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Thesis abstract

A robust multimodal biometric scheme for human recognition and authentication

Mozammel Chowdhury †

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Biometric recognition and authentication are crucial and gaining popularity in many security applications, including secure access control, human surveillance, suspicious activity recognition, border monitoring, preventing criminal acts, alarm monitoring and so on. Biometric recognition identifies a human identity based upon their physiological or behavioral characteristics, such as face, ear, fingerprint, palm print, iris, voice, gait and signature. Among these biometrics, the face and ear are considered as the most reliable traits due to their uniqueness and easy data acquisition. However, both face and ear recognition suffer from lack of accuracy and robustness for real-time applications. The performance of the face recognition process is significantly affected by variations in facial expressions, the use of cosmetics and eye glasses, the presence of facial hair, including beards, and aging. On the other hand, the reduced spatial resolution, uniform distribution of color and sometimes the presence of nearby hair and ear-rings make the ear very challenging for non-intrusive biometric applications. Therefore, fusion of face and ear data in an efficient way may be useful for mitigating these challenges. They are also good candidates for fusion due to their physical proximity. In recent years, multimodal biometric systems based on two or more biometric traits have been found to be extremely useful and exhibit robust performance over unimodal biometric systems. We therefore propose a multimodal biometric scheme by combining the local features of face and ear biometrics in a computationally efficient manner.

In this dissertation, we develop robust and efficient algorithms for face and ear recognition and, finally, the fusion of face and ear biometrics for human recognition and authentication. In this research, face recognition is accomplished by means of matching facial local features between the probe image (left or right face sequence) and the gallery face images within a database. For ear recognition, the system first detects and extracts the ear region from the facial image geometry. To detect the ear of the user from the facial images, we employ a fast technique based on the AdaBoost algorithm. Similar to the face recognition scheme, ear recognition is accomplished by matching the ear data (probe) of an individual to the previously enrolled (stored) ear data in a gallery database for verification and recognition of the person.

† Dr Chowdhury died in 2021. He received the Vice-Chancellor's Award as well as the Dean's Award for his outstanding thesis.

In this research, we present a method for fusing the face and ear biometrics at the match score level. At this level, we have the flexibility to fuse the match scores from various modalities upon their availability. Firstly, the match scores of each modality are calculated. Secondly, the scores are normalized and subsequently combined using a weighted sum technique. The final decision for recognition of a probe face or ear is done upon the fused match score. Once the person is identified, based on the fused features of face and ear modalities, authentication to a secure environment is granted. The experimental evaluation reported in this research demonstrates that fusion of these two (face and ear) biometrics results a significant improvement in recognition accuracy, compared to the accuracy achieved by using individual one. The unimodal and multimodal biometric approaches proposed in this dissertation using face and ear biometrics can be extended for recognition with other biometric traits. The dissertation is organized with a set of papers already published and submitted to journals or internationally refereed conferences.

Dr Mozammel Chowdhury died in 2021. His PhD supervisor was Professor M. D. Rafiqul Islam, who can be contacted at mislam@csu.edu.au.

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