Crime Recognition in Skin Images Using Vein Patterns

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Abstract – Relatively Permanent Pigmented or Vascular Skin Marks (RPPVSM) were recently introduced as a biometric trait for identification in the cases in which the evidence images show only the nonfacial body parts of the criminals or victims, such as in child sexual abuse and riots.As manual RPPVSM identification is tiring and time-consuming, an automated RPPVSM identification system is proposed in this projects.The system comprises skin segmentation, RPPVSM detection, and RPPVSM matching algorithms.To handle identification with limited numbers of RPPVSM, a fusion scheme with inferred vein patterns is also proposed. To the best of our knowledge, this is the first work on automated identification in color skin images based on nonfacial skin marks and fusion with inferred vein patterns in forensic settings.

Index terms – Relatively Permanent Pigmented, Skin Segmentation, Inferred Vein Patterns

1. INTRODUCTION

The main aim of the proposed system is to identify the criminal based on the vein pattern recognition by comparing the vein pattern capture from the crime scene with the image in the database.Nowadays, it has become easier for anyone to produce digital images in day to day life. Along with this trend, digital images have become increasingly important in forensic investigations. Using these images for criminal and victim identification can be very challenging at times. One of the challenges is the lack of biometric traits available for identification. Gunmen, terrorists, and rioters often cover their faces with masks or clothing, making face recognition impossible. The same challenges are encountered in the cases of child sexual abuse (e.g., child pornography), where pedophiles' faces and tattoos are rarely visible in the evidence images or purposely blurred to avoid recognition. 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 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.

Even though skin marks in evidence images can be detected manually by investigators or expert witnesses, it is nearly impossible to process criminal databases manually due to their large size and complexity. To address this problem, an automated RPPVSM identification system which is comprised of skin segmentation, RPPVS[Grab your reader's attention with a great quote from the document or use this space to emphasize a key point. To place this text box anywhere on the page, just drag it.

All the related works that have been done by other researchers that are related to the current research

1.Point set registration: Coherent point drift

2.Face Matching and Retrieval Using Soft Biometrics

3.Facial Marks to Distinguish Between Identical Twins

1.1. Point set registration: Coherent point drift

Point set registration: Coherent point drift is a key component in many computer vision tasks. The goal of point set registration is to assign correspondences between two sets of points and to recover the transformation that maps one point set to the other. Multiple factors, including an unknown nonrigid spatial transformation, large dimensionality of point set, noise, and outliers, make the point set registration a challenging problem. We introduce a probabilistic method, called the Coherent Point Drift (CPD) algorithm, for both rigid and nonrigid point set registration. We consider the alignment of two point sets as a probability density estimation problem. We fit the Gaussian mixture model (GMM) centroids (representing the first point set) to the data (the second point set) by maximizing the likelihood. We force the GMM centroids to move coherently as a group to preserve the

topological structure of the point sets. In the rigid case, we impose the coherence constraint by reparameterization of GMM centroid locations with rigid parameters and derive a closed form solution of the maximization step of the EM algorithm in arbitrary dimensions. In the nonrigid case, we impose the coherence constraint by regularizing the displacement field and using the variational calculus to derive the optimal transformation. We also introduce a fast algorithm that reduces the method computation complexity to linear. We test the CPD algorithm for both rigid and nonrigid transformations in the presence of noise, outliers, and missing points, where CPD shows accurate results and outperforms current state-of-the-art methods.

1.2 Face Matching and Retrieval Using Soft Biometrics

Face Matching and Retrieval Using Soft Biometrics Soft biometric traits embedded in a face (e.g., gender and facial marks) are ancillary information and are not fullydistinctive by themselves in face-recognition tasks. However, thisinformation can be explicitly combined with facematching scoreto improve the overall face-recognition accuracy. Moreover, in certain application domains, e.g., visual surveillance, where aface image is occluded or is captured in off-frontal pose, soft biometric traits can provide even more valuable information for face matching or retrieval. Facial marks can also be useful to differentiate identical twins whose global facial appearances are very similar. The similarities found from soft biometrics can also be useful as a source of evidence in courts of law because they are more descriptive than the numerical matching scores generated by a traditional face matcher. We propose to utilize demographic information (e.g., gender and ethnicity) and facial marks (e.g., scars, moles, and freckles) for improving face image matching and retrieval performance. An automatic facial mark detection method has been developed that uses 1) the active appearance model for locating primary facial features (e.g., eyes, nose, and mouth), 2) the Laplacian-of-Gaussian blob detection, and 3) morphological operators.Experimental results based on the FERET database(426 images of 213 subjects) and two mugshot databases from the forensic domain (1225 images of 671 subjects and 10 000 images of 10 000 subjects, respectively) show that the use of soft biometric traits is able to improve the face-recognition performance of a state-of-the-art commercial matcher.

1.3 Facial Marks to Distinguish BetweenIdentical Twins

Identical twin face recognition is a challenging task due to the existence of a high degree of correlation in overall facial appearance. Commercial face recognition systems exhibit poor performance in differentiating between identical twins under practical conditions. In this paper, we study the usability of facialmarks as biometric signatures to distinguish between identical twins. We propose a multiscale automatic facial mark detector based on a gradient-based operator known as the fast radial symmetry transform. The transform detects bright or dark regions with high radial symmetry at different scales. Next, the detections are tracked across scales to determine the prominence of facial marks. Extensive experiments are performed both on manually annotated andon automatically detected facialmarks to evaluate the usefulness of facial marks as biometric signatures. Experiment results are based on identical twin images acquired at the 2009 Twins Days Festival in Twinsburg, Ohio. The results of our analysis signify the usefulness of the distribution of facial marks as a biometric signature. In addition, our results indicate the existence of some degree of correlation between geometric distributions of facial marks across identical twins.

2. PROPOSED MODELLING

In this proposed system an automated RPPVSM identification system which is comprised of skin segmentation, RPPVSM detection, and RPPVSM matching algorithms. In addition, a fusion scheme integrating RPPVSM with vein patterns inferred from color skin images for multimodal identification is also proposed. The fusion is especially useful for Asian population since many Asian subjects tend to have only a few RPPVSM in their bodies.
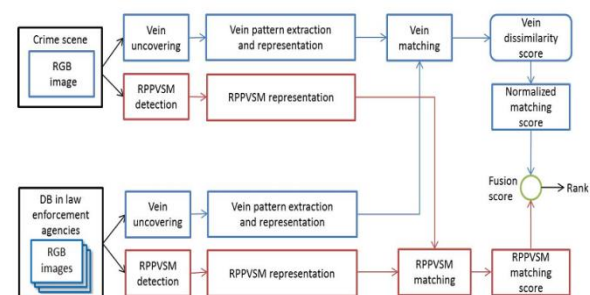
BLOCK DIAGRAM OF THE PROPOSED SYSTEM

Fig. 1 Block of the proposed system

2.1 MODULE DESCRIPTION

1. Image Segmentation

Image skin segmentation is used as a preprocessing step to suspect databases which are usually collected in controlled environments, such as the prisoner databases and the sex offender registries. Due to their large sizes, these database images demand much more automatic processing than evidence images collected from crime scenes, which can be processed manually or semi-automatically by forensic officers.

2. Training Database

In this the various vein images are collected from the various database such as criminal record, Government database etc., will get stored which will be useful for the further analysis.

3. Testing Database

In this stage the various image collected from the crime scene will be get stored in the database which will be used image which has to be undergo the testing process incase to compare which the original database collected from the various sources.

4. Feature Extraction

In this process the Principle component analysis algorithm has been implemented in order to extract the various features of the vein image collected from crime scene in order to compare it with the database images stored.

5. Classification

In the classification process the Euclidean algorithm has been implemented in order to differentiate the image collected from the crime scène and the database after extracting the various feature points from the images to be compared in order to find whether the images in the database and the images taken from the crime scene or matching
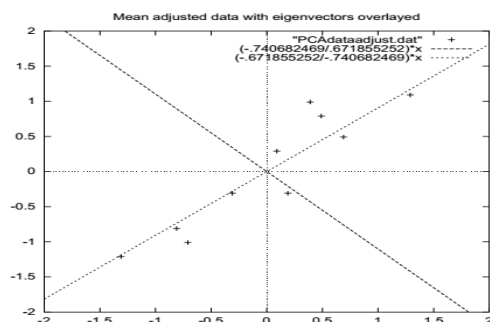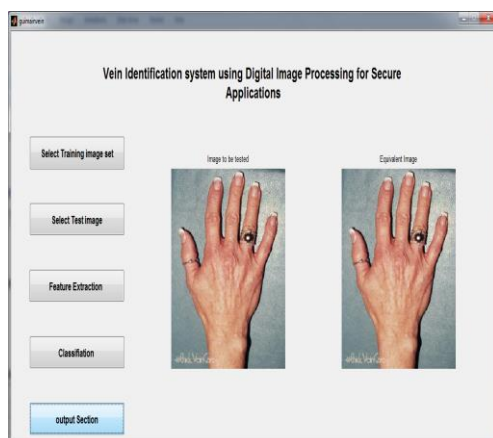

Fig.2 Mean adjusted data with eigenvector overlayed

It is important to notice that these eigenvectors are both unit eigenvectors ie. Their lengths are both 1. This is very important for PCA, but luckily, most maths packages, when asked for eigenvectors, will give you unit eigenvectors.

3. RESULTS AND DISCUSSIONS

4. CONCLUSION

While it is rare to observe the criminals' faces in the evidence images of child sexual abuse, masked gunmen, and riots, their non-facial body parts are often visible. To identify the criminals in these skin images, an automated RPPVSM identification system, which is comprised of skin segmentation, RPPVSM detection, and RPPVSM matching algorithms, is proposed in this project. According to our best knowledge, this work is the first systematic study on non-facial skin marks and their fusion with vein patterns for automated criminal identification in color skin images in forensic settings.

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