Chapter 8
Pre-Clinical ASD Screening Using Multi-Biometrics-Based Systems

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ABSTRACT

Autism Spectrum Disorder (ASD) screening is still an ongoing process due to few objective and effective screening approaches. The consideration of facial patterns, fingerprints, and other metrics such as footprints and ear size can well explain the ASD phenotypes. These physical anomalies provide a simpler and more objective approach to screen the disorder through rather than considering the complex biological factors. Moreover, it is very easy to acquire these metrics as compared to those lengthier and restrictive procedures. The screening engine in which both the biometrics are integrated has better and reliable outcomes as compared to singular approaches. The objective of this chapter is to present an ASD screening system based on the combination of biometrics of face and fingers. The novelty of the chapter is that the classifier-based matching and fusion of the modalities has been proposed. Hence, multi-biometric-based pre-clinical system has the potential to follow ASD-affected individuals continuously, objectively, and periodically.

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INTRODUCTION

Biometrics is widely used in pattern recognition based on the physiological or behavioral features such as fingerprint, DNA, earlobe geometry, iris pattern, gait and facial pattern (Jain, Ross & Prabhakar, 2004). The biometric based identification system relies on the features that are unique and free from temporal variations (Jain, Flynn, & Ross, 2007). These are widely used in surveillance, personalized identification, screening, interaction, encryption, and verification. The screening and monitoring of healthcare diseases can be done using the biometric traits of the individuals (El-Latif, Hossain, & Wang, 2017). In healthcare systems, biometrics help in detecting ocular pathologies (Trokielewicz, Czajka, & Maciejewicz, 2017), genetic disorders and neurodevelopment disorders such as ASD (Kazemi et al, 2017) and in assessing emotions and finding the effect of music on emotions (Alhussein, 2016). In this chapter, the biometric system for screening the Autism Spectrum Disorder (ASD) affected individuals has been utilized.

ASD represents a spectrum of etiologically and clinically non-uniform neuro-developmental disorders. It majorly comprises of autism, Pervasive Development Disorder Not Otherwise Specified (PDD-NOS), and Asperger's syndrome (AS) disorders. These disorders have been merged under a single umbrella and their clinical symptoms should accomplish the diagnostic criteria mentioned in DSM-5 (Diagnostic and Statistical Manual-V; Tanu & Kakkar, 2018). ASD affects the social interaction and communication ability of the individuals and leads to restricted & repetitive behavior (Tanu & Kakkar, 2018). It is diagnosed by targeting the behavioral symptoms, outcome oriented patterns such as social skill, clinical course of disorder such as regression, neurological abnormalities and physical modalities (Obafemi-Ajayi et al., 2015). The behavioral symptoms include: social interaction, sensory processing, aggression, attention deficit and motor movements/gait patterns. The neurological abnormalities include: brain patterns, seizures, deafness and cognitive ability. The physical identity includes the facial morphology and different modalities viz. fingerprints, footprints, ear size and iris. These identities are advantageous due to ease of acquiring, analysis and non-invasiveness & have detected various developmental disorders such as Down syndrome and Williams syndrome (Gilani et al., 2015). Diagnosis of ASD is a challenging task since the behavioral and the developmental traits of the subject have to be carefully observed by an expert to detect disorders. Recent years, have observed a shift in the detection of ASD towards the physical modalities viz. facial morphology and dermatoglyphics which act as assistive tools for the detection and are solely based on behavioral observations. The detection through these biometric based approaches is relatively simple and does not involve the iterations associated with detection.

Based on the recent advances and usage, the dermatoglyphics (finger prints) and face morphology studies have been considered in this chapter. Dermatoglyphics is a scientific process of taking impressions or patterns of fingerprints, palm and feet for the analysis of disorders. The patterns are hereditarily decided due to which these are highly variable and no two people or even the twins have the same pattern. It is strongly related to genetics and hence, this is highly utilized for diagnostic purposes. The dermal ridges start developing in the 13th week (Okajima, 1975) of intrauterine life and completely develop up to the 21st week. From then onwards, ridges remain same and consequently can be considered as fossils of a particular time of pre-birth development (Fatjó-Vilas, Gourion, Campanera, Mouaffak, Levy-Rueff, Navarro & Fañanás, 2008; Fearon, Lane Airie, Scannell, McGowan, Byrne & Waddington, 2001). So, this has a great role in identification of an individual and diagnosis of hereditary disorders (Turek, 1990). Though, the interest in dermatoglyphics research sustained from the earliest starting point of the twentieth century, but it has now gone into a stage where it is drawing an incredible number of researchers from all portions of biology and medicine. Moreover, it has many advantages over other