CAMERA MODEL IDENTIFICATION

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***Abstract*—The Camera model is used to shoot a picture for solving wide series of forensic problems ,from copyright infraction to owner's equity. In today's digital age , the manipulation of image is very simple by digital processing tools and they are widely available. An interesting problem in digital forensics is ,given a digital image , would it be possible to identify the camera model which was used to take the picture. Our goal is to classify camera model used in particular image. To identify camera model we will use intrinsic hardware artifacts and software artifacts which could be used by various machine learning algorithm(Logistic Regression, Support Vector Machine, K-Nearest Neighbors, Random Forest, Perceptron) to identify correct source camera of a image. we will carried out the experiment on dresden image dataset and try to get reasonable accuracy in distinguishing pictures.**

Keywords: Camera Model Identification , Machine learning algorithms, Forgery Detection, Image Source Identification, Digital Image Forensics

I. INTRODUCTION

Everybody is keen on demonstrating that a specific picture is taken by his/her camera, so as to guarantee the property. Additionally ,when all is said in done an image was taken by specific camera, however it is vital component for choices in court and It can't depend on Meta data(EXIF labels) which can be effectively manipulated.It is noticed that in 2015 more than 1.8 billion pictures distributed on the web every day [12], and this pattern is going increasingly more every day. Source Identification significantly depending on the Photo Response Non-Uniformity(PRNU) design , it is steady in time, it is begun by the inevasible flaws occuring amid the sensor producing process. Since each image is taken by specific camera has hints of PRNU Pattern, It can be dependable and conceivable distinguishing proof, Image Falsification identification and furthermore improving acknowledgment calculations.

As Indicated by the study PRNU approach isn't increasingly helpful in light of the fact that an extensive number of pictures taken by that camera is vital and furthermore it is outlandish without participation of the camera proprietor. Moreover, PRNU based systems are extraordinarily tedious and it can't be effectively connected to an extensive dataset of pictures. The yield picture is gotten by applying a few number of complex calculations; every one is described by parameters. For instance, Demoaicing and JPEG pressure, in this quantization lattice can be characterized by the client.

Reviewed that Kharrazi et al.[2] in 2004 considered the use of generic features (Average Pixel Value, RGB Pairs Correlation, Image Quality Matrix,etc)for camera model iden- tification. Actually it is the first paper to present an approach that did not focus on a specific camera artifacts.

There are mainly 3 approaches of camera model identifi- cation: Image Metadata based , watermark based and feature based. Image metadata based approach relies on Image source related information such as camera model, brand , date and time. However image metadata is easy to be manipulated. The Watermark based approach that has watermark carries source related information. It is inserted during the creation of an image. This increases the production cost of the digital cameras. In recent era of research, important efforts have been devoted in the Feature based approach. In this approach, it extracts features on intrinsic hardware artifacts and software related fingerprints left during the image acquisition process.

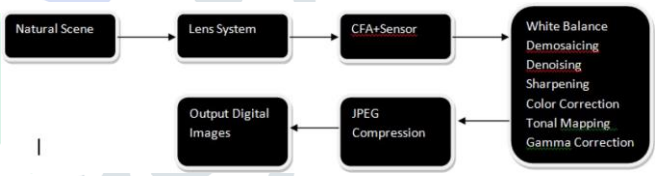

Fig. 1. Image Processing Pipeline in Digital Camera.

Figure 1. offers a rundown of a run of the mill picture process pipeline in computerized cameras. everything about stages generally upheld by plant made of different camera models. Past analysts have some expertise in beyond any doubt stages amid this pipeline like focal point abandons, Color Filter Array(CFA),Demosaicing, JPEG Compression , Denoising, Sharpening, white equalization and gamma amendment , and so on. Some mull over very one phases or entire pipeline.

Pragmatic trial settings for camera demonstrate recognizable proof need in more than one camera from every show with the top goal to evacuate the unclearness of whether or not the highlights, on that the classifiers square measure factory-made, catch camera show attributes or individual camera qualities [11-13]. within every model, testing footage ought not come back from an identical individual cameras that square measure related to getting ready. In any case, the bigger a part of the

past appearance into simply utilize one camera to talk to a camera show thanks to the constraints of camera sources.

Parallel likeness measures (BSM) determined from 3 least essential piece planes was used in [10] for camera display ID. close by another 2 sorts of capabilities (HOWS and IQM).

In this paper, we tend to propose to local paired examples (LBP) as connected math alternatives. Considering 8-neighbor dim dimension refinement for each picture component around a circle, fifty nine local paired example square measure separated, severally, from spacial area of red and unpracticed shading channels, their expectation mistake second clusters, and along these lines the first dimension inclining swell subband of each picture. shifted AI calculation's Classifier's model square measure designed for grouping of eighteen camera models from 'Dresden Image Database'. Contrasted with the leads with writings, the identification exactness revealed amid this paper isway higher.

The rest of the paper is structured as follows. In Section two, the LBP options that we have a tendency to use, a way to extract options. In Section3, experimental works square measure given and a few discussions square measure created. Conclusions square measure drawn in Section four.

II. PROPOSED METHOD

In this section, we have a tendency to 1st provides a transient description of uniform native binarypatterns planned in[15].Our planned featureextractionframework can th en be introduced. we have a tendency to 1st provides a transient description of uniform native binary patterns planned in [15]. Our planned feature extraction framework can then be introduced.

A. Local Binary Patterns

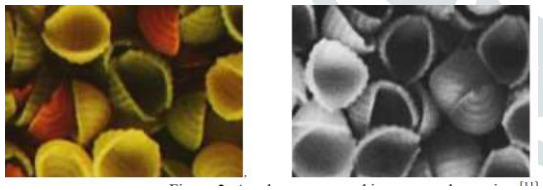

Fig. 2. A color texture and gray-scale version of image.

Surface examination ways are developedwithgray-scale pictures, naturally for all time reasons. People will essentially catch the surfaces on a surface, even with no shading information. Figure.2 demonstrates a photo of tricolor nutritious glue and its dark scale adaptation. the sole factor that can't be told, upheld the dim scale information, is that the shade of the nutritious glue — the vibe itself is that the equivalent. The human tangible framework is prepared to translate much colorless scenes for example in low enlightenment levels. Shading acts even as a sign for more extravagant understandings. Indeed, even once shading information is misshaped, for example because of innate oddity, the tactile framework still works. Naturally, this implies at least for our tangible system,color and surface ar separate marvels. all the equivalent, the usage of joint colortexture alternatives has been a favored way to deal with paint surface examination

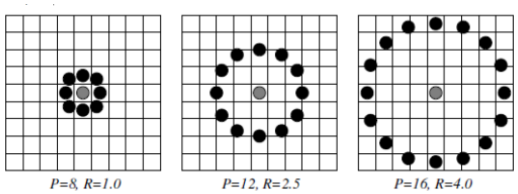

Fig. 3. Circularly trigonal neighbor sets. Samples that don't specifically match the picture element grid ar obtained via interpolation.

$$\mathrm{LBP}_{P,R}(x_c, y_c) = \sum_{p=0}^{P-1} s(g_p - g_c)2^p. \tag{1}$$

wherever R is that the sweep of a circularly trigonal neighborhood utilized for local paired patterns calculation P is that the assortment of tests round the circle. In this paper, we set R =1, P =8 . c g and p g speak to dark dimensions of the center picture component and its neighbor pixels, severally. In pursue, Equation 2.1 means the signs of the variations in a very neighborhood ar taken as a P-bit binary variety, leading to 2P distinct values for the LBP code. The native gray-scale distribution, i.e. texture, will therefore be close to delineated with a 2P -bin distinct distribution of LBP codes:

$$T\_t(\mathrm{LBP}P,R(xc, yc)). \tag{2}$$

Give us a chance to accept we are given a N M picture test (xc 2 0, . . . ,N 1, yc 20, . . . ,M 1).

In figuring the LBPP,R circulation (highlight vector) for this picture, the focal part is considered on the grounds that an adequately extensive neighborhood can't be utilized on the outskirts. The LBP code is determined for every pixel in the trimmed segment of the picture, and the circulation of the codes is utilized as a component

vector, signified by S:

$$S = t(\mathrm{LBPP},R(x, y)), x\ 2\ \{dRe, \ldots, N - 1 - dRe\}, y\ 2\ \{dRe, \ldots, M - 1 - dRe\} \tag{3}$$

$$s(x) = \begin{cases} 1, x \geq 0 \\ 0, x < 0. \end{cases} \tag{4}$$

Figure 4. (Left) Constellation of neighborhood. (Right) Examples of 'uniform' and 'non-uniform' neighborhood double patterns.[11]

As indicated by Equations (2.1) and (2.4), graylevel contrast is first determined between focus pixel and its eight neighbors.The distinction will at that point be double quantized and coded,producing nearby twofold examples, which, basically, structure a 8-dimensional histogram with an aggregate of 28 of 256 canisters.

B. Framework for Feature Extraction

Enlivened by the way that a very some of picture preparing calculations, for example, demosaicing, sifting, JPEG pressure, are square shrewd executed inside cameras, it is sensible to think about that some confined qualities or then again curios have been produced. These attributes or curios could be successfully caught by the uniform grayscale invariant neighborhood twofold examples, presented in Section 2.1. Grayscale invariance is accomplished by figuring contrast among focus and neighbor pixels' gray levels. This procedure to some degree stifles the impact ofdifferent picture substance. The presentation of 'uniform' nearby double examples empowers a characteristic component dimensionality decrease which is wanted by example order calculations. Along these lines, we propose to utilize the uniform grayscale invariant neighborhood double examples as highlights to catch camera display attributes.

As a large portion of the camera picture process calculations include spatial space, a not too bad option would separate choices legitimately from graylevels of each shading direct in spatial area. From each shading channel, a 59-dimensional LBP include set is determined by Equation (2.1) underneath the conviction of R =1, P =8 (Each 59-D LBP highlight set square measure standardized to dispose of the impact of differ- ent picture goals). Furthermore, a comparable arrangement of LBP alternatives square measure separated from expectation mistake (PE) picture. alphabetic character picture is acquired by subtracting a normal picture from the underlying picture. Considering a 2x2 picture component square, expectation of an is elementworth accomplished

$$\hat{x} = \begin{cases} \max(a,b) & c \le \min(a,b) \\ \min(a,b) & c \ge \max(a,b) \\ a+b-c & otherwise \end{cases} \quad (5)$$

a, b are, severally, the like a shot horizontal and vertical neighbors of the element x. c is at the diagonal neighbor of x, and x̂ is that the prediction worth of x. As some image process algorithms take issue mostly at edges like demosaicing and filtering, the prediction error image, which is, in essence, a spacial domain high pass filtered image, is another ideal option to extract options from.

List of Camera Models	# of cameras
Sony NEX-7	275
Motorola Moto X	275
Motorola Nexus 6	275
Motorola DROID MAXX	275
LG Nexus 5x	275
Apple IPhone 6	275
Apple Iphone 4s	275
HTC One M7	275
Samsung Galaxy S4	275
Samsung Galaxy Note 4	275

TABLE I
EXPERIMENTAL DATASET

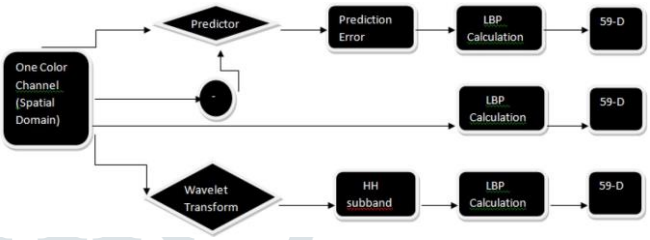

Fig. 4. (Feature extraction framework for one color channel.

One of the reactions of the element of LBP is its harshness to dim dimension change in spatial area. In spite of the fact that this could be a decent component for a few applica- tions, it isn't wanted for camera display recognizable proof, as some picture preparing calculation, for example, gamma adjustment has spatial space monotonic nature and thus the refinement of these computations couldn't be gotten by our LBP features. To redesign the division limit, despite the spatial space, wavelet zone is considered and we propose to expel another 59-dimensional LBP feature set from corner to corner subband (HH subband) of first measurement Haar wavelet change. parallel precedents enables trademark component di- mensionality decline which is needed by model request counts. Thusly, we propose to use the uniform grayscale invariant close-by combined precedents as features to get camera show characteristics.

To finish up, from each shading channel, we will in general concentrate LBP alternatives from unique picture, its expecta- tion blunder second cluster, and its first dimension inclining moving edge subband, prompting a total of 59x3=177 choices. The component extraction system of 1 shading divert is ap- peared in Fig. 4. Considering the established truth that red and blue shading channels once in a while share indistinguishable picture process calculations, we will in general exclusively utilize red and unpracticed channels. Subsequently, a definitive component measurements extricated from a shading picture is 177x2=354.

III. EXPERIMENTS AND DISCUSSIONS

A. Dataset for Experiments

We picked steady ten camera models from 'Dresden Image Dataset' as utilized in [10]. the measure of camera each model extents from two to five. the measure of pictures per demonstrate is 275. Every one of the photos ar direct camera JPEG outputs that are caught with various camera settings. Subtleties ar given in Table one.

Images in the test set were captured with the same 10 camera models. For example, if the images in the train data for the iPhone 6 were taken with Ben Hamner's device (Camera 1), the images in the test data were taken with Ben Hamner's second device (Camera 2), since he lost the first device in the Bay while kite-surfing. None of the images in the test data were taken with the same device as in the train data.

While the train data includes full images, the test data contains only single 512 x 512 pixel blocks cropped from the center of a single image taken with the device. No two image blocks come from the same original image.

B. Experimental Settings

In the majority of our investigations, various Machine Learning rule is prepared and utilized on the grounds that the classifiers for testing. From the full dataset, we will in general erratically pick one camera for each model, and utilize every one of the photos taken by the picked cameras for testing. pictures from the rest of the cameras type the training learning. This arbitrary decision system is iterated multiple times for each experiment. Involving pictures from more than one camera of each model (aside from those have solelya pair of cameras) for instructing will significantly downsize the likelihood of overtrainng[9]. exploitation the cameras that don't appear to be worried inside the instructing techniques for testing makes the investigations extra reasonable[13].

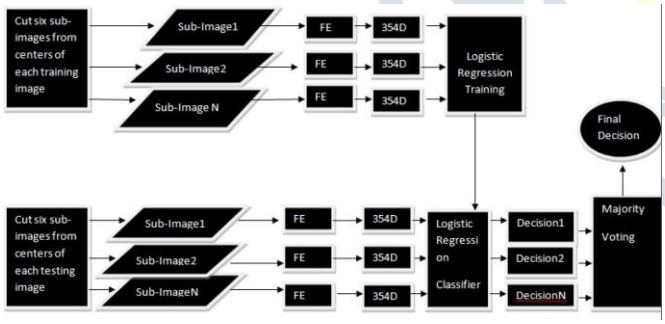

Fig. 5. Diagram of training and testing phases. FE=Feature Extraction.

In every iteration, pictures for each coaching and testing are take away six sub-images from centers. The ultimate call in testing stage is created for every image by majority balloting supported the six individual choices. This cropping and balloting procedure not solely will increase the quantity of samples for coaching, however conjointly brings lustiness against the regional anomalies in testing pictures. A diagram is shown in Fig. five which incorporates each the coaching and testing stages (only one image is shown within the testing gadgets for

stage).

C. Results and Discussions

The proposed was tested on dataset of 10000 images with the 10 cross fold validation technique. This approach involves randomly dividing the set of observations into 10 groups, or folds, of approximately equal size. The first fold is treated as a validation set, and the method is fit on the remaining k -1 folds.

The choice of k is usually 5 or 10, but there is no formal rule. As k gets larger, the difference in size between the training set and the re-sampling subsets gets smaller. As this difference decreases, the bias of the technique becomes smaller.

A confusion matrix is a table that is often used to describe the performance of a classification model (or "classifier") on a set of test data for which the true values are known.

As we can see in the below figure , I achieved highest accuracy in random forest algorithm that will be considered as an over fitting problem so the accuracy of SVM and Logistic regression gives good outcome.

	Train Accuracy
Support Vector Machines	93.33
KNN	88.00
Logistic Regression	94.00
Random Forest	100.00
Perceptron	92.00

Fig. 6. Accuracy of various kind of algorithm

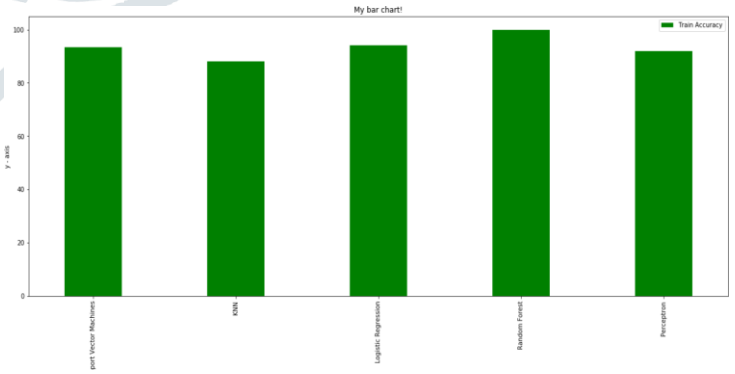

Fig. 7. bargraph of algorithm

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