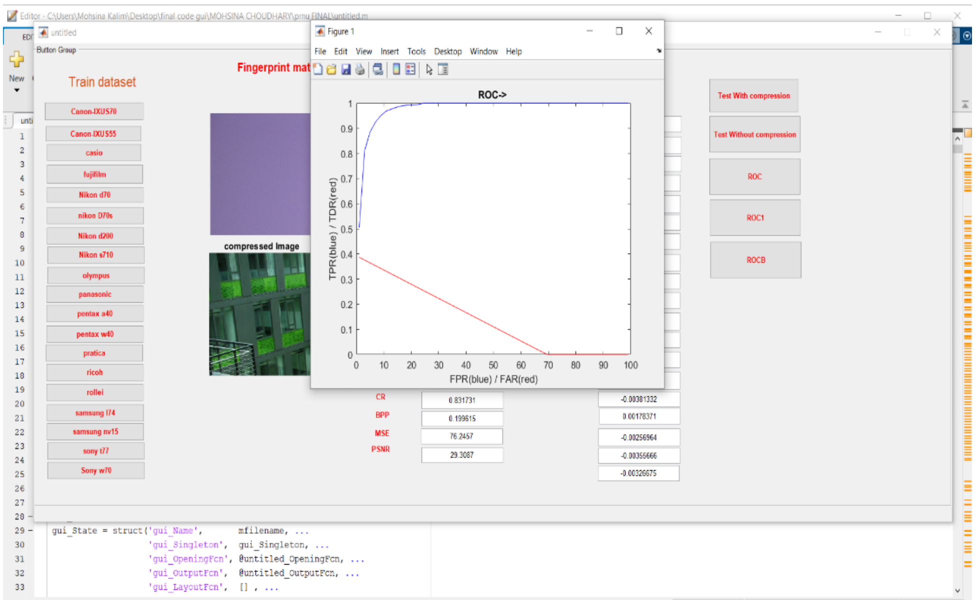

Fig 6. ROC curves for the database i.e True Positive Rate vs False Positive Rate

VI. CONCLUSION

In this paper, we present a source camera device identification model based on PRNU extraction using de-noising filter. The Photo Response Noise Uniformity is a unique pattern which can be used for identification of source device from captured data like images or videos. By averaging extracted PRNU reference pattern is generated which is nothing but a fingerprint. Channel-wise correlation achieves better results.

VII. REFERENCES

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