Criminal Identification in Color Skin Images Using Birth Marks and Fusion with Inferred Vein Patterns

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Abstract – Criminal detection in recent time has become most challenging task. Most of the cases are acquired with non-facial body organs at crime scene. In this paper, semi-automated criminal detection system is introduced. The system projects on improvement with current RPPVSM approach for enhanced results. In this paper, hand vein clustering and region analysis is conducted as it is not acceptable under every scenario for back images. A clinical trial is conducted on few samples and has archived the results.

Index Terms – Criminal identification, fake detection, birthmark, criminal history identification

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I. INTRODUCTION

Criminal citations and record maintainer department has projected some of the most important facts on criminal detection challenges. Each case is correlated with criminal identification, according to a survey, 4 out of 5 cases in Indian courts are under trail and are pending due to lack of photographical in-person criminal identification. Many high profiled cases are conducted with a mask or face covered, thus identification becomes a challenge. However, it is not rare to observe bare skin of other body parts, such as back, chest, arm, and thigh in the evidence images of these cases. For example, rioters and masked gunmen often wear short sleeve shirts revealing their bare hands and arms despite having their faces covered [1] and sometimes even take their shirts off and show their chests and backs.

The image quality of rioters and protesters can be very high since news reporters use professional cameras to capture the images. The quality of child sexual abuse images is also usually high since the typical resolutions of commonly available digital cameras are higher than five megapixels. Moreover, in the scenario of self-taken child sexual abuse images, close-up views of pedophiles' and victims' naked bodies can often be seen due to the short distances between the cameras and the subjects.

Although skin marks have been used in forensic investigations for some time, automated skin mark identification is still focused on facial marks, which range from temporary marks (e.g., acnes, which may disappear within a few days) to permanent marks (e.g., nevi, which are usually stable for years). RPPVSM are different from facial marks since they are not specific to the face and only skin marks which are stable for six months or longer are considered as RPPVSM. RPPVSM are also different from birthmarks since birthmarks are congenital (i.e., appear at birth or shortly after birth) but RPPVSM can be congenital or acquired. In fact, most RPPVSM are acquired.

II. RELATED WORK

Several skin mark detection and matching methods have been proposed in literature for face recognition systems, where skin marks are used as additional discriminative features (e.g., to discriminate monozygotic twins) or alternative identification features when face recognition fails (e.g., due to occlusions) [2]–[6]. Zhang et al. [4] detected facial marks in a semi-automated fashion by manually labeling seed pixels of facial marks and using region growing operations to grow the seeds of the selected facial marks from one pixel into a group of pixels with similar intensity. The irregular details were detected and matched using a SIFT-activated pictorial structure, which combines the Scale Invariant Feature Transform (SIFT) for detecting and describing the local interest regions on the face [7].

To perform matching in a pose-independent manner, the locations of nevi in different images were then encoded into a face-centric coordinate system using a 3D Model. In addition to face recognition, automated skin mark detection has also been proposed for melanoma diagnosis, where new appearance or disappearance of nevi and changes in pre-existing nevi [8] are observed through regular screenings of patients. Cho et al. [9] detected nevi by applying multi-scale Difference of Gaussian (DoG) filters separately to the R, G, and B channels of input images and considering the set union of the output maxima over different scales and channels as nevus candidates. Subsequently, each detected candidate was classified as nevus or non-nevus by a trained support vector machine.

The proposed RPPVSM identification system differs from the existing facial mark identification methods [2]–[6] in the following aspects. It is targeted on pigmented and vascular skin marks and to realize this purpose, several classifiers were trained using a dermatologist-labeled dataset to classify skin marks as RPPVSM and non-RPPVSM. Second, the proposed RPPVSM identification system does not employ specific face-centric coordinate systems as in [2]–[6] and the matching algorithm is applicable to various body parts

III. METHODOLOGY

From detailed survey conducted we have formulated the proposed system model as shown in Fig 1. The system consist of dedicated criminal detection and vein pattern extraction algorithm using mild segmentation and pattern recognition technique. The proposed system is simulated under MATLAB 2014 Version environment.

The proposed work consists of a vein pattern extraction unit for detecting and fetching the vein intensities of pattern of an individual. The trained data samples are stored and archived at the back end central database and thus on demand, cyclic pattern check is performed. The system segmentation detects the skin color and reduces the skin pigmentation contrast for deeper extraction. Each pigment segment is under ROI for primary analysis.

For algorithm development and system evaluation, color images of various body parts were collected. To simulate a suspect database, images were collected in a standard pose and viewpoint condition, while to simulate evidence images, images were collected in varying pose and viewpoint conditions. Two common characteristics were observed from the images collected in the standardized setting. First, pixels of skin representing different parts of the human body (e.g., back, chest, arm, and thigh) form homogeneous groups of pixels in the images, and second, skin is usually the largest homogeneous region in the images. Based on these two properties, the Fuzzy C-Means (FCM) algorithm, which is a popular clustering method, was adopted for skin segmentation.

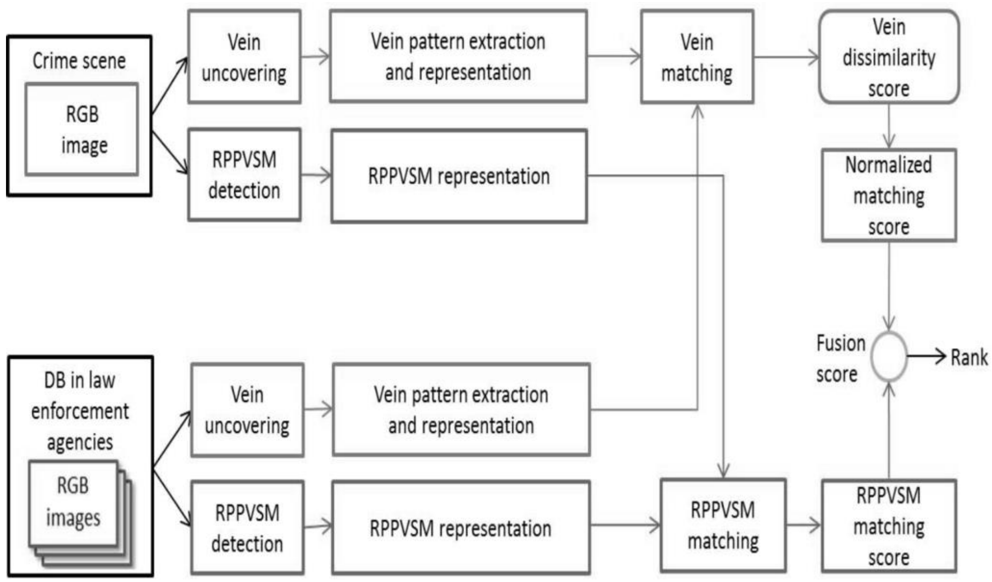

Fig 1: Overall block diagram

IV. EXPERIMENTAL OBSERVATION

Under experimental trail, the system includes a back image of processing as shown in Fig 2, this input sample is processed under proposed algorithm. The resultant outcomes are projected in Fig 3, Fig 4 and Fig 5 respectively.

Fig 2: Sample Input Image

Fig 3: Sample Image Skin Color analysis and Preprocessing

Fig 4: Image Segmentation and Pigment Analysis

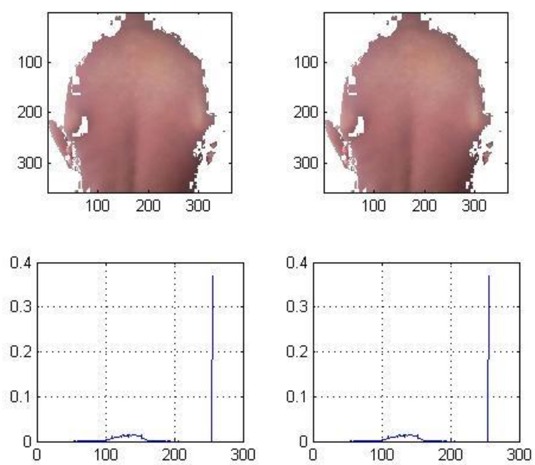

Fig 5: Overall Criminal Image Comparison and Detection

The resultant outcomes on experiment is shown and are clinically approved for justifying pattern of an individual, unique patterns and density ratio is fetched for individuals under the given system.

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