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Fine Motor Therapy Using Avatar-based AI for Autistic Children (Virtual Reality)

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Abstract

People who have autism spectrum disorder (ASD) frequently encounter situations in which they must give answers but are unsure of how to do so, such as questions from strangers about routine daily activities. ASD is a spectrum disorder that is characterised by impairments in social interaction and repetitive patterns of behaviour. The potential of the experience as a learning tool was increased with the addition of virtual reality (VR) support, which increased the experience's sense of presence and realism. Research that aims to use technology to improve social and communication deficits in autistic children is currently in progress. Immersive virtual reality (VR) is a relatively new technology that may be an effective therapy tool for helping autistic youngsters learn a variety of skills. The interactive scenario-based VR system described in this research was created to help autistic kids communicate more effectively. The HTC Vive Pro serves as the virtual reality headset for the game, which is currently being created using the Unity game engine. In order to test this "REAL-TIME project" and confirm the impact of the immersive environment on the social performance of autistic children, the system makes use of speech recognition to allow natural interaction and turn-taking. In this project, we create and model a virtual kind of fine motor therapy for kids. The kids will get to experience an immersive VR environment full with fun games, interactions, and educational opportunities.

Keywords: VR (VirtualReality), Blender, Unity, iClone, Shapepuzzle, Ringtower, Color Separation, 3D Environment.

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Introduction

A spectrum of neurodevelopmental problems known as autism spectrum disorder (ASD) are characterised by difficulties with social communication and the prevalence of repetitive behaviour. It is a neurological and developmental condition that has an impact on how people behave, connect with others, and communicate. As a result of the vast variety in the nature and severity of symptoms, it is classified as a "spectrum disorder." Others may struggle greatly with social connection, have poor expressive language, and engage in repetitive behaviours like whirling toys, opening and closing doors or drawers, head banging, repeating the same thing, etc. The number of papers incorporating computer-based or VR/AR examinations and innovations involving people with autism has dramatically expanded during the past ten years. In this project, we are primarily focusing on virtual fine motor treatment for kids. They will therefore undergo the therapy with AI support in Virtual Reality in accordance with the segmentation done based on the children's level (VR).

Literature Survey

1. Virtual Avatar-Based Life Coaching for Children with Autism Spectrum

Author Name:- Fengfeng Kel. Jewoong Moonl, and Zlatko Sokolik

Year: 2021 - In this research, the authors discuss how rapidly evolving computer and mobile technology have made it possible for people facing a range of physical and mental health issues to use coaching systems. The goal of this article is to review current research on the use of computer technologies based on virtual avatars to enhance social and communication skills in children with autism spectrum disorder (ASD) and to outline the research required to develop the next-generation virtual avatar-based life coaching system for ASD. Is a neurological and developmental condition that can have a substantial impact on how people behave and socialise. It could greatly improve the emotional and mental health of kids with ASD while also lowering the expense of autism care.

Authors Names:- Behnaz Nojavanasghari, Louis Philippe Morency, Charles E. Hughes

Year:- 2021 - They have demonstrated in this article how Avatar-mediated and virtual settings offer a special potential for fostering social skills in autistic youngsters. The "Exceptionally Social" interactive system, which uses avatars to mediate human-to-human interactions for social skills training for kids with autism, is the subject of this research. The following features are intended to be provided by this system: (1) allows kids to practise social skills in a secure setting and in a range of situations. (2) based on the child's emotive states, alters the dynamics of the encounters. (3) gives kids visual assistance to teach them various social skills and to speed up their learning.

By offering real-time input on a child's emotive states and recommending suitable visual supports through a recommendation system, (4) lessens the cognitive load on the interactor (a trained human orchestrating the avatars activities). Autism is a term used to describe a group of brain development abnormalities that affect social interaction and communication.

Author's Names:- Fengfeng Ke a & Tami Im a

Year:- 2020 - The utilisation of a desktop virtual reality (VR) learning environment for children with autism spectrum disorder to enhance socially oriented role-playing, gaming, and design was examined in this study (ASD). The researchers built the VR learning environment using Open Simulator. Sev This virtual reality-based social skills programme involved children with ASD aged 10 to 14 and lasted, on average, 20 hours. Screen recording, pre- and post-intervention observations, and play - and design-oriented social skill enactment were used to collect data. Social communication and skills questionnaires in comparison to the baseline phase, participants fared well in the intervention phase with their social skills.

The results offered early support for the use of a VR-based social skills learning environment for kids with ASD. All racial, ethnic, and socioeconomic groups are affected by autism spectrum disorder (ASD), which affects 1 in 54 children in the United States (Centers for Disease Control and Prevention (CDC) 280). The fastest-growing segment of children with ASD, 44 percent of whom had IQ scores in the average to above-average range (CDC, 2020, Ran et al. 2008).

Authors' Names: Ali Adjorlu, Aishah Hussain, Camilla Modekjært. Nicoline Warming Austads

Year:- 2021 - In this research, the authors describe a study that was done to determine whether it would be possible to teach social skills to children with autism spectrum disorder using a Head-Mounted Display (HMD)-based Virtual Reality (VR) application (ASD). An HMD VR-based social tale application was created in partnership with teachers

at a school for kids and teens with mental illnesses with the aim of teaching kids with ASD about sharing, taking turns, and theory of mind. The application was assessed by two teachers who led social story sessions with a total of five ASD-diagnosed students using a Mixed Method Sequential Explanatory Design.

The findings show that a VR intervention using an HMD has the ability to teach proper social conduct. Social interaction and communication are two of the main weaknesses of people with ASD, according to the most recent edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5).

Authors Names:- M. Bellanil, 1. Fornasari 2, L. Chittaro 3 and P. Brambilla 4,5)

Year:- 2021 - A category of persistent developmental disorders known as autism spectrum disorders (ASD) affects more boys than girls and is characterised by core abnormalities in three areas, including social interaction, communication, and repetitive or stereotypical behaviour (American Psychiatric Association, 2000). (4.1). Incidence of ASDs has increased significantly during the past few decades, ranging from 4 per 10,000 to 6 per 1,000 children (Lasalvia & Tansella 2009). Faras et al. 2010; Pejovic Milovancevic et al. 2009). There is evidence that autism may be inherited, yet the causes are still mostly unclear.

Problem Definition

1. Problem Statement

Children with autism frequently struggle to make eye contact, communicate effectively, and engage in repetitive actions like flailing arms. Head thumping or repeatedly whirling an item. It is challenging to care for them, and these habits are challenging to alter. It also takes a long time for their therapeutic abilities to develop. A severe developmental disorder that affects a person's capacity for interaction and communication the neurological system is impacted by autism spectrum disorder, which also has an impact on the sufferer's general cognitive, emotional, social, and physical health. This project aims to make it simpler for kids with autism to interact with others. Social interaction and emotional issues are the main disorder. Children with autism were divided into mild, medium, and severe categories based on their difficulties. Therapy, both psychological and physical, is the answer to this issue Virtual assistants are necessary for youngsters with autism, according to cognitive scientists. Over the past ten years, the field of virtual humans has advanced significantly from a conceptual, design, and empirical standpoint. Due to the lack of commercial technology that can be used to create avatars that can look like and behave-via real-time tracking-like the user, embodied agents, which are digital models driven by algorithms, and avatars, which are digital models driven by human interaction with the world in their presence, have both been taken into consideration in this field of study.

2. Existing Designs

There is ongoing study into how to use technology to help autistic children with their social and communication difficulties. Immersive virtual reality (VR) is a relatively new technology that has the potential to be an effective therapy tool for aiding the development of a number of skills in autistic children. The interactive scenario-based VR system discussed in this study was developed to improve communication for autistic children. In studies, users using computer-augmented virtual environments (CAVEs) outperformed those using head-mounted displays (HMDs) or normal desktop computers. According to the research, immersive VR may be more engaging and fulfilling for children with autism than desktop. Particularly VR has been investigated recently as a possible helpful device to promote social relationships in this population. Given that young children frequently display atypical eye movements during social interactions, When creating intervention plans, it can be helpful to keep an eye on their gaze. But the VR-based solutions that are currently available are designed to chain learning through a user's performance, allowing for relatively little individualization. Due to the promise of VR-based social interaction and the importance of tracking eye-gaze in real-time, a novel VR-based dynamic eye tracking system is developed in this work.

Requirement Analysis and Specifications

1. Technology Stack

Users join 3D environments where they can move about freely and participate in activities to do tasks and achieve goals. VR is distinct from mixed reality (MR), which is referred to as extended reality, and augmented reality (AR), where users interact with digital elements that are tethered to the real world while remaining in the real world (XR).

2. Blender

A free and open-source 3D computer graphics tool for making animated movies is called Blender. Video games, virtual reality, motion graphics, interactive 3D applications, and visual effects.

3. Unity

Cross-platform game engine Unity was introduced as a Mac OS X game engine at the Apple Worldwide Developers Conference in June 2005. Since then, the engine has gradually been expanded to support a number of PC, mobile, console, and virtual reality platforms.

4. Character Creator 3 (CC3)

Software offers designers a complete character creation solution that makes it simple to create, import, and alter realistic or stylized character assets for use with iClone.

5. iClone7

By importing common 3D file types, such as FBX, and using a 3D video game engine with functionality like full facial and skeletal animation of human and animal figures, lip-syncing, a timeline for editing and merging motions, a Python API, and a scripting language (Lua) for character interaction, real-time playback is made possible.

6. Maximum Requirements for VR

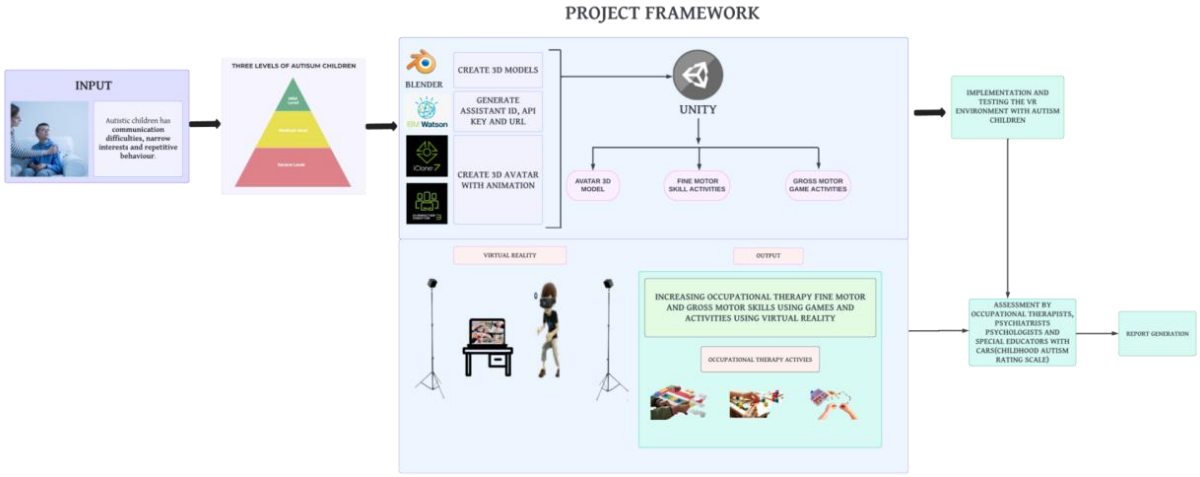
Intel i5-4590 or AMD Ryzen 5 1500X processor; NVIDIA GTX 1060 or AMD Radeon RX 480 graphics card; or NVIDIA GTX 970 alternative graphics card or AMD Radeon R9 290 or higher.

RAM memory: 16 GB

System of operation: Windows 10

There has one USB 3.0 port (3x USB for Oculus Rift C1)

System Framework



1. Displays

The HMD, together with all the sensors and controllers, is included in the VR setup, which provides a full-screen, immersive experience. The HTC VivePro HMD is the primary display, and the secondary display is a standard monitor display.

2. Interaction VR

The use of computer technology to create a simulated environment is known as virtual reality (VR). The head-mounted display is the element of virtual reality that is most easily recognised (HMD). The two primary methods used by VR content producers are computer generation, in which every region of the world is created artificially, designed, and interactively integrated using code, and 360-degree video, in which the video is captured using an omnidirectional camera and edited to create an immersive experience.

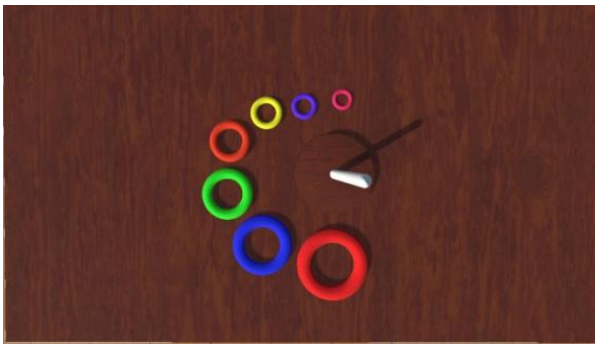
3. Shape Puzzle

Children will observe a variety of differently coloured and shaped puzzles in this activity, which will immediately draw them approach the game to play.



4. Tower Ring

This is a highly popular children's toy that comes with many rings of all sizes and brilliant colours that can be placed on a stand. Children can pick up the rings, stack them on the stand, and place them there.



5. Color Separation

There will be three containers in this task, each containing two or three boxes of a different colour. The goal of this game is to select a colour box, match it to the other container's colour, and place it inside.



Result

When the project was implemented, people welcomed it and showed their thanks. The project was deployed in any VR implementation and the occupational therapy environment was finished. The figures below display the results.



3D Avatar

Conclusion and Future Work

In this project, we created an interactive VR-based (verbal/nonverbal) system to demonstrate how well children with autism can communicate using a predetermined greeting scenario. The purpose of this approach is to assist autistic children in adjusting to new and unfamiliar circumstances, improve their capacity to function in social situations, and boost their social skills. In the future, we may incorporate a variety of languages into the system to ensure that language is not an obstacle to the learning process for these special needs kids. In order to improve the children's immersive interaction with the virtual character, we might also add roleplay to the 3D avatar. Children's talents will be improved in a variety of ways as a result of this.

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