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Image Forgeries Detection by Color Illumination Approach

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***Abstract*—**In recent days, photographs have been used as evidence in courts. Photographers are able to create composites of analog pictures, this process is very time consuming and requires expert knowledge. Today, Powerful digital image editing software makes image modifications straightforward. This undermines our trust in photographs. In this paper, one of the most common forms of photographic manipulation, known as image composition or splicing is analysed .A forgery detection method that exploits subtle inconsistencies in the color of the illumination of images. The proposed approach is machine-learning based and requires minimal user interaction. The technique is applicable to images containing two or more people and requires no expert interaction for the tampering decision. Here, the existing work can be extended by using advanced face detection method using skin tone information and edges . A lighting insensitive face detection method based upon the edge and skin tone information of the input color image is proposed. From these illuminant estimates, we extract texture- and edge-based features which are then provided to a machine-learning approach for automatic decision-making.

Index Terms—Color constancy, illuminant color, image forensics, machine learning, spliced image detection, texture and edge descriptors.

INTRODUCTION

Digital image processing is the use of computer algorithms to perform image processing on digital images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modelled in the form of multidimensional systems.

Figure 1: Spliced image containing peoples that look authentic subjectively

The set of image forensic tools can be roughly grouped into five categories: 1) pixel based techniques that detect statistical anomalies introduced at the pixel level; 2) format-based techniques that leverage the statistical correlations introduced by a specific lossy compression scheme; 3) camera-based techniques that exploit artifacts introduced by the camera lens, sensor, or on-chip postprocessing; 4) physically based techniques that explicitly model and detect anomalies in the three-dimensional interaction between physical objects, light, and the camera; and 5) geometric based techniques that make measurements of objects in the world and their positions relative to the camera. Therefore, just before thinking of taking vital actions upon a questionable image, one must be able to detect that an image has been altered. Image composition (or splicing) is one of the most common image manipulation operations. One such example is shown in Fig. 1, in which the girl on the right is inserted. Although this image shows a harmless manipulation case, but several more controversial cases were reported, e.g., the 2011 Benetton Un- Hate advertising campaign1 or the diplomatically delicate case in which an Egyptian state-run newspaper published a manipulated photograph of Egypt's former president, Hosni Mubarak, at the front, rather than the back, of a group of leaders meeting for peace talks2.

While checking the authenticity of an image, forensic investigators use all available sources of tampering evidence. Among other telltale signs, illumination inconsistencies are potentially effective for splicing detection: from the viewpoint of a manipulator, proper adjustment of the illumination conditions is hard to achieve when creating a composite image.

In this spirit, Riess and Angelopoulou proposed to analyze illuminant color estimates from local image regions. Unfortunately, the interpretation of their resulting so-called *illuminant maps* is left to human experts. But in real it turns out, this decision is, in practice, often more challenging than it seems. Reason, relying on human visual assessment can be misleading, as the human visual system is quite inept at judging illumination environments in pictures. Because the human visual system has its limitation Thus, it is preferable to transfer the tampering decision to an objective algorithm.

Hence in this work, we make an important step in reducing the user interaction for an illuminant-based tampering decision- making. So proposed a new semiautomatic method that is also significantly more reliable than earlier approaches. Quantitative evaluation study shows that this particular proposed method achieves a detection rate of 86%, where as existing illumination-based work is slightly better than guessing. We exploit the fact that local illuminant estimates are most discriminative when comparing objects of the same (or similar) material. Thus, we focus on the automated comparison of human skin, and more specifically faces, to classify the illumination on a pair of faces as either consistent or inconsistent. In the proposed method User interaction is limited to marking bounding boxes around the faces in an image under investigation. In the simplest case, this reduces to specifying two corners (upper left and lower right) of a bounding box.

In summary, the main contributions of this work are:

• Interpretation of the illumination distribution as object texture for feature computation.

•A novel edge-based characterization method for illuminant maps which explores edge attributes related to the illumination process.

• The creation of a benchmark dataset comprised of 100 skillfully created forgeries and 100 original photographs3

RELATED WORK

Illumination-based methods for forgery detection are either geometry-based or color-based. Geometry-based methods focus at detecting inconsistencies in light source positions between specific objects in the scene [5]–[11]. Color-based methods search for inconsistencies in the interactions between object color and light color. Johnson and Farid proposed a method which computes a low-dimensional descriptor of the lighting environment in the image plane (i.e., in 2-D). It estimates the illumination direction from the intensity distribution along manually annotated object boundaries of homogeneous color. Farid along with Kee extended this approach to exploiting known 3-D surface geometry. In the case of faces, a dense grid of 3-D normal improves the estimate of the illumination direction. Fan *et al.* Propose a method for estimating 3-D illumination using shape-from-shading in which no 3-D model of the object is required. The applicability of both approaches, however, is somewhat limited by the fact that people's eyes must be visible and available in high resolution.

Gholap and Bora introduced physics-based illumination cues to image forensics. The authors examined inconsistencies in specularities based on the dichromatic reflectance model. the authors require manual annotation of specular highlights. Additionally, specularities have to be present on all regions of interest, which limits the method's applicability in real-world scenarios. To avoid this problem, Wu and Fang assume purely diffuse (i.e., specular-free) reflectance, and train a mixture of Gaussians to select a proper illuminant color estimator. The angular distance between illuminant estimates from selected regions can then be used as an indicator for tampering. Unfortunately, the method requires the manual selection of a "reference block", where the color of the illuminant can be reliably estimated. This is a significant limitation of the method.

Riess and Angelopoulou followed a different approach by using a physics-based color constancy algorithm that operates on partially specular pixels. In this approach, the automatic detection of highly specular regions is avoided, which used *illuminant map*. Implausible illuminant color estimates point towards a manipulated region.

In the field of color constancy, descriptors for the illuminant color have been extensively studied. Most research in color constancy focuses on uniformly illuminated scenes containing a single dominant illuminant. For an overview, see e.g., However, in order to use the color of the incident illumination as a sign of image tampering, we require multiple, spatially-bound illuminant estimates.

Ebner presented an early approach to multi-illuminant estimation. Assuming smoothly blending illuminants, the author proposes a diffusion process to recover the illumination distribution. Unfortunately, in practice, these approach over smoothes the illuminant boundaries. Gijsenij *et al.* proposed a pixelwise illuminant estimator. It allows segmenting an image into regions illuminated by distinct illuminants. Differently illuminated regions can have crisp transitions, for instance between sunlit and shadow areas. While this is an interesting approach, a single illuminant estimator can always fail. Thus, for forensic purposes, we prefer a scheme that combines the results of multiple illuminant estimators. In this paper, we build upon the ideas in which, We use the relatively rich illumination information provided by both physics-based and statistics-based color constancy methods. Decisions with respect to the illuminant color estimators are completely taken away from the user, which differentiates this paper from prior work.

EXISTING SYSTEM

In existing, many methods has been proposed for detecting the forged images .Tiago jose de carvalho proposed that illumination-based methods for forgery detection are either geometry-based or color-based has been used . Geometry-based methods focus at detecting inconsistencies in light source positions between specific objects in the scene has been use. Color-based methods search for inconsistencies in the interaction between object color and light color has been used .

An early approach of multi-illuminant estimation has been done.In this smoothly blending illuminants used a diffusion process to recover the illumination distribution.By exploring with this pixelwise illuminant estimator is used . It allows to segment an image into regions illuminated by distinct illuminants. Differently illuminated regions can have crisp transitions, for instance between sunlit and shadow areas. The issues of the existing system are it oversmooths the illuminant boundaries.And it donot scale well on smaller image regions.A single illuminant estimator always fails.

PROPOSED SYSTEM

We make an important step towards minimizing user interaction for an illuminant-based tampering decision-making. We propose a forgery detection method that exploits subtle inconsistencies in the color of the illumination of images. Interpretation of the illumination distribution as object texture for feature computation. Our approach is machine-learning-based and requires minimal user interaction.

We classify the illumination for each pair of faces in the image as either consistent or inconsistent. The proposed method consists of five main components:

1) *Dense Local Illuminant Estimation (IE):* The input image is segmented into homogeneous regions. Per illuminant estimator, a new image is created where each region is colored with the extracted illuminant color. This resulting intermediate representation is called illuminant map (IM).
2) *Face Extraction:* This is the only step that may require human interaction. An operator sets a bounding box around each face (e.g., by clicking on two corners of the bounding box) in the image that should be investigated. Alternatively, an automated face detector can be employed. We then crop every bounding box out of each illuminant map, so that only the illuminant estimates of the face regions remain.
3) *Computation of Illuminant Features:* for all face regions, texture-based and gradient-based features are computed on the IM values. Each one of them encodes complementary information for classification.
4) *Paired Face Features:* Our goal is to assess whether a pair of faces in an image is consistently illuminated. For an image with faces, we construct joint feature vectors, consisting of all possible pairs of faces.
5) *Classification:* We use a machine learning approach to automatically classify the feature vectors. We consider an image as a forgery if at least one pair of faces in the image is classified as inconsistently illuminated.

In the proposed system, an important step towards minimizing user interaction for an illuminant-based tampering decision-making was made. A new semiautomatic method that is also significantly more reliable than earlier approaches has been proposed.

The technique is applicable to images containing two or more people and requires no expert interaction for the tampering decision. To achieve this, we incorporate information from physics- and statistical-based illuminant estimators on image regions of similar material. From these illuminant estimates, we extract texture and edge-based features which are then provided to a machine-learning approach for automatic decision-making.

We use the relatively rich illumination information provided by both physics-based and statistics-based color constancy methods. Decisions with respect to the illuminant color estimators are completely taken away from the user. In order to describe the edge information, we propose a new algorithm based on edge-points and the HOG descriptor, called HOGedge.

The Fig.4 shows the overview of the proposed method. It gives the complete knowledge of the work done in the project. Initially the images are taken and it is splitted into original and edited image. The images are splitted for the purpose of comparison of detection of forged and original image. Here it describes two types of process. One is test stage while the other one is training process. First the dense illuminant estimation is extracted from the images of the training examples. The illuminant is found for all images in the database. Then the face extraction is done where here the faces is cropped by using a rectangle boxes. And the images are splitted to extract the illuminant features. These features are extracted using SASI and HOGedge algorithm. The features are then paired to give a combination of features which is used to detect the forgery image for future use. These processes are done in the training database. The test stage also follows the same steps done in the training set, but the only change is that an individual image is taken for the process. At the last the SVM (Support Vector Machine) is used to classify the images which are from training feature vector and test stage. In the classification step, the forged image is detected if any of the features mismatch each other, so that image is called as forged image.

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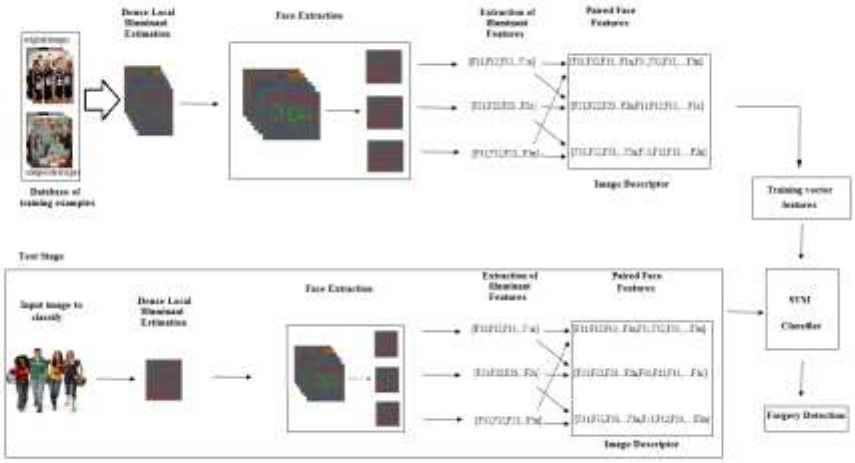

Fig.4. Overview of the proposed method

Algorithm:

Texture Description: SASI Algorithm: We use the Statistical Analysis of Structural Information (SASI) descriptor to extract texture information from illuminant maps. In our work, the most important advantage of SASI is its capability of capturing small granularities and discontinuities in texture patterns. Distinct illuminant colors interact differently with the underlying surfaces, thus generating distinct illumination "texture". This can be a very fine texture, whose subtleties are best captured by SASI. SASI is a generic descriptor that measures the structural properties of textures. It is based on the autocorrelation of horizontal, vertical and diagonal pixel lines over an image at different scales. Instead of computing the autocorrelation for every possible shift, only a small number of shifts is considered.

One autocorrelation is computed using a specific fixed orientation, scale, and shift. Computing the mean and standard deviation of all such pixel values yields two feature dimensions. Repeating this computation for varying orientations, scales and shifts yields a 128-dimensional feature vector. As a final step, this vector is normalized by subtracting its mean value, and dividing it by its standard deviation.

2. Interpretation of Illuminant Edges: HOGedge Algorithm

Differing illuminant estimates in neighboring segments can lead to discontinuities in the illuminant map. Dissimilar illuminant estimates can occur for a number of reasons: changing geometry, changing material, noise, retouching or changes in the incident light. Thus, one can interpret an illuminant estimate as a low-level descriptor of the underlying image statistics. When an image is spliced, the statistics of these edges is likely to differ from original images. To characterize such edge discontinuities, we propose a new feature descriptor called *HOGedge*. It is based on the well-known HOG-descriptor, and computes visual dictionaries of gradient intensities in edge points. We first extract approximately equally distributed candidate points on the edges of illuminant maps. At these points, HOG descriptors are computed. These descriptors are summarized in a visual words dictionary.

The SASI and HOGedge descriptors capture two different properties of the face regions. From a signal processing point of view, both descriptors are *signatures* with different behavior. We then computed the mean value and standard deviation per feature dimension. SASI and HOGedge, in combination with the IIC-based and gray world illuminant maps create features that discriminate well between original and tampered images, in at least some dimensions. Secondly, the dimensions, where these features have distinct value, vary between the four combinations of the feature vectors. We exploit this property during classification by fusing the output of the classification on both feature sets.

CONCLUSIONS AND FUTURE WORK

In proposed work, new method for detecting forged images of people using the illuminant color has been described. The illuminant color using a statistical gray edge method and a physics-based method which exploits the inverse intensity chromaticity color space has been estimated. These illuminant maps are treated as texture maps. Information on the distribution of edges on these maps is extracted. In order to describe the edge information, a new algorithm based on edge-points and the HOG descriptor, called HOGedge is proposed. We combine these complementary cues (texture and edge-based) using machine learning late fusion. The results are encouraging, yielding an AUC of over 86% correct classification. Good results are also achieved over internet images and under cross-database training/testing.

The proposed method is custom-tailored to detect splicing on images containing faces. The proposed method requires only a minimum amount of human interaction and provides a crisp statement on the authenticity of the image. Another advantage is, the exploitation of illuminant color in forensic area.

Methods that operate on illuminant color are inherently prone to estimation errors. Thus, future enhancements can be achieved when more advanced illuminant color estimators become available. An incorporation of a machine-learning based illuminant estimator particularly for faces is subject of future work. Incorporating effective skin detection methods & techniques can further expand the applicability of our method. Such an improvement could be employed, for example, in detecting pornography compositions.

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