ABSTRACT

Biometrics is defined as the measurable physiological or behavioral characteristics of a particular object. It includes the identification of people by unique body features, scars or a combination of other physiological criteria, such as height, eye color and complexion. Study of biometrics consists of two main research areas: image processing that deals with the extraction of numerals from imagery data, and pattern recognition, a part of statistical machine learning theory that can match numerals to one another. Biometric techniques are used mainly in security operations that include physical access control, customer/employee verification, computer log-in, welfare disbursement, international border crossing, national ID card and keyless entry and keyless ignition in automobiles.

Biometric-based personal recognition is described as an automated method to recognize individuals based on their distinguishing physiological or behavioral traits. The well-known biometric technologies include fingerprinting, hand geometry, signature verification, voice verification, retinal scanning, iris scanning and facial recognition. Fingerprint identification has progressed over many years, but it cannot be used in a small part of the population due to age, accidents, genetic reasons, environmental or occupational reasons. Although iris and retinal recognition provide optimum accuracy, the high costs of input devices or intrusion into users prevent the
use of this method. Researchers developed face and voice verification systems, but their performance is still not satisfactory.

In this regard, authentication based on palmprint extraction has attracted many researchers. In contrast with other available authentication methods, palm print authentication has several advantages. When the fingerprint provides a small area, the palm provides a larger surface area so that more features can be extracted. The damage in palm does not occur easily as other parts and also the line features of a palm are constant during one’s life span. Low resolution images are sufficient for palmprint recognition.

Researchers are working on performance improvements in palmprint recognition system by incorporating different features, fusing multiple palmprint features or using different matching algorithms. Only few works have been done in palmprint preprocessing. The accuracy and performance of the palmprint authentication system can be improved by doing enhancement in the preprocessing stage. This research work is focused on developing new enhancement techniques to improve contrast and remove noise of the palmprint image. This work also focuses on palmprint recognition system incorporating enhancement algorithms.

This research work proposes four methods for palmprint contrast enhancement and one method for noise removal. They are local contrast palmprint enhancement, bi-histogram equalization with threshold, recursive histogram equalization, entropy optimized palmprint enhancement and curvelet-based palmprint enhancement. The local contrast enhancement
method uses the mean and variance of the neighborhood to perform contrast enhancement. Bi-histogram equalization with threshold divides the input histogram of palmprint image into two sub histograms based on the mean value and then equalizes these histograms after thresholding. Recursive histogram equalization method divides the input histogram of the palmprint image into a number of sub histograms recursively based on the mean of the input histogram. These sub histograms are modified using a weighting process and then equalized independently. Entropy optimized palmprint enhancement uses genetic algorithm to optimize the parameters of enhancement algorithm using entropy as a fitness function. These proposed techniques are compared using three quality measures, namely peak signal to noise ratio, absolute mean brightness error and entropy. Recursive histogram equalization performs well compared to all other methods. This method improves the contrast of the palmprint image and preserves the mean brightness without introducing any artifacts. Curvelet-based palmprint enhancement method is used to reduce noise in the palmprint image. This method achieved better performance while compared to mean filter, median filter, wavelet and contourlet methods.

The proposed recursive histogram equalization and curvelet methods are incorporated in the palmprint recognition system to improve the performance. Two palmprint recognition systems are proposed in this work incorporating these enhancement techniques. They are palmprint recognition system using symbolic aggregate approximation features and palmprint recognition system using multiple palmprint features with enhanced palmprint
images. Both the methods use recursive histogram equalization and curvelet as enhancement techniques. Optimum performance improvement is obtained when both recursive histogram equalization and curvelet are used. An improvement of about 8% in total success rate is seen in the proposed methods compared to the previous methods.

A summary of the research contributions of the study are presented. The limitations and the possible extensions for future research are also suggested in the concluding chapter of the thesis. An extensive reference on the subject is included. A substantial part of this research work is reported in various international journals / national journals / international conferences / national conferences. A list of papers published / presented based on the work reported is given at the end.