Intelligent Aided System to Support Autistic People

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Abstract

Autism is a lifelong neurodevelopmental disorder that affects several aspects of a person's life, including communication, learning patterns, social skills, and perception. Although prior applications exist to assist autistic individuals, they are not as affordable and efficient as required due to the increasing prevalence rate. Therefore, this study presents a system that uses deep learning and computer vision techniques, including face recognition, facial expression recognition, speech to text, text to speech, Haar cascade, CNNs, LBPH, and hand landmark of media pipes, to engage autistic individuals in meaningful activities that improve their communication skills and movement. The system does not have a model to recognize autism, as it is not distinguishable through appearance. The system was tested on an autistic child and found to be easy to use, with games increasing concentration and improving control of movements. Future recommendations are suggested to improve the system further.

Introduction

Autism Spectrum Disorders (ASDs) impact social interaction, communication, and behavior, affecting the quality-of-life outcomes of children and their families. The prevalence of ASDs has increased, leading to a demand for improved understanding of effective treatments and service provision. ASDs are a spectrum disorder, with each autistic person being unique. The Centers for Disease Control (CDC) reported in 2018 that one out of 44 children in the US are diagnosed with autism, a significant increase from the previous estimate of one out of 54 children in 2020. This increase may be due to growing public awareness, efforts to increase diagnosis rates, and environmental factors such as air pollution, low birth weight, and stress.

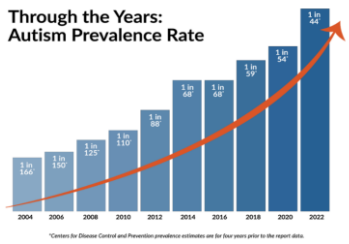

Figure 1

Due to the lack of available therapists and knowledge on how to properly deal with autistic children, this study presents a system including educational programs and games designed based on a psychiatrist's recommendation to assist with the autistic child's progress. Prior solutions lack affordability and cost efficiency. The system was tested on autistic children and showed promising results.

Methods and architecture

The final product, as shown in Figure 2, was developed through several steps. First, the system uses face recognition algorithms to identify the user and display a hello message using their name. Next, the user chooses between "let's go together" or "choose by yourself". If the user chooses "choose by yourself", they can select from a list of available educational videos or games. If they choose "let's go together", the system proceeds to facial expression recognition using CNNs and Haar cascade algorithms. Based on the user's emotions, a sequence of games and videos is determined. The games include Spin Ball, Snake, Car, Card, and Virtual Paint, and employ algorithms such as face blaze and hand landmark detector of cv zone. The educational videos cover topics such as alphabets, numbers, colors, ablution, praying, shapes, and fruits. The sequence varies depending on the user's emotions, with a different order for "happy", "sad", "angry", "neutral", and "surprised".

Figure 2

Figure 3 *Figure 4*

Results:

The models used in the system are trained using datasets, with the face recognition model trained on a dataset consisting of 30 pictures for each user, and the facial expression recognition model trained on a dataset obtained from a kaggle competition. The system overall works well, but the accuracy of the face recognition model can be lower than 50 percent without a variety of poses and movements in the user's pictures in the dataset. The system was tested on a 5-year-old autistic child with ADHD, who enjoyed the GUI, interacted with the educational videos, and learned to playthe games after practicing. The child particularly enjoyed the snake game and paint game, and the system successfully educated and entertained the child in both the games after practicing. The child particularly enjoyed the snake game and paint game, and the system successfully educated and entertained the child in both the happy and neutral sequences.

Figure 5

Figure 6

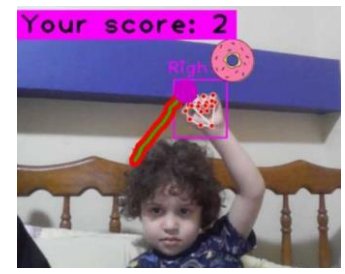

Figure 7

Conclusion

The interactive system aims to educate children with ASD in a fun way and help manage the disorder and its symptoms. It utilizes face recognition and facial expression recognition, along with educational videos and interactive games such as car, snake, spin ball, virtual, and card games, to improve the child's motor functions, communication skills, and ability to follow directions. The facial expression recognition model is trained using a custom CNN with data preprocessing and augmentation techniques, achieving a validation accuracy of 68.19%. The system was tested on a child with ASD and ADHD, showing positive results in their performance and grasp of the concepts mentioned above. Overall, the system provides an engaging and effective way to educate and entertain children with ASD.

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