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Source Camera Based Image Retrieval From Internet Using Simplified Total Variation

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Abstract: *Retrieving pictures from large collections according to a specific criterion is an increasingly relevant task. An important, but so far overlooked, such criterion is the retrieval of pictures acquired by a specific camera. Content primarily based image retrieval may be an ancient approach for retrieving images. The most important task is that the retrieval of pictures matching specific criterion. A vital however to this point unmarked, such criterion is that the retrieval of images captured by a specific camera device. Photo Response Non-Uniformity (PRNU) of the camera sensor is employed to retrieve image taken by specific camera. Sensing element imperfections in the form of photo response non-uniformity (PRNU) patterns area unit a well established fingerprinting technique to link footage to the camera sensors that acquired them. As PRNU pattern have constant size as imaging sensing element, massive scale image retrieval is a very difficult task. In our proposed work PRNU Extraction is done by Simplified total variation algorithm as shown in paper. To influence retrieving on massive scale PRNU pattern is compressed exploitation Random Projection. A system comprises four components crawling pictures from Internet, Extracting PRNU from pictures, Compression of PRNU fingerprints, and fingerprint matching. A performance of system is analyzed on dresden image database. A result shows that proposed approach is relatively faster than state of art method.*

Index Terms— *Image forensics, Image search and retrieval, Photo response non-uniformity (PRNU), Random projections, Total variation.*

1. INTRODUCTION

Each day, innumerable photos are uploaded, shared, and browsed by web users, leading to terribly massive collections of pictures that decision for economical solutions for management. A vital task is that the retrieval of images matching a specific criterion, which will be used for looking out footage of interest or for classifying similar photos. During this sense, content-based image retrieval could be a technology that has received a lot of attention in recent years [2]. The second approach in image retrieving is device specific image retrieval. When an image is acquired by a digital detector, slight imperfections within the producing of individual detectors turn out a singular fingerprint, remarked as photo-response non-uniformity (PRNU) [1].

The main focus is to deal with the problem of large-scale image retrieval supported PRNU fingerprints. An oversized assortment of images is obtained by scanning parts of the web, employing crawler software that downloads photos from in public accessible repositories. From this assortment, anoversized fingerprint database is automatically generated by extracting the PRNU pattern of every individual picture. A question is given to the system within the sort of a camera fingerprint, and also the goal is to retrieve all the photos acquired by constant device [10].

With the advances in digital technologies, it's potential to edit and manipulate multimedia system with low price, effort, and experience. The provision of such technologies and their simple use risk the believability of digital data. Thus, once digital data is employed or bestowed, there ought to be some guarantee regarding its origin, integrity, and nature of the digital content. In recent years copyright pictures used illicitly on net, it's vital for photographers to search out their photos taken by specific camera misused by somebody else. Also child pornography is major challenge for investigating because it is tough to search out supply device. There square measure countless photos square measure on net. As we've got to trot out massive image information it's time and area overwhelming. Camera identification has emerged as a robust tool for enforcement. The objective of a camera identification system is, given a photograph, to spot the camera that took the photograph. This may be category identification, or it are often identification of a private camera. This capability is of use in enforcement when the case involves dirty pictures. The owner of the camera that took the images may be thought-about a suspect. Pictures have a range of process operations at numerous stages of their use. Seldom square measure they distributed while not some or all of the subsequent operations being applied: cropping, scaling, rotation, contrast enhancement, gamma correction, white balance correction, denoising, compression, and recompression [8]. In addition, common exposure redaction software invitations additional refined manipulations like copy/paste, and image compositing. Most significantly, a artist would deliberately take actions to hinder camera identification.

The proposed method uses a new noise removal technique instead of using state of the art method. The noiseless image is

achieved by minimizing the total variation norm of the estimated solution. The constraints are determined by the noise statistics. PRNU Extraction is done by Simplified total variation algorithm.

2. REVIEW OF LITERATURE

R. Datta et al. in [2] survey gives theoretical and empirical contributions within the current decade associated with image retrieval and automatic image annotation, and within the method discuss the spawning of connected subfields. They conjointly discuss important challenges concerned within the adaptation of existing image retrieval techniques using CBIR, EXIF which will be helpful within the digital world.

Authors in [3] this paper introduces the matter of image acquisition forensics and proposes a fusion of a group of signal process options to spot the supply of digital pictures. Results show that the devices color interpolation coefficients and noise statistics will conjointly function smart rhetorical options to assist accurately trace the origin of the input image to its production method and to differentiate between pictures made by cameras.

Authors in [4] looked into completely different ways of examining the cameras to see if a particular image has been created with a camera: defects in CCDs, file formats that area unit used, noise introduced by the constituent arrays and watermarking in pictures utilized by the camera manufacturer.

Authors in [5] explains varied properties of PRNU and sensible aspects of PRNU is given.

Authors in [6] supply camera identification supported photo-response non-uniformity noise (PRNU) has been proved to be an efficient approach in digital image forensics. Since the precision of the extraction of PRNU has vital influence on the identification accuracy, the performance of PRNU extraction methodology is incredibly vital. It provides steerage for the choice of PRNU extraction methodology in digital image forensics.

Authors in [7] use the pattern noise of Associate in nursing imaging sensor to classify digital pictures in keeping with the supply camera from that they originated. This is often timely work as new camera models giant imaging sensors, afford vital enhancements in classification rates victimisation pattern noise.

Authors in [8] propose aa methodology for the matter of camera identification from its pictures supported the sensor's pattern noise. For every camera underneath investigation, first verify its reference pattern noise, that is a singular identification fingerprint. This can be achieved by averaging the noise obtained from multiple pictures employing a denoising filter. To spot the camera from a given image, we tend to think about the reference pattern noise as a spread-spectrum watermark, whose presence within the image is established by employing a correlation detector.

Authors in [9] propose to use real-valued or binary random projections to effectively compress the fingerprints at a little value in terms of matching accuracy. The performance of arbitrarily projected fingerprints is analyzed from a theoretical stand and by experimentation verified on databases of real pictures. Sensible problems regarding the complexness of implementing random projections are addressed victimization circulant matrices.

Authors in [10] propose economical techniques for man-agement and retrieval of large pictures using the PRNU, and check them on a information of 1174 cameras and half a million photos downloaded from the web. Retrieving photos from giant collections in step with a selected criterion is an progressively relevant task. A vital, however up to now unnoticed, such criterion is that the retrieval of images non inheritable by a selected camera. In this paper a hierarchical search algorithm using MapReduce is introduced that is very effective in large scale image retrieval.

Authors in [11] propose a brand new resolution to quick fingerprint search. Tend to first store the knowledge of the reference fingerprint digests within the separate-chaining hash table, so introduce a brand new rule to pick the candidate reference fingerprint digests before playing the correlation. The choice rule is incarnated with the search priority vector. Experimental results have shown that the planned formula outperforms current algorithms.

Authors in [12] introduce and document a completely unique image info specifically engineered for the aim of development and benchmarking of camera-based digital rhetorical techniques. Over fourteen thousand pictures of varied indoor and out of doors scenes are acquired below controlled and so wide comparable conditions from altogether seventy three digital cameras. The cameras were drawn from solely twenty five totally different models to confirm that device-specific and model-specific characteristics will be disentangled and studied severally, as valid with leads to this text.

Authors in [13] though sensor noise is mostly referred to as a awfully reliable suggests that to unambiguously establish digital cameras, care must be loving relation to camera model characteristics that will cause false accusations. Whereas earlier reports centered on supposed linear patterns with an everyday grid structure, conjointly distortions as a result of geometric corrections of radial lens distortion have recently gained interest. Here, we tend to report observations from a case study with the 'Dresden Image Database' that exposed any artefacts. We tend to found diagonal line artefacts in Nikon CoolPix S710 device noise, yet as non-trivial dependencies between device noise, exposure time (FujiFilm J50) and focal distance (Casio EX-Z150). At slower shutter speeds, original J50 pictures exhibit a small horizontal shift, whereas EX-Z150 pictures exhibit irregular geometric distortions, that rely upon the focal distance and that show within the p-map of state-of-the-art resampling detectors.

3. PROPOSED SYSTEM ARCHITECTURE

The large-scale image retrieval based on PRNU fingerprints is addressed in figure 1. A large collection of pictures is obtained by scanning portions of the web, using a crawler software that downloads photos from publicly available repositories. From this collection, a large fingerprint database is automatically generated by extracting the PRNU pattern of each individual photo using simplified total variation denoising. Size of fingerprint is same as sensor size so for fast retrieval fingerprint is compressed using random projection. A query is presented to the system in the form of a camera fingerprint, and the goal is to identify and retrieve all the photos acquired by the same device.

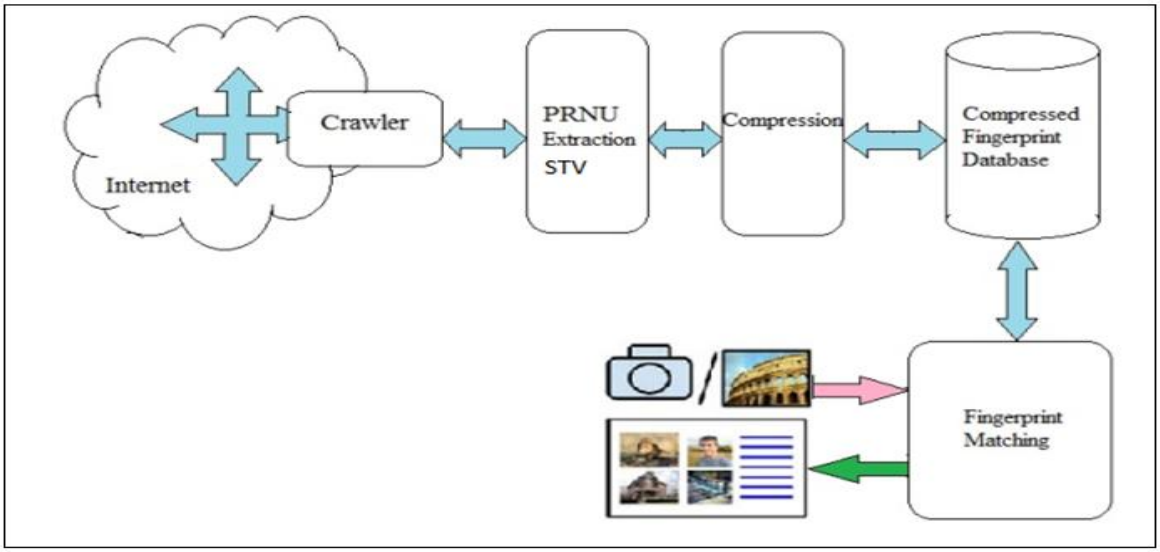

Figure 1.: System Architecture

The proposed technique improves the speed of PRNU extraction with maintaining accuracy when relate to the wavelet method. In [1] wavelet based denoising is used as the standard for PRNU extraction. The proposed method is based on a simplified version of the Total Variation based noise removal technique.

The proposed method uses a noise removal method for images which involves the minimization of the total variation. For PRNU extraction a simplified version of the TV model will be used [14]. Simplifications are applied in order to reduce the complexity of the problem and thus reducing the computation time. This will result in a fast fingerprint extraction than when using the wavelet method. For any image retrieval system, performance and accuracy plays an important role. From the point view of practical application, it is necessary to consider the running time of algorithm to speed up the performance of system. The problem with existing system is that it is time consuming for image retrieval. So the focus is on the accuracy and performance metrics. For achieving accuracy and better performance, Simplified total variation based noise removal algorithm is used instead of wavelet denoising.

Denoting the observed intensity as $u_0(x, y)$ for pixel values of a noisy image, the desired clean image is denoted as $u(x, y)$ for $x, y \in \alpha$ the image domain, as

$$u_0(x, y) = u(x, y) + n(x, y)$$

where n is white additive zero mean noise. The constrained minimization problem is defined as [15] to be

$$minTV[u] = \min \int_0 |\nabla u| dxdy$$

Where ∇is the gradient operator. The first constraint is automatically satisfied due to the translation invariance of the TV norm [16]. Adjusting the second constraint and introducingthe Lagrange multiplier λ, the formulation of an energy minimizing function for additive noise removal problem as,

$$J[u] = \int_\alpha |\nabla u| \mathrm{dxdy} + \boldsymbol{\lambda/2} \int_{\boldsymbol{\alpha}} (\boldsymbol{u} - \boldsymbol{u_0}) = \mathbf{0}$$

The corresponding Euler Lagrange equation will then be

$$-\nabla\left(\frac{\nabla u}{|\nabla u|}\right) + (u - u_{0)=0}$$

In the process, singularities are avoided by introducing a small positive parameterϵ

$$|\nabla u|_\epsilon = \sqrt{|\nabla u|^2 + \epsilon^2}$$

Each successive approximation of the denoised image can be formulated as an iterative equation.

$$u_{n+1} = \nabla\left(\frac{\nabla u_n}{|\nabla u_n|_\epsilon}\right)\Delta t + u_n$$

The simplified algorithm will be named First Step Total Variation (FSTV) and is denoted as,

$$w = u_0 - u_1 = \nabla(\nabla u_0 / |\nabla u_0|_\epsilon)$$

where the time step Δt is left out. The time step is an added time evolution step and only of importance when using multiple steps to arrive at the solution.

FSTV is a relatively simple and fast algorithm which removes a small amount of noise. Because PRNU noise is the largest noise component, it is hypothesized that FSTV still removes a sufficient amount of PRNU of camera. Due to its simplicity computation time should be much less than state of the art methods.

3.1 Random Projection

The prior disadvantage of PRNU patterns is their size as it is same as sensor size. Due to their noise-like nature, they are difficult to compress using standard image compression techniques. This problem arises when it is essential to build a large database of PRNU fingerprints. Recently, a certain number of works started considering the problem of compression of PRNU fingerprints. The sensor fingerprints is represented in binary-quantized form. Binarization of fingerprint can speedup the fingerprint matching process and reduce the storage requirements. A compact representation of PRNU fingerprints based on a fixed number of random projections [9]. In particular, a collection of N n-dimensional fingerprints, $D \in R^{n \times N}$, is reduced to a m-dimensional subspace $A \in R^{m \times N}$ by,

$$\boldsymbol{A = \Phi D}$$

A single query fingerprint $k \in R^n$ to be matched with the database can be first compressed using the same sensing matrix Φ used to compress the database, namely

$$\boldsymbol{y = \Phi k}$$

Then, the compressed query fingerprint is compared to each column of the compressed database A to find the most correlated by computing the euclidean distance. The sensing matrix is created using sparse compressive matrix.

4. EXPERIMENT AND RESULT

This section discuss about the dataset used in the proposed system and result set. System is implemented in JAVA with Intel core i3, 1.90 GHz processor. processor and 4 GB of RAM.

4.1 Dataset

'Dresden Image Database' is used for experiment. This dataset is freely available on the website forensics.inf.tudresden.de/ddimgdb/ for the purpose of development in camera based digital forensic. In this experiment we use 150 images of different camera device and model.

4.2 Result Set

We tested a system on different density of images 50,100 and 150. As shown in figure 2., graph shows a time required for system using FSTV and Wavelet method. Red line shows a time required by a system using wavelet method and blue line shows a time required by system using FSTV method. From graph it is observed that time required using FSTV is 3-3.5 times minimum than Wavelet denoising method. As number of images increases, a time required by Wavelet denoising method is linearly increases. Therefore a from graph we can say that our proposed system is much faster than previous state of the art method.

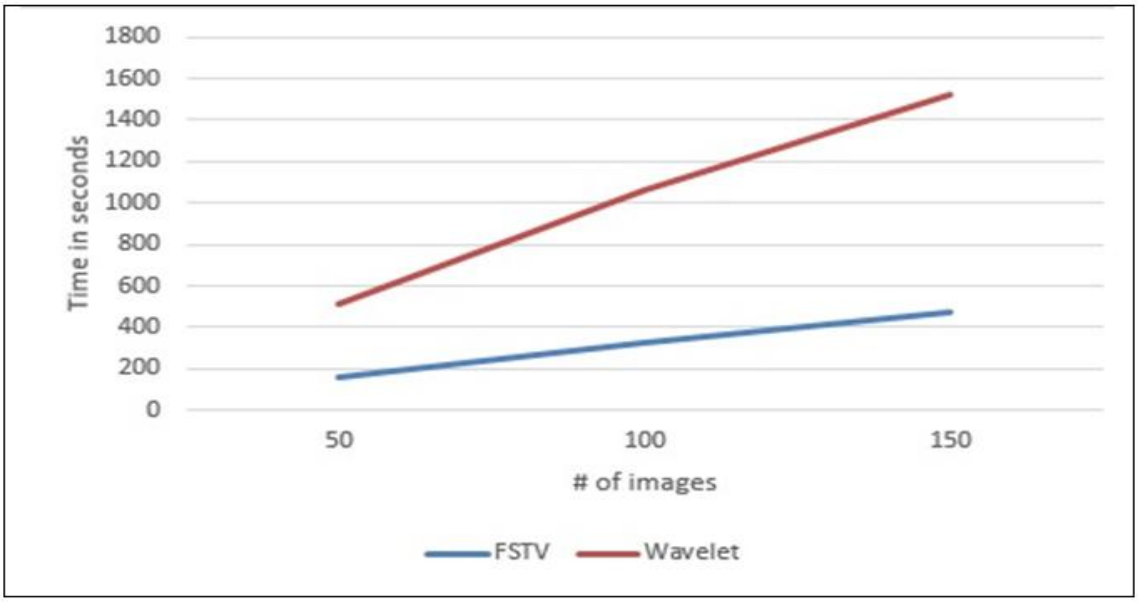

Figure 2.: Graph of time required for system using FSTV and wavelet method

As we discussed PRNU fingerprint is of same size as original image. Therefore we compress fingerprint using random projection. A comparison of uncompressed and compressed fingerprint is shown in graph below. A graph in figure 3 shows size in MB of fingerprint database before and after random projection. Blue bar shows the size of uncompressed fingerprint database and red bar shows the size of fingerprint database after compression. We observed that after compression size of database is compressed to 10%-12%.

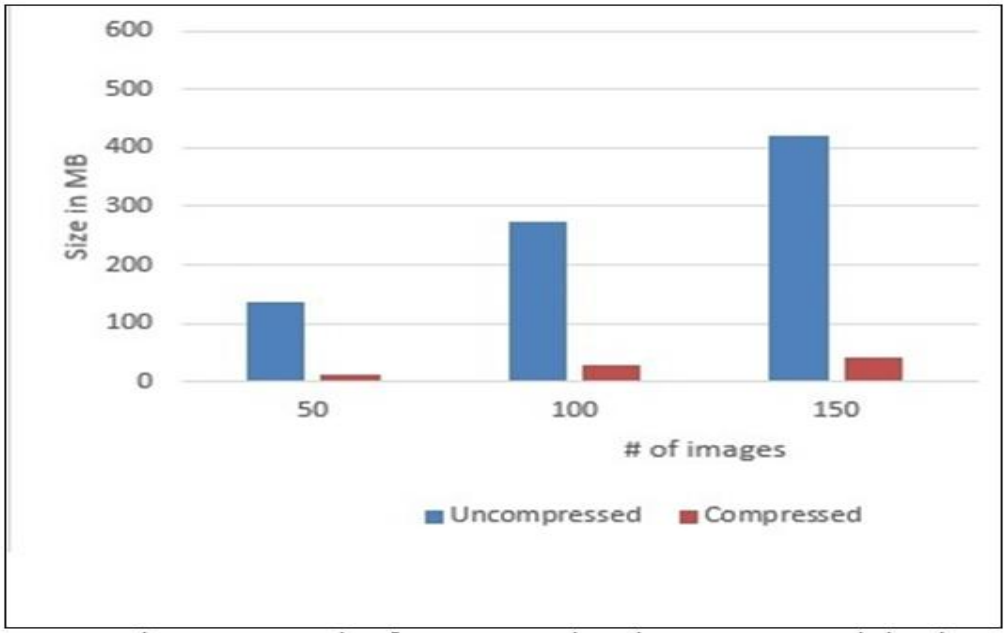

Figure 3: Graph of compressed and uncompressed database.

5. CONCLUSION

Image retrieval system retrieves device specific images from web. According to literature survey, all existing systems are time consuming while retrieving data on large scale. The proposed system can effectively speed up the fingerprint extraction and random projection is used for compression thathelp to deal with large image database efficiently. Results suggest that Simplified total variation algorithm is 3-3.6 times faster than wavelet denoising and system has accuracy above same as system using wavelet method. This system helps professional photographers to monitor use of their images illegally on web and helps to find clue in police investigation. In future work, large scale video retrieval can be done, for that more efficient searching technique will be required.

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