Eye Tracking Game and Its Applications in Various Fields

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***Abstract*— Eye tracking has the potential to characterize autism at a unique intermediate level, with links 'down' to underlying neurocognitive networks, as well as 'up' to everyday function and dysfunction. Because it is non-invasive and does not require advanced motor responses or language, eye tracking is particularly important for the study of young children and infants. In this article, we review eye tracking studies of young children with autism spectrum disorder (ASD) and children at risk for ASD. Reduced looking time at people and faces, as well as problems with disengagement of attention, appear to be among the earliest signs of ASD, emerging during the first year of life. In toddlers with ASD, altered looking patterns across facial parts such as the eyes and mouth have been found, together with limited orienting to biological motion. We provide a detailed discussion of these and other key findings and highlight methodological opportunities and challenges for eye tracking research of young children with ASD. We conclude that eye tracking can reveal important features of the complex picture of autism.**

Keywords—Eye tracking, Augmented Reality, Autism Spectrum Disorder.

I. INTRODUCTION

The developing game is called "eye tracking and its applications in various fields". Our game gets controlled via the eyes of the player as the eye tracking software and the game is calibrated in such a way. Our Aim/Action of the project is to develop the mind of the players and measure their brain development. Along with this we also measure the reaction time and precision of the players. Using these respective results, we can comprehend various inferences. We can say that the style of our game is an "Evaluating Game" where we engage the players in an immersive environment and use this to evaluate various aspects of our aim. The characteristic of our game that makes it stand out from other games is that it acts as an all-in-one game that not only evaluates the control and coordination of eyes for an autistic patient but also evaluates the precision and reaction time in military, motor sports, medical fields.

II. BACKGROUND STUDY

A. Literature Rivew

Autistic children have severe disorders of communication and social interaction. A game-based online learning intervention is a new approach to improve the social interaction skills of autistic children through appropriate socially stimulating learning materials. At the same time, it is also necessary to learn analysis of autistic children. This study used an eye-tracking technique to analyze the visual attention characteristics of autistic children while viewing different shapes and complexities of social stimuli. 23 autistic children were recruited as subjects, who used cartoons and real social stimuli as test material. A multifactorial within-subjects design was used. The results showed that autistic children paid more attention to cartoon stimuli than to real stimuli. As complexity increased, they spent more time looking at the eyes in the cartoon stimuli, while fixation durations decreased in the real stimuli. Autistic children paid more attention to the mouth than to the eyes. The results of this study can provide theoretical support for a game-based online learning intervention and provide guidance for the development of game-based e-learning packages and the design of intervention learning materials[1].

Eye Gaze Tracking is a technology that tracks a person's gaze using either contacts and invasive devices or expensive and non-standard devices. This article introduces a driver monitoring system that uses watching technology. In this method, the first step is to track a person's face from a live video series to locate the eye area and determine how many times the user blinks. The main goal is to use this eye tracking system to detect driver drowsiness while driving, thus reducing the number of car accidents that occur every day. It was implemented on a Raspberry pi board to create a more convenient portable system. If the flashing lasts more than 2 seconds, driver drowsiness is detected and the driver is alerted with an audio and steering wheel vibration warning.

The purpose of this study is to create and evaluate an eye tracking system specifically for children with autism spectrum disorders (ASD). New technology tracks the gaze of ASD children and provides feedback on their social interactions using a combination of computer vision techniques and machine learning algorithms. According to the authors' experiments with a group of ASD children, the eye-tracking system proved successful in measuring social interaction skills such as eye contact and gaze duration. The challenge of effectively assessing the social interaction skills of children with autism spectrum disorders (ASD) is the topic addressed in this research paper. These skills, including eye contact and gaze duration, are critical to the diagnosis and treatment of ASD. These are important signs of social interaction. However, effective assessment and monitoring of treatment progress can be difficult, as conventional methods of assessing these skills are often subjective and unreliable.[3]

That article [4] offers a solution to the problems of divided attention in children with autism spectrum disorders (ASD). The ability to direct attention with another person and share focus on an object or event is called joint attention. Joint attention is a challenge for many children with ASD, which can impair their ability to communicate and interact with others. The authors suggest that this problem can be solved by creating a virtual reality (VR) game specifically designed to help the joint attention skills of ASD youth. The VR game uses eye-tracking technology to give real-time feedback to the youngster and adjust the difficulty of the game based on how well the child is doing.

The authors [5] suggest that this problem (ASD) can be solved by creating a multi-user desktop application specifically designed to help social attention coordination skills in youth with ASD. Desktop technology often includes large screens, touch-sensitive surfaces, and various input devices such as cameras and microphones. These technologies allow multiple users to interact with digital content and with each other in a shared physical space. The desktop application provides an interactive environment for children with ASD to practice social attention coordination skills without forcing them to follow a gaze, which can be distracting for some children with ASD. The ability to provide real-time feedback, a controlled and safe environment, and the potential for higher motivation and engagement compared to traditional training methods are some of the potential benefits the authors discuss of using desktop technology to train social attention coordination.

The purpose of this article [6] is to discuss autism spectrum disorder, which is a reduced sensitivity to eye gaze cues (ASD) in children. The authors recommend the use of "serious game technology" (ie, video games designed specifically for educational or therapeutic purposes) to help children with ASD become more sensitive to gaze. They describe the research methodology of a phase I randomized controlled trial in which children with ASD participate in a serious game with eye gaze tasks. Some people with autism struggle to recognize and understand visual gaze. This can make it difficult to communicate, interact with others, and function as a whole. The authors believe that youth's ability to understand and respond to eye gaze cues in social settings helps more than typical therapeutic techniques. Research suggests using serious gaming technology to teach autistic children to understand eye gaze.

A study of gaze patterns of autistic children during interaction with robots. The authors [7] used eye gaze analysis to assess how well robots promoted social engagement with autistic children. The publication may discuss research procedures, results of eye gaze analysis, and new information on the use of robots to promote social contact in children with autism. According to the authors, using robots as a non-threatening, controllable social partner can help autistic youth interact more socially. The approach is based on the idea that autistic children benefit from interacting with robots in a safe and controlled environment, which can help them gain confidence and improve their social skills. Based on the results of eye gaze analysis and other metrics that were used to evaluate the effects of robot-child interaction.

This study [8] investigates how fuzzy logic can be used to determine what people with autism spectrum disorder (ASD) look at when performing actions. The authors aim to improve our knowledge of the specific difficulties faced by people with ASD by using eye gaze analysis as a technique to study how people with the condition perform tasks. The problem is the lack of knowledge about how people with autism spectrum disorder (ASD) behave when performing tasks. It can be difficult for researchers to analyze these questions without access to detailed and comprehensive data about an individual's behavior on tasks, as individuals with ASD often face specific challenges that can interfere with their ability to complete tasks. By creating a fuzzy logic-based method to assess people with an ASD perspective on how they perform these activities, the authors hope to solve this problem and increase our knowledge of the difficulties and behaviors these people face.

III. PROPOSED METHODLOGY

A. RULES OF PROGRESSION

The game starts with the first part where we evaluate the control and coordination of eyes via tracking. Here an object is to be dragged along a specific track in the least time while achieving high accuracy. After this we enter the second part of our game where we evaluate the reaction time of the player via tracking. Here the player has to track objects whose color are changing rapidly at regular intervals as fast as possible.

B. Challenge Mechanics

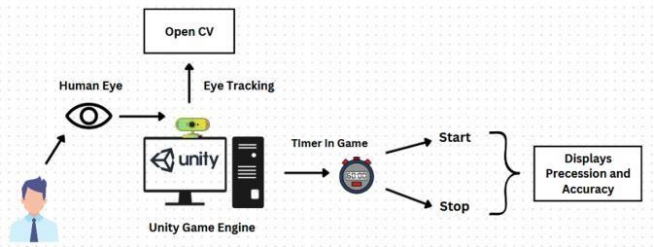
In all the whole game can be considered as competitive and challenging as better the score in the end more fit and agile a player is considered. Tracking objects along a path in least time with high accuracy is quite difficult and also having less reaction time while tracking fast changing objects makes this game extremely challenging. Although being challenging it also provide an easy and attractive playful environment for mentally challenged players.

C. *The premise*

Our game is two folds, first where we evaluate the control and coordination of eyes via tracking an object precisely along a specific predefined track secondly, we evaluate the reaction time of the player by tracking fast moving/changing object as fast and accurate as possible.

- Our game acts as an evaluating criterion in various fields like military, medical, motor sports.
- It acts as a measure of brain development for challenged patients.
- It increases concentration and helps in development of mind.
- It evaluates players in the form of measurable value making it competitive.
- Criteria of evolution for mentally challenged patients.
- Measure of precision accuracy.
- Evaluating reaction time.
- Measure of concentration.
- Measure of endurance

D. *Architecture Diagram*



IV. IMPLEMENTATION

A. UNITY

Unity acts as a front-end for the users, bearing all the basic authentications like login and register. It also contains the main game menu where all the games can be chosen from, to play. It also contains the page from where we can access the analytics of the user after each game is played.

B. *Node JS*

We use Node JS as a medium to connect our front-end (Unity) with our back-end (Mongo DB). Here we associate each user login with a session cookie that not only provides authorisation facility but also tracks the user data which can further be sent to the database. Using the same we can also track the session time out if the game is kept idle for more time. We are further using Chart JS for the analytics part of our game which is very crucial to gather inference from.

C. *Mongo DB*

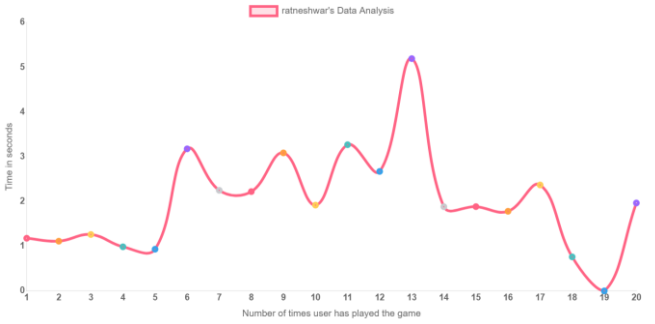
We are using Mongo DB as our database for the game. We have a USERS schema (table) where we store each users authentication credentials with the password in encrypted format. Then we have separate schemas for each of the games. The STOPWATCH schema stores the reaction time of each user with its username. This is then used to plot the graph with the help of Chart JS.

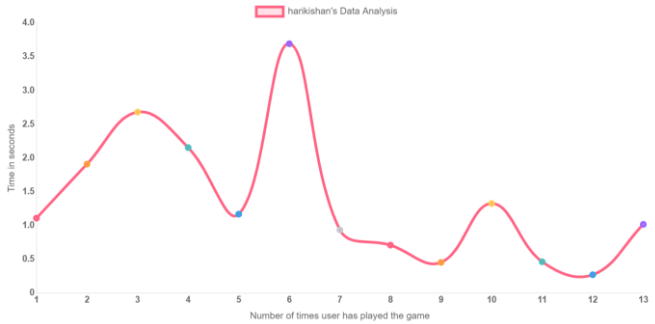
V. EXPERIMENT

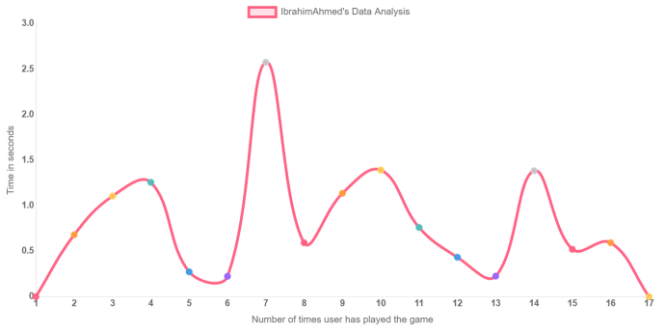
We have developed two games one is stop watch and one more is coin collection using cursor-follow. At first the autistic children's username is created and registered and then they are able to login and access the right to play the game through their eyes. Challenges that the child will go through is that he/she has to start the game and stop the game in a very less time, from this we can calculate the reaction time and we can plot the chart to analyze how the child is playing the game. If the reaction time is reducing then he/she is improving, no need of medication else, they have to undergo through medication. Second game (this is in developing stage) is about collecting coins, where we have used good graphics to attract the child to play the game and concentrate on the game, after collecting all the coins, score will be displayed and stored in the mongo dB database. All the data's which are stored in the database are plotted with graphs to visualize it.

VI. RESULT

Below are the charts of different users (autistic children).
As we can infer from the graphs that it records the reaction time of the user with respect to each game trial that they play. From this we can deduce that whether there is any improvement in their performance i.e., whether their reaction time decreases with the increase in the number of game trials. Doctors can perform analysis with the help of these graphs and suggest the various steps that is supposed to be taken in the future. Doctors can also monitor whether if the patient is playing the game consistently.







VII. Conclusion

Overall, an eye-tracking game for autistic children can be a valuable tool for improving attention and concentration, but it should be part of a comprehensive and individualized treatment plan. However, it's important to consider the specific needs and preferences of the individual child, as not all autistic children have the same sensory and cognitive profiles. It's also important to involve parents, caregivers, and professionals in the design process to ensure that the

game is appropriate and effective for the child. Doctors can perform analysis with the help of the graphs and suggest the various steps that is supposed to be taken in the future. Doctors can also monitor whether if the patient is playing the game consistently.

VIII. Future Work

In the future we aim to develop more number of different attractive games that can seek the attention of the child. We further also aim to integrate voice command typing/movement to our games. We also aim to integrate the whole system as a unified app/tool and monetize it to the world.

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