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ABSTRACT

Biometrics comprises physiological and behavioral traits that facilitate humans in recognizing others. Biometrics has become an important and integral part of effective and reliable personal verification system and has applications in commercial, forensic and government sectors. Biometrics based authentication has been evolving as a technology in view of ever growing security requirements.

The unimodal biometric system is based on a single trait and it suffers from various limitations such as noise in sensed data, intra-class variations, distinctiveness, non-universality, spoof attacks etc. The multimodal biometric system combines the evidences from different sources. A multimodal biometric system can be created by combining various unimodal systems. Multimodal biometric system improves the performance by reducing the error rates. By having more than one biometric modality improves the reliability of the system by making up the loss of one modality with another and it also helps against the spoofing. Fusion techniques are used to aggregate the feature data extracted from the modalities to produce the improved recognition rates.

The work in this thesis investigates how the performance of a biometric system is improved by combining online signature, fingerprint and palmprint. The choice of modalities depends on the fact that signature is used in most of the daily applications and is socially accepted, fingerprint is a mature technology and palmprint is simple and provides large area to extract rich texture descriptors. Therefore, main objective of the research is to investigate the effectiveness of fusion techniques to develop a multimodal system that outperforms individual unimodal systems.

In this thesis, a memory efficient method of online signature verification is developed employing global features and by integrating Genetic Algorithm with Support Vector

machine. We have proposed a novel adaptive segmentation method for online signature verification, wherein instead of extracting the features the signature is segmented at the points of geometric extrema followed by the feature extraction and fuzzy modeling of each segment. A novel adaptive segmentation method improves the quality of segments and produces more accurate segment-to-segment correspondence. A minimum distance alignment between two samples is made using dynamic time warping (DTW) technique that provides a segment to segment correspondence. Fuzzy modeling of the extracted features is carried out in the next step. A user dependent threshold is employed to classify a test sample into genuine or forged classes. A user dependent threshold captures the inherent variability in a particular user's signatures and thus helps to reduce both false acceptances and false rejections.

A fingerprint recognition system is developed based on the non-minutiae features. SIFT based method gives an accurate and reliable core point in a fingerprint image. Experimental results demonstrate the effectiveness of Gabor feature extraction and Euclidean distance based similarity measure for developing fingerprint recognition system. Another biometric recognition system is developed based on palmprints. In this unimodal system, ROI images are used to extract the texture features using the Local Binary Pattern and these features are matched by Chi square distance measure.

To improve the performance of individual unimodal biometric systems we have gone in for the score level fusion of unimodal biometric systems, viz., on line signature, fingerprints and palmprints. We have combined the online signature with either fingerprint or palmprint. Next we have combined all three modalities using the conventional rules and then also using the t-norms in the score level fusion. The t-norms performs the operation of conjunction of the scores. The multimodal biometric system employing Hamacher and Frank t-norms for the fusion yields EERs of 0.5% and 0.3% whereas the sum and product rules yield EERs of 0.45%. and 0.85% respectively. The multimodal biometric system employing Frank t-norm tops the other t-norms with EER of 0.3%. The experimental results show that the use of t-norms for the score level fusion overcomes the shortcomings of the individual unimodal biometric systems thus improving the performance over the unimodal biometric systems.