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Recovering Finger-vein authentication based on feature extraction

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ABSTRACT

Finger-vein biometrics has been extensively investigated for personal verification. Despite recent advances in finger vein verification, current solutions completely depend on domain knowledge and still lack the robustness to extract finger-vein features from raw images. A Firstly, based on a combination of known state ofthe art handcrafted finger-vein image segmentation techniques, we automatically identify two regions: a clear region with high separability between finger-vein patterns and background, and an ambiguous region with low separability between them. The first is associated with pixels on which all the segmentation techniques above assign the same segmentation label (either foreground or background), while the second corresponds to all the remaining pixels Secondly, a Convolutional Neural Network (CNN) is trained on the resulting dataset top redict the probability of each pixel of being foreground (i.e. veinpixel) given a patch centered on it. The CNN learns what a finger vein pattern is by learning the difference between vein patterns and background ones. The pixels in any region of a test image can then be classified effectively. Thirdly, we propose another new and original contribution by developing and investigating a Fully Convolutional Network (FCN) to recover missing finger vein patterns in the segmented image. The experimental results on two public finger-vein databases show a significant improvement in terms of finger-vein verification accuracy.

1. INTRODUCTION

The blood vessels, as part of circulatory system, transport blood throughout the body to sustain the metabolism, using a network of arteries, veins and capillaries. The usage of such vascular structures in the palm, palm-dorsal and fingers has been investigated in the biometrics literature with high success. The finger vein patterns are believed to be quite unique, even in case of identical twins and even between the different fingers an individual. There are two key factors that are cited for the preference of finger vein biometrics; firstly, the finger veins are hidden structures, it is extremely difficult to steal the finger vein patterns of an individual without their knowledge and therefore offering high degree of privacy. Secondly, the usage of finger vein biometrics offers strong anti-spoofing capabilities as it can also ensure liveness in the presented fingers during the imaging. Personal identification using finger vein patterns has invited lot of research interest and currently several commercial products are available for civilian applications . The individuality of fingerprints can be largely attributed to the anomalies in the friction ridges (*e.g*. rid geendings, bifurcations, *etc*.) which can be acquired when the imaging resolution is higher than 400 dpi. The low resolution finger images that can be typically acquired from the webcam imaging often illustrate finger flexion creases and also the friction ridges which are rather blurred, *i.e.*, inadequate to clearly extract the ridge endings and bifurcations. Despite poor image clarity (or stability), such finger surface texture feature scan be jointly acquired and exploited for personal identification as investigated in this paper. The generic vascular network is highly unique in human fingers and varies from thick to thin.

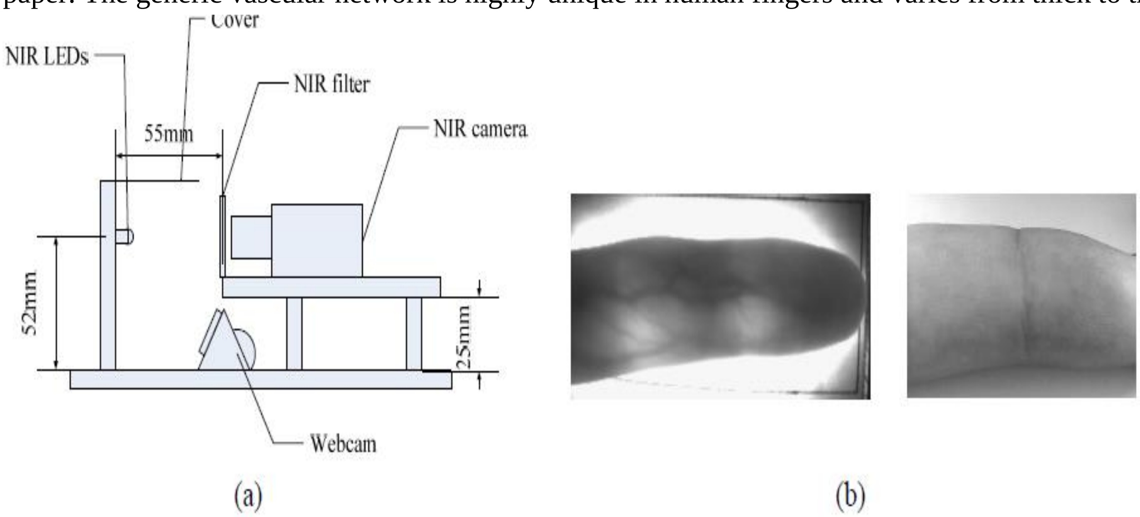

Figure 2: (a) Unconstrained finger identification using near infrared camera and webcam imaging; (b) simultaneously acquired image samples from the imaging device.

Our finger vein identification approach utilizes peg-free and more user friendly unconstrained imaging. Therefore the steps for the acquired finger vein image normalization, rotational alignment, and segmentation to effectively minimize resulting intra-class variations in the finger images are also developed. The unconstrained finger texture imaging with low resolution webcam presents high rotational and translational variations. Robust image normalization scheme is developed, rotational and translational variations are also accommodated in our matching strategy, which results in significantly improved performance.

2. RELATED WORK

The main three components of the skin, the outermost epidermis, dermis, and subcutaneous layers, contain fat and blood. The veins and arteries are located inside the subcutaneous layer. The finger-vein pattern extends from finger root to fingertip, showing clear network and good connectivity . In general, the finger-vein pattern is not easily observed in visible light. Different skin layers have different responses to infrared light, so the vein pattern can be captured by infrared light. In current works infrared illumination with wavelength of 850 nm is typically employed to capture finger-vein images with high contrast.

Finger-vein extraction approaches based on detecting valley features: In clear regions of the finger-vein image, the pixel values in vein patterns are lower than those in background, so the cross-sectional profile of a vein pattern shows a valley shape. Therefore, various approaches have been proposed to detect the valley. For example, repeated line tracking methods extract the vein pattern by computing the difference between the center value and the neighboring ones in the Cross-sectional profile., the finger-vein image, by contrast, is enhanced based on curvelets, and then a local interconnection neural network with a linear receptive field is employed to learn straight-line vein features based on labeled patches. The network is trained to detect a horizontal line and the receptive field of the neural network is further rotated by an angle to extract other lines. Unfortunately, no details on the experimental setup are given and the pixels seem to be manually labeled.

2. LITERATURE SURVEY

M. A. Turk and A. P. Pentland, "Face recognition using eigenfaces": Eigenfaces technique uses principal component analysis of the images of the faces. This analysis reduces the dimensionality of the training set, leaving only those features that are critical for face recognition. Eigenfaces are a set of eigenvectors used in the computer vision problem of human face recognition. The approach of using eigenfaces for recognition was developed by Sirovich and Kirby (1987) and used by Matthew Turk and Alex Pentland in face classification. It is considered the first successful example of facial recognition technology. These eigenvectors are derived from the covariance matrix of the probability distribution of the high-dimensional vector space of possible faces of human beings. Most of the previous methods were mainly focused on frontal face images or single-view-based face recognition. However, identifying face in different views remains as a big challenge.

Jain, L. Hong, and R. Bolle, "On-line fingerprint verification" explains about the Fingerprint verification is one of the most reliable personal identification methods. However, manual fingerprint verification is so tedious, time-consuming, and expensive that it is incapable of meeting today's increasing performance requirements. An automatic fingerprint identification system (AFIS) is widely needed. It plays a very important role in forensic and civilian applications such as criminal identification, access control, and ATM card verification. This work describes the design and implementation of an on-line fingerprint verification system which operates in two stages: minutia extraction and minutia matching. The verification accuracy is found to be acceptable. Typically, a complete fingerprint verification procedure takes, on an average, about eight seconds on a SPARC 20 workstation. These experimental results show that our system meets the response time requirements of on-line verification with high accuracy.

4. PROPOSED SYSTEM

In this proposed work doing segmentation foreground pixel from background pixels by predicting the probability of the pixel belong to a vein pattern given limited knowledge. Recovering missing pattern using fully convolution network. The advantages of proposed system are CNN based scheme is automatically learn feature from raw pixels, FCN based scheme is used to recover missing pattern, Avoid heavy manual labeling and reduce label errors and Improve accuracy of finger vein verification.

5. RESULT ANALYSIS

In recent years, deep learning-based approaches have been successfully applied for computer vision and object tracking speech recognition and handwriting recognition . In the light of their powerful capacity for feature representation, some researchers brought them into biometrics. Several Deep learning models such as in have been built for face verification and have shown great success on the LFW face dataset, for instance. Deep neural networks (DNN) have also been employed recently in several medical images segmentation tasks. In their work, the DNN is trained for segmentation using a ground truthed database. Many experimental results in prior work have shown that deep learning based approaches outperform handcrafted feature based approaches. A CNN-based scheme is employed to automatically learn features from raw pixels for finger-vein verification. First, a dataset is constructed based on patches centered on the labeled pixels, and we take the patches as input for CNN training. In this context, we perform a rigorous experimental analysis that shows that our scheme does succeed in recovering missing patterns which further improves the verification performance.

CONCLUSION

On large public datasets show that the proposed model is able to extract the vein patterns from raw images in a robust way, which leads to a significant improvement in finger-vein verification accuracy. This paper investigates a new approach for recovering vein patterns in the extracted finger-vein image. As finger-vein patterns may be missing by corruption during the imaging stage and the inaccurate estimation of parameters during the preprocessing stage (i.e. alignment and feature extraction), we develop a robust finger-vein feature recovering scheme based on a Fully Convolutional Network (FCN).

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