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ScienceDirect

Procedia Computer Science 54 (2015) 799 – 808

Procedia Computer Science

Eleventh International Multi-Conference on Information Processing-2015 (IMCIP-2015)

Online Touchless Palmprint Registration System in a Dynamic Environment

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Abstract

In this paper we proposed a novel method to acquire the ROI (Region of interest) from touchless palmprint captured from a web camera in real time. A new algorithm is used to find the candidate key points of hand roughly and quickly. An improved method is used to capture maximum ROI using these key points along with finger width to get maximum ROI of the palm. The results show that approach is robust and efficient in color palmprint images which are acquired in different lighting conditions, cluttered background, different palm orientation and scaling effect.

Peer-review under responsibility of organizing committee of the Eleventh International Multi-Conference on Information Processing-2015 (IMCIP-2015)

Keywords: Palmprint; Region of Interest (ROI); Skinlikelihood; Touchless; Valley points.

1. Introduction

Biometric based recognition systems have wide applications in the field of personal identification/verification. Fingerprint based systems are most widely used while iris based systems are considered to be most reliable. The palmprint is the region between the wrist and fingers. It has features such as texture, wrinkles, principle lines, ridges and minutiae points that can be used for its representation. The use of palmprints over other biometric technologies has several advantages. Firstly, the print patterns are unique, and the palm characteristics are more abundant than fingerprint and iris. Secondly, the iris patterns required high resolution images while the palmprint recognition uses the principal lines and wrinkles which are also discriminating in low-resolution images. So the capture device is less expensive than iris recognition. Moreover, palmprint recognition system presents much higher user acceptability than iris and fingerprint. Most current palmprint recognition systems have a complex device for controlling the background and light, and hand position. These systems are much larger than fingerprint recognition system. The users must put their hand in the semi-enclosed box, on the sensor or a plate with pegs. It makes user very uncomfortable during identification and causes sanitary issue in the public areas. These reasons greatly limit the application of the palmprint recognition system. So it is very beneficial to design a novel system to process the touchless and unsupervised hand image for palmprint registration (accept or reject palm image that merit further processing) considering the following factors:

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Peer-review under responsibility of organizing committee of the Eleventh International Multi-Conference on Information Processing-2015 (IMCIP-2015)
doi:10.1016/j.procs.2015.06.094

- Scaling Effect: Palm at varying distances from the axis of camera.
- Rotation: Palm in different orientation.
- Cluttered Background: Segmenting palm image from complex background.

In Touchless palmprint registration system users need not touch their palm on a scanner or any complex devices that restrict them to have their palm in a certain pose and make them feel uncomfortable. The ROI from the palmprint of user can be captured in Touchless mode from the low resolution CCD camera. The user simply puts their palm in front of camera without much restrictions.

2. Related Work

Palmprint acquisition process is the very first and key step for developing fast and durable online palmprint recognition system. Ink-based palmprint images had been used in earlier studies[1,2] where the palmprints were inked to paper and digitized using scanner. This two-step process was slow and not worthy for the online palmprint recognition system. However, various input sensor technologies like flatbed scanner, CMOS camera, CCD camera and infrared sensor have been developed for direct acquisition of palmprint. Among these technology scanners and CCD camera are most frequently using input devices[3,4]. Scanner and CCD camera provides high quality of images with little loss of information but scanner takes some time (few seconds) for image acquisition and this delay could not address the requirements of the online palmprint recognition system. Zhang *et al.* (Zhang *et al.*, 2003)[5] suggests to use a CCD camera in a controlled environment and reported good results. Michael Goh Kah Ong (Michael Goh Kah Ong., 2008)[6] has proposed the use of a low-resolution webcam for ROI acquisition in real-time system but in semi-controlled environment, considering only the effect of background images. But still there are various other factors, that are needed to be considered like scaling effect, rotation etc. while capturing the ROIs from the real-time video frames.

3. Proposed Methodology

In order to solve the problems that touchless palmprint system is facing, we attempt to propose the basic building blocks which use the following methods:

- A Gaussian skin color model is used to reduce effect of background images and Segment the hand image.
- A novel valley detection algorithm is used to find valley locations. An improved method is used to capture maximum ROI using these valley points along with finger width.
- Area of convex hull (polygon formed by joining extreme boundary pixels) is used to reduce scaling effect.
- slope of line joining two valley points $V1$ and $V3$ is used to correct the palm in different orientations.

In this paper, we proposed essential building blocks to develop a touchless palmprint registration system which can capture hand images in a touchless environment. These building blocks would make the system more robust and sensitive to different background images, different palm orientation, different lightening conditions and scaling effects without the additional sensor cost or adding user complication. The users do not need to touch or hold on to any peripheral for their hand images to be acquired. When their hand images are captured, the ROI of the palm will be tracked and extracted under all these dynamic environment.

4. Building Blocks

4.1 Skin-color model

Skin Color of hand has proven to be a useful and robust cue for hand detection and tracking and carry relatively stable information on hand. It is different from most of the background color. In order to segment the hand from the background based on skin color, we need a reliable skin color model. It has been shown in the researches, skin colors of different people are very close, but they differ mainly in intensities. The skin classification based on the Gaussian skin color model have been used much in the previous work[7,8]. One advantage of the Gaussian skin color model is that they can be made to perform reasonably well even in small amounts of training data. Therefore, a skin color