Dear Editor,

AUTEMOGAZE – Efficient Emotion and Gaze Change Identification System for Autism Spectrum Disorder

The development of social skills such as facial emotions and eye gaze in children are the primary contributors to participate in a social environment (Lozicer et al., 2014). Clinically it has been proved that the typically developed children could start showing facial emotions from a very early age (Farah et al., 2000). In contradiction, most of the individuals with Autism Spectrum Disorder (ASD) could have emotional deficits and are also unable to show their emotions (Fridenson-Hayo et al., 2016). The typically developed individuals are also able to represent eye gaze patterns differently during valance and emotional states (Tanaka et al., 2012), whereas individuals with ASD tend to lack in eye-to-eye emotional contact (Cañigueral & Hamilton, 2019). The relevant detection of a change in facial expressions of ASD individuals could play an important role in regulating their emotional state and improving their social behaviour.

It has been observed that the facial expressions of typically developed individuals could be recognized with the clinical potential of computer-based conventional computer systems, but the accurate identification of change in facial emotion and eye gaze of individuals with ASD could be difficult to understand or detect with manual or conventional methods (Bekele et al., 2014; Lahiri et al., 2015).

We have developed a system called AUTEMOGAZE in an attempt to optimize the facial diagnosis system of ASD and to detect changes in facial emotions and eye gaze of such individuals. The design of AUTEMOGAZE is able to detect the change in facial emotions and eye gaze in individuals with ASD through deep learning (2D-CNN) model. To achieve optimum accuracy, the AUTEMOGAZE system was trained with emotional facial images and tested with video data of 10 individuals with ASD and 10 typically developed individuals, collected from online sources (Asteriadis et al., 2009; LoBue & Thrasher, 2015; Lucey et al., 2010; Lyons et al., 1998; Smith et al., 2013). The input images were pre-processed according to the requirements of the 2D-CNN model and then converted into gray-scale through the Viola-Jones algorithm (Patacchiola & Cangelosi, 2017).
for training and testing purposes. 2D-CNN algorithm was implemented for the change identification in a facial image through the AUTEMOGAZE system.

The training analysis of the AUTEMOGAZE system was conducted using combined data sets of images and videos to identify the training capability of the system. Further, trained AUTEMOGAZE was also tested and validated through real-time videos of individuals with ASD and typically developed individuals to analyze the efficiency in terms of acquired accuracy. During the training, the proposed system reflected the average accuracy of 94.9 % and 93.3 % for the identification of change in facial emotion and eye gaze respectively. During the real-time facial videos for both groups in AUTEMOGAZE, the average percentage accuracy of 94.24% for facial emotion and 93.9% for eye gaze was observed. Thus, the statistical analysis showed that the AUTEMOGAZE system was able to produce similar results for both groups. The t-test revealed no significant difference in the facial emotion change identification percentage of the typically developed group ($M=94.76$, $SD=2.39$) and the ASD group ($M=94.24$, $SD=2.45$) under conditions; $t(9)=0.57$, $p=0.28$. No significant difference was observed in the results of gaze change identification percentage in the case of typically developed group ($M=94.01$, $SD=3.35$) and ASD group ($M=93.9$, $SD=3.24$) under conditions; $t(9)=0.064$, $p=0.47$. The t-statistics showed that the outcome of the system was stable with insignificant differences. The significant increment in accuracy of the proposed system was found to compare with studies by Liu et al., 2016 and Smitha & Vinod, 2015, where accuracies were found to be 82.3% and 88.51% respectively, in comparison to the proposed system, where the accuracy was approximately 94%.

REFERENCES


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