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A Review Paper on: Virtual Reality Based Adaptive Response Technology for Autistic Children

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***Abstract*—ASD (Autism spectrum disorder) is a neuro developmental disorder characterized by core deficit or demonstrates potent impairments in social communication skills. The behavior of an individual with ASD includes repetitive or typical viewing patterns during social interactions. To address these deficits, recently several technologies have been investigated. In this project eye-gaze and some other physiological measurements have been considered for understanding how an individual is engaged in a particular task. The presented work seeks to bridge a platform by developing a novel interactive system with Gaze-sensitive adaptive response technology that can seamlessly integrate with eye-tracking techniques to intelligently facilitate an individual in task relevant to social communication skills. This project presents the design and development of a system with adaptive response technology that is based on the composite effect of ones viewing pattern, eye physiology, and one more parameter that is speech or voice recognition have also been considered to precisely demonstrate the ASD.**

***Index Terms*—Autism spectrum disorder(ASD), Virtual reality(VR), Blink rate(BR), Eye tracking(ET), Voice tracking(VT)**

I. INTRODUCTION

This paper presents the development and application of virtual-reality based Gaze sensitive system with adaptive response technology for children with Autism Spectrum Disorder (ASD). Such a system can intelligently adapt itself in an individualized manner to encourage a child to participate in social communication tasks while trying to improve his/her level of engagement and performance in the social task. Autism spectrum disorder (ASD) is a neurodevelopment disorder characterized by core deficits in social interaction and communication accompanied by restricted patterns of interest and behavior commonly demonstrate difficulties related to complex fluid reciprocal social interactions, including difficulties related to social information processing and understanding non-verbal aspects of communication. Given these vulnerabilities, a specific focus of autism research has been to understand how people with autism process salient social and emotional cues from faces. [2]The ability to derive socially relevant information from faces is considered to be a very important skill for facilitating fluid interpersonal communication. In addition to providing indexes of social information processing during interactions, eye-gaze and physiological measurement of aspects of that gaze may simultaneously provide markers for understanding how an individual is engaging with a task.

Specifically, such markers may provide clues as to whether an individual is attending to specific aspects of interaction and for the nature of his affective experiences (e.g., enjoyment, anxiety, boredom, etc.) during tasks. Such a capability may enable the development of intelligent systems capable of providing real-time adaptations that greatly bolster improvements in the core areas of deficit related to ASD.

A. Characteristics of ASD

Repetitive behavior: Autistic individuals display many forms of repetitive or restricted behaviour, which the Repetitive Behavior Scale-Revised (RBSR) categorizes as follows:

1. Stereotypy is repetitive movement, such as hand flapping, head rolling, or body rocking.
2. Compulsive behavior is intended and appears to follow rules, such as arranging objects in stacks or lines.
3. Sameness is resistance to change; for example, insisting that the furniture not be moved or refusing to be interrupted.
4. Ritualistic behavior involves an unvarying pattern of daily activities, such as an unchanging menu or a dressing ritual.

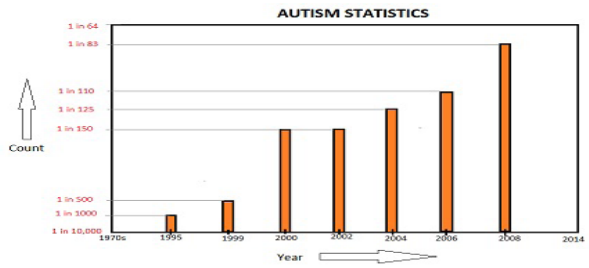
This is closely associated with sameness and an independent validation has suggested combining the two factors.

5. Restricted behavior is limited in focus, interest, or activity, such as preoccupation with a single television program, toy, or game.
6. Self-injury includes movements that injure or can injure the person, such as eye poking, skin picking, hand biting, and head banging. A 2007 study reported that self-injury at some point affected about 30% of children with ASD.

Behaviour	Description	Example
Aggression to therapist (0.48 ± 0.07, 98%)	Any aggressive actions directed toward the therapist.	Hitting, kicking, biting, etc. – antisocial behaviours directed toward the therapist.
Self-injurious behaviour (0.38 ± 0.19, 94%)	Any aggressive actions or behaviours directed toward self.	Hitting, scratching, biting, etc. – behaviours directed toward self.
Irrelevant and repetitive vocalisations (0.50 ± 0.23, 93%)	Any vocalisation from the subject that is not task-relevant or part of an appropriate vocal response.	Screaming, yelling, inappropriate laughing, or any other irrelevant and/or in appropriate vocalisations
Repetitive motor movement (0.48 ± 0.11, 91%)	Motor movements that occur at least three times, plus any additional occurrences of those movements.	Flapping of arms, rocking, flicking fingers, tapping.
Repetitive object usage (0.37 ± 0.12, 95%)	Any seemingly non-communicative, repetitive physical manipulation of an object.	Repetitively spinning, tapping, rolling an object.

B. History of ASD

In 1938 The word autism was first given its modern sense by Hans Asperger of the Vienna University Hospital.[3]then in 1943 Leo Kanner, while at Johns Hopkins, was first to describe autism. His article described 11 children who had an apparently rare syndrome of extreme autistic aloneness. In 1944 Hans Asperger also described a group of children with similar symptoms who were highly recognizable. In 1947 The earliest well-documented case of autism was successfully given by Hugh Blair of Borgue. In mid 1970's There was little evidence of a genetic role in autism; now it is thought to be one of the most heritable of all psychiatric conditions. In 1990's till today Rate of autistic children is frequently increasing as shown in the graph above and it is as high as 1 in every 64th child in 2014.



II. OBJECTIVES AND GOALS

The objective of this paper is three fold:

1) To allow the measurement of ones looking pattern and associated eye physiology that will detect the state of autism of an individual.

2) To adapt the tasks in this environment, provide individualized feedback based on the inferences made from these measurements.

3) To identify voice such as crying or shouting by using voice recognition IC that will also use to detect the autism state of an individual.

III. SYSTEM DESIGN

The VR-based system with adaptive response technology comprised of :

1) transmitter section that consists of a PC interfaced with the micro-controller used for eye tracking, voice recognition IC that too interfaced with micro-controller for voice recognition of an autistic peer, RFID reader that is used to navigate or to track an autistic individual to avoid Accidents, SD card for storing system database that is stored in the form of .wav file, LCD is used to visualize the output of the application.

2) Receiver section that consists of GSM interfaced with micro-controller that is used to send SMS to the respective authorities as per programmed.

IV. RESULTS AND DISCUSSION

This paper presents a VR-based engagement sensitive system with an adaptive response technology for intervention of individuals with ASD. The developed system can communicate with the participants and detect subtle variations in ones eye-physiological features, and viewing pattern. Also, it seamlessly integrates this information with the VR-platform to provide intelligent individualized adaptive response.

In this project two parameters are considered for the detection of the autism state of an individual, they are eye-gaze tracking and sound recognition that will detect autism state, to have proper controlling that will save the autistic children from self injury or accidents. Also if an individual is in its state of autism he can fall or accidents can cause from places

like balcony or terrace, so RFID is used to navigate or to track an autistic individual and to avoid accidents.

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