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The use of augmented reality in assessing and training children with attention deficit hyperactivity disorder

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ABSTRACT

Attention deficit hyperactivity disorder (ADHD) is a serious issue that must be addressed in the modern world. Treatment for ADHD is challenging because it is costly, has adverse effects, might not be successful, and is not considered an emergency. The reason that ADHD is hard to manage is because it causes people-especially children-to make impulsive decisions that hinder their ability to succeed in school, the workplace, and other areas of life. As an alternative approach, neurofeedback therapy or play therapy, which relies on real-time feedback of an individual's brainwave activity typically collected through electroencephalogram (EEG), has demonstrated promising outcomes in the treatment of mental disorders and enhancing cognitive capabilities. On the other hand, prolonged exposure to repetitive feedback might result in lower engagement since people may become disinterested in the process and find it difficult to continue participating. An extensive assessment on the use of augmented reality (AR) in the context of pediatric ADHD has been carried out, with an emphasis on the benefits of creating games specifically for kids with ADHD. By using AR technology in a group of children, the goal of this study was to investigate the basic characteristics of AR systems that aid in the identification and treatment of ADHD in children.

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1. INTRODUCTION

Augmented reality (AR) refers to a real-time, direct or indirect depiction of the real world that has been altered or augmented with computer-generated data. By fusing virtual information with their immediate surroundings, AR allows users to interact more deeply and perceive the real world more fully [1], [2]. Like virtual reality (VR), AR has the ability to stimulate all five senses. Because AR adds useful information to the real world, it can also help compensate for those senses that are compromised [3], [4]. Additionally, AR can be used in both indoor and outdoor settings because its main benefit is its ability to interact with the real world. A fixed AR system may need moving the entire system configuration because it is locked to a single spot and restricts user mobility to predetermined zones. These systems do, however, have the benefit of continuing to be reliable and consistent. When combined with a stationary setup, action tracking offers additional controls and processing power to improve the AR experience's realism. It is possible to use fixed AR outside as well as indoors. On the other hand, mobile AR differs from AR on mobile phones in that it allows users to set up the AR system wherever they choose [5]. Although this may result in a reduction in computational power, users can utilize this interface with freedom because the portable technology required to implement the AR system is easily accessible wherever they choose. AR on the move, or mobile AR, is

widely used, and its main platform is smartphones because almost everyone in developed countries owns a cell phone that can be used as a "computer". Static and mobile AR components is used to create mixed reality (MR). The AR system can be transitioned more smoothly, and mobile AR is a sensible option because it doesn't require significant advancements in wearable technology [6].

Normally, the user has to carry the computer system, but these difficulties can be avoided if the apparatus is built inside an automobile. However, the viability of mixed deployable AR has greatly grown because to developments in portable technology. A viewfinder, which is typically a camera, is required to record environmental data because AR replaces real-world elements with virtual ones or superimposes virtual items on the real world. Users can then experience AR in two ways: through smart device display, where virtual objects appear on the screen, or through mounted spatial view, which facilitates spatial AR. Thanks to continuous technical breakthroughs, state-of-the-art AR technology has been designed with portable screens in mind, combining the advantages of both approaches [7]. Holograms and video projection are examples of optical components used in spatial AR to project information directly onto actual objects without the need for a traditional monitor. Multiple people collaborating on a single virtual object could be made possible with this approach's potential for further advancement [8].

By bridging the gap between the virtual and the real world, AR makes it easier to extrapolate from real-world circumstances to digital information. It also capitalizes on immersive visual features that coincide with the talents frequently observed in individuals with attention deficit hyperactivity disorder (ADHD), which increases attention and engagement. Deeper learning experiences and increased stimulation might result from the integration of new technologies. Moreover, AR's adaptability makes it possible to improve tried-and-true evidence-based healthcare techniques like video modeling and picture prompting [9].

In the field of healthcare, AR technology is still in its infancy, especially when it comes to ADHD. A significant number of youngsters suffer with ADHD, a neurodevelopmental disorder (NDD) that highlights the need for prompt intervention to stop it from continuing into adulthood. Non-pharmacological approaches such as behavioral training, neurofeedback, play therapy and cognitive training have gained popularity recently as beneficial substitutes that therapists support in order to lessen the need for medication in children. However, research indicates that patients' motivation, focus, and attention spans can be improved by simply adding an AR component to current therapy [10]. Since the results reported here just scratch the surface of the therapies' potential, the future looks bright for the clinical implementation of AR-based treatments. The AR application is designed to promote cognitive performance in people with ADHD. It is especially intended for patients who are 8 years of age and older. It helps with tasks like attention, impulsivity reduction, and planning, organizing, and carrying out everyday activities.

- AR technology is particularly good at producing aesthetically pleasing virtual worlds that draw users in and increase interaction.
- AR provides a means for users to engage with virtual items in the actual world, enabling a smooth transition between virtual and real-world experiences.
- AR is a state-of-the-art, highly technologically advanced technology that simulates three-dimensional (3D) settings, allowing users to fully immerse themselves and have realistic experiences.

2. RELATED WORK

Treating ADHD in childhood is the main way to stop it from continuing into adulthood, despite the fact that it affects a significant number of children [11]. Since therapists are beginning to realize that non-pharmacological therapies work better than drugs for children and can often reduce the risk of reliance, non-pharmacological therapies have gained popularity [12]. These treatments include behavioral therapy, play therapy, neurofeedback, and cognitive training. In addition to these, a number of non-pharmacological therapies have been developed to address this NDD, including robotics, the internet of things (IoT), artificial intelligence (AI), VR, AR, MR, and extended reality (XR).

We provide an overview of AR technology use from the patient's perspective in this study and compare it to the benefits and drawbacks of current practices. The purpose of this article is to give readers insight into the best methods for using AR to treat ADHD [13]. In light of the following important questions, the systematic review is organized around the chosen works:

- Which research has focused on the use of AR to improve the quality of life for those with the ADHD?
- What crucial areas of the patients' recovery, such their social skills, their capacity for learning, and their ability to finish tasks, have these research enhanced? Which AR technology were used for these?
- In what ways have these research been beneficial?
- Which major drawbacks or difficulties have these research pointed out?

In order to shed light on the potential advantages and disadvantages of AR in the context of ADHD rehabilitation, the systematic review will address these concerns in order to provide a thorough understanding of the application [14]. ADHD treatments aim to prevent academic failure and social disorders. In recent years, as an adjuvant to non-pharmacological therapies (such as psychological, psychoeducational, and occupational therapies), technical help has been provided through the use of developing technologies like IoT, AI, VR, AR, MR, XR, as well as, particular, robots. They looked into the feasibility of deploying a social robot during speech therapy interventions after having used robotic aid in speech therapy for children with ADHD.

- Inattentive type: the main difficulty faced by members of this subtype is inattention. Individuals may experience challenges maintaining concentration, completing assignments, and planning events.
- Hyperactive-impulsive type: impulsivity and hyperactivity define this subtype. It can be difficult for people of this kind to manage their impulses because they are frequently impulsive, restless, and fidgety.
- Combination type: this type combines signs of impulsivity and hyperactivity. A wider spectrum of ADHD symptoms may be experienced by those who belong to the combination type, which combines several of these traits.

As part of the study, these kids took part in one-on-one sessions with the nasal airway obstruction (NAO) robot [15]. Children's motivation and involvement increased with NAO, and the treatment focused on writing and attention. Handwriting is a complex perceptual-motor skill that requires attention, perception, language, and fine motor abilities [16]. When handwriting becomes problematic, a condition known as dysgraphia may emerge, which is described as a quality or speed impairment in creating adequately smooth and automatic handwriting [17]. Numerous advancements in robotics have been developed to support the fine motor skills improvement of individuals with motor impairments. Among these innovations, the effectiveness of a robotic handwriting aid in helping children with motor deficiencies improve their handwriting was investigated in a study involving eighteen participants who had conditions like cerebral palsy (CP), autism spectrum disorder (ASD), attention deficit disorder (ADD), and ADHD [18]. A robotic system that was specifically created for the study was used, and it took place over the course of four to eight weeks. Every day, the participants participated in fifteen to twenty sessions, each lasting twenty to thirty minutes. This robotic system's software generated a three-dimensional haptic path. The user's input, which included entering letters, numbers, and punctuation marks, was evaluated to create this path. A variety of parameters were considered in the evaluation of the haptic route, including the user's left- or right-handedness, typing speed, glyph size, number of attempts, force used, and stroke patterns.

Consistent observation of the patient's behavior is essential to develop a thorough understanding of the disorder's causes, create intervention strategies that work for treating ADHD in children, and choose the best resources. Along with issues with social and communication skills, emotional regulation is a common challenge for children with ADHD. When working with children who have ADHD, therapists frequently have communication challenges. This is mainly because these children are highly expressive and have erratic speech patterns, which can negatively impact the child's comfort level. The academic and social integration of the kid may be severely impacted by the behavioral and emotional issues that frequently accompany ADHD. The study makes the claim that emotions can be identified by the examination of visual and physiological data [19]. But kids with extreme ADHD could have trouble controlling their facial expressions, which can make it difficult for them to identify and communicate their feelings. The purpose of this research is to use IoT robotic devices to predict ADHD and treat emotional issues.

Treatments for ASD and ADHD are expected to benefit from experiments centered on human-robot communication and attention modeling [20]. The cognitive architecture of the Bioloid employs a motion selection module for a number of purposes. When the kids are engaged in these activities, the robot records the duration of their attention spans and stores the data in its memory. The implementation of the interaction scenario tasks, which were directed by the robot's short-term memory, was aided by the Bioloid's long-term memory. They offer a novel technique for diagnosing ADHD in kids [21]. This study presents the creation of a robotic helper that uses machine learning techniques in addition to an evaluation tool that is akin to a game and is intended to efficiently record children's movements in order to analyze symptoms of ADHD. Thanks to its sensors, the behavior of the kids may be automatically measured by the robot Silbot. Children participate in activities led by Silbot during the assessment as a part of the evaluation procedure. These exercises are intended to show how three primary characteristics-deficits in executive function and working memory, hyperactivity and impulsivity, and inattentiveness—can be used to assess ADHD. As the youngster advances through the levels, the test's complexity progressively rises, and passing each test is a prerequisite.

Currently, a strategy for treating children with ADHD is being developed. In order to implement this technology, AR glasses and a single-channel, non-invasive brain-computer interface (BCI) based on steady-state theory must be created. The foundation for visually evoked potentials is the use of steady-state visual evoked potentials (SSVEPs) [22]. By focusing on flashing stimuli and employing eye blinks through

the BCI channel, an inexperienced user can operate a robot (SanBot Elf) in this system. This method provides an efficient way to treat hyperactivity, impulsivity, and focus issues in ADHD patients. The goal of the AR application is to create a rehabilitation robot that can be remotely controlled by a child and can respond to commands via speech or movement, depending on the user's preferred behaviors. By guaranteeing active patient participation, this strategy eventually improves the efficacy of the rehabilitation process. The Raspberry Pi server received data from the robot and sent it over WiFi in JSON format. There is no need for any prior training for the feature extraction algorithm used here. The user can concurrently sense the robot's motions and visual stimuli thanks to optical see-through AR technology. Four ADHD patients, ages six to eight, underwent initial testing, and the results showed great promise.

2.1. Augmented reality implication on attention deficit hyperactivity disorder

Real and virtual data are merged in what Milgram called a "virtuality continuum". The integration of a certain set of virtual features into the physical environment is known as AR. As a result, AR refers to a collection of technical instruments that seamlessly combine the virtual and the actual world in three dimensions [23]. An important turning point in AR was reached in 1968 with Sutherland's groundbreaking technological development of an optical see-through head-mounted display (HMD). However, other display formats, including hand-held or spatial displays, can also be used in addition to HMD to enjoy AR. When explained, the appeal of AR to people with ADHD becomes more evident. Studies show that kids with ADHD frequently struggle when it comes to creative, unstructured pretend play. This kind of play is thought to be a factor in the decline of social connection and is acknowledged for its developmental significance in the formation of essential life skills. Studies have indicated that the use of AR technology improves kids' impromptu involvement in solo and group pretend play. A 3D AR-based application for human-computer interaction was presented by Kerdvibulvech *et al*. who emphasized the technology's potential for social innovation. In order to assess the learning process through the use of mobile AR applications, Lumbreras *et al*. help individuals engage with others [24]. Using AR systems as a teaching tool, the ability of three elementary-aged ADHD children to complete a chain assignment is examined [25]. A mobile AR application created as a game is evaluated to determine how it affects children's interaction, taking into account the difficulties that children with ADHD have in reading facial expressions and the emotions connected with them [26].

2.2. Augmented reality practical implementation

After the game therapy sessions, the experimental group's attention test performance returned to normal, and their omission/commission errors decreased significantly. Furthermore, the results of an interactive metronome test revealed a significantly shorter mean response time in addition to a decrease in error rates. The game is incredibly important because it allows people to receive this treatment at home without having to be constantly monitored by doctors. To the best of our knowledge, this is one of the first studies to use a MR HMD to treat ADHD in children, demonstrating the device's potential as an effective treatment for ADHD-diagnosed youngsters. Symptoms of impulsivity, hyperactivity, and inattention are common in individuals with ADHD, a NDD [27]. A well-established method called cognitive behavioral therapy can help people with ADHD change the way they think and behave. People with ADHD frequently need psychological treatment. Traditional cognitive behavioral therapies do have one significant drawback, though, which is that therapists may find it challenging to maximize neuropsychological involvement while following a pre-established treatment plan. This implies that generating a vivid mental picture to nudge patients' thoughts in the right direction may prove difficult for therapists. In response to the limitations of traditional cognitive-behavioral therapies, such as issues with therapist availability, accessibility, and competency level, a gamification paradigm known as "AR-therapist" emerged. This technology uses AR to immerse patients in both virtual and real-world game scenarios. This strategy addresses the limitations of traditional cognitive-behavioral therapies by allowing for real-time evaluations of patients' progress during therapy sessions.

Arylsulfatase G (ARSG) development software architecture was suggested by the researchers as a solution to this problem. They placed a strong emphasis on how important software development tools are to the process's validation. By utilizing the designated software architecture to develop an ARSG creation process, the design approach aimed to give users a formal and automated way to create ARSGs. The consequence of this was the creation of the ZeusAR development methodology and architecture, which is independent of software development tools and programming languages [28]. In order to demonstrate the efficacy of their methodology, the researchers carried out a case study in which they created geometry ARSGs to help high school pupils comprehend geometric shapes and their characteristics. They developed a tool that generated augmented reality study games (ARSGs) while adhering to the desired architecture. A qualitative evaluation was conducted to determine the usefulness and efficacy of the ZeusAR tool. The

evaluation comprised information obtained from a survey administered to a group of geometry instructors using the system usability scale (SUS). Setup and usability were among the many factors taken into account. Furthermore, a group of researchers and software engineers evaluated the ZeusAR tool's effectiveness in terms of game production time.

Using a multiplayer AR game equipped with haptic feedback and BCI, the researchers proposed a novel way to treat ADHD in children. With the help of seven domain experts with a range of relevant experiences, they conducted exploratory user research to evaluate their methodology [29]. According to the results, different technologies may live in harmony with one another, and the game's haptic elements and multiplayer mode are considered fun supplements to more traditional therapy methods. Potential avenues for future research in patient-centered neurofeedback systems for the treatment of ADHD are paved by this study.

This method makes advantage of the fundamental ideas of operant conditioning by giving users immediate feedback on their brainwave activity, which is frequently captured using an electroencephalogram (EEG). Long stretches of the same feedback, however, have been shown to be boring and cause users to lose interest in continuing to interact. Graphical user interfaces and captivating games have been created to solve this problem and improve the efficacy of therapy. These methods are extended and research engagement is increased through the use of AR within the context of a virtual telekinetic game. Realistic object merging between virtual and real-world elements is the aim of AR applications [30]. Evaluating lighting conditions effectively is crucial to creating realistic AR experiences. The researchers in this study provide a method that quickly evaluates lighting conditions in real-world scenarios from a single image by employing data from an optional support plane that is supplied by sophisticated AR frameworks like ARKit and ARCore.

The most prevalent behavioral illness among children, according to a number of authors, is ADHD. There are a few things to take into account when correctly diagnosing ADHD in kids. Inattentiveness, distractibility, subpar academic performance, impulsivity, hyperactivity, and behavioral issues at home and at school are a few examples of these variables [31]. Video games played on VR technology are known as VR games. Player immersion is a major component of these games, and it is usually enhanced by the use of a HMD or other headgear that has one or more controllers and stereoscopic displays [32]. Singular value decomposition (SVD) was used by Eslami and Saeed to classify ADHD patients based on discrepancies between them. In a similar spirit, Sadatnezhad *et al*. used EEG waves and linear discriminant analysis to identify symptoms of ADHD. Similar techniques were also used by Ghassemi *et al*. to pinpoint features in EEG data linked to ADHD.

3. METHODOLOGY ADOPTED

They go one step further and use AR inside the framework of a virtual telekinetic game to boost engagement. Three elements make up the system: an AR mobile application to present the feedback, MATLAB to signal processing, and an Emotiv headset for EEG recording. A detailed description of the neurofeedback protocol, signal processing techniques, and software and hardware implementation is provided [33]. Their next move is to evaluate the nuances of the procedure by running a pilot trial with a sample of healthy kids. The results of the study showed that the standard method's instruments for differentiating between ADHD in children are not up to par with the needs for care. The researchers provide an alternate digital tool that they created using the AR foundation software development kit (SDK) in conjunction with the Unity3D game engine, and it is intended for use with Android mobile devices. The goal of this tool is to make the differential diagnostic procedure easier. By examining the family context, it helps psychologists make an early diagnosis of possible family-related problems that might be aggravating the patient's illness. It also provides a virtual substitute for the memory tile cognitive behavioral game. Through the use of AR smart glasses and flashing icons, the suggested system enables real-time control of a social robot by the user. This novel method improves user control and interaction, and the social robot has already shown promising results when used to treat ADHD. A one-month therapy program was carried out with 7 participants after an initial evaluation of the children's adherence to therapy, which involved 18 individuals [34], [35]. The youngsters were given different tasks to do during the tests according to how engaged they were. Results demonstrated that even with a very small number of therapy sessions, all participants improved on the various tests given, as measured by the Italian Battery for ADHD. Tables 1 and 2 shows the existing surveys on ADHD.

3.1. Types of games

3.1.1. Virtual reality games

Video games that are played using VR devices are called VR games. HMD or other headgear with stereoscopic displays and one or more controllers is widely used. For enhancing the player immersion in VR games [32].

- Players can experience an immersive three-dimensional world by using VR headsets with stereoscopic displays to play VR games.
- Positional tracking, which picks up on a player's head movement and direction of gaze, is a function found on most headsets. The four corners of the play area are equipped with cameras and sensors that are either external or built into the device itself to facilitate tracking.

3.1.2. Augmented reality games

Computer-generated content is combined with the actual world to create an interactive experience known as AR. A variety of sensory modalities, including as haptic, somatosensory, visual, auditory, and olfactory aspects, may be included in this content. This comes into the category of AR games.

- Enhancing natural environments or scenarios using AR creates more perceptually pleasant experiences.
- With the use of sophisticated AR technology, a user's physical environment can be made interactive and manipulable through the use of computer vision integration, AR camera integration with smartphone applications, and object recognition.

Table 1. Survey on existing research

Author	Methodology	Advantage	Research gap
[11]	HoloLens is used	It is widely used in medical. It is very helpful for patients.	Implementation of this technology in video game.
[3]	Prototype modeling is designed where planning, design and construction of the model is made.	It is used to scan the objects.	Addition of more objects may be considered.
[4]	AAR applications and BPSP's is used.	It is used for blind and partially sighted people.	The nature connectedness for BPSPs, the design of AAR.
[5]	HMD and AR are used.	it is used to increase the sound awareness of the deaf people.	The more diverse or complex sound of hearing.
[6]	SSEVP algorithm is used.	Robots are moved by blinking their eyes and focusing on flickering stimuli.	utilizing cutting-edge techniques to help youngsters with ADHD recover.
[8]	Conners' teacher rating scale (CTRS)	There are different tests conducted for tracking.	Focus could be levied on studies comparing treatment and control groups
[9]	Neurophysiological testing, AULA VR test.	Different analysis is performed on the test result.	A chance of improving the accuracy of diagnosis.
[10]	Clinical features of children, robotic trust intervention.	The youngster cooperated during the entire TruST-intervention.	The absence of ambulation and poor seated function.
[11]	Participants and group assignment.	Gross motor activity is going to be measured the children activities.	The greater levels of gross movement that don't interfere with academic performance were overlooked by the author.
[12]	to look into the long-term implications on the growing human brain of a reduced serotonin synthesis	The consequences of TPH1 mutations in mothers versus fathers were examined across all families.	Replication studies are required for ADHD patients.
[15]	The KIDSCREEN-10 was one of both qualitative and quantitative assessment tools we utilized to gauge people's quality of life.	Adolescents' quality of life is positively affected by the psycho-pedagogical intervention.	This treatment only focuses on writing and attention parameters.
[16]	A recently created triangular prism-shaped sensitized pencil is created.	inexpensive compared to similar developments	Multi-layer sustainable development model does not present yet.
[17]	intends to implement AI perception technology to help teachers address behavioral issues.	behavioral problems are closely examined	Majorly focuses on behavioral issues.
[18]	When used in a clinical setting, identifying a set of behavioral patterns associated with ADHD	Obtain satisfactory outcomes in the context of dynamic time warping (DTW) when compared to standard state-of-the-art procedures.	Deals only with emotional problems during ABHD
[19]	Examine how robot-assisted therapy (RAT) affects nonverbal kids with severe forms of ADHD ASD.	All set to go for RAT research.	Development and continuation of this research is still going on.
[21]	Robotic assistant using machine learning technology is demonstrated	To allow robotic assistance to engage in treatments for ADHD	The difficulty of the test increases as the child advances through the levels
[22]	Examine the VC's diagnostic validity in relation to a conventional continuous performance exam.	The notable variations in performance between the typical computerized environment and the virtual one	potential threat to internal validity as evidence for the external validity of this research
[23]	DJINNI comprises an innovative VR exposure therapy system	The feasible and effective AR/VR-based exposure therapy.	Do not differ on the cognitive absorption perceived by the children.

Table 2. Survey table

Author	Findings	Advantage	Research Gap
[25]	The prototype of augmented reality serious games (ARSG) improves the attention span of youngsters with ADHD.	Player focus and retention both rose.	Need to implement more ARSG
[26]	SSVEP paradigm to enhance the attention ability	High accuracy in terms of results.	Low-cost ADHD is not available
[27]	Both wireless wearable EEG recordings and the conners kiddie continuous performance test (K-CPT) were utilized.	measured brain activity in the continuous performance test (CPT) at different task rates	Not implemented on all types of tasks.
[28]	Examine the incorporation of an EEG-regulated serious gaming	demonstrates excellent accuracy when classifying EEG data to identify the appropriate type of game control.	Multiplayer game are not supported
[29]	Examine whether gcForest and fMRI data can be used to distinguish ADHD patients from healthy controls.	Outperforms the approaches that have been documented.	Functional PCA methods are not taken into consideration while processing fMRI data.
[31]	Driving behaviors may be utilized to identify ADHD	Driving patterns can be used to identify drivers with ADHD.	No any app to provide specific tips to drivers with ADHD
[32]	A framework for binary hypothesis testing is presented.	surpasses alternative cutting-edge techniques in terms of average accuracy.	Proper amount of data is required.

3.1.3. 2D–game

2D video games do not use 3D geometry; instead, they use two-dimensional pictures known as sprites. Because the camera, which is frequently an orthographic camera, lacks perspective. The games look as flat visuals on screen, depriving the viewer of the ability to perceive depth.

- Video games feature two-dimensional pictures that are flat to the millimeter, including flat characters, flat graphics, and a flat overall visual style.
- The environment found in 2D games is limited to two dimensions and has just two axes: X and Y.

3.1.4. 3D–game

3D images that include depth, breadth, and height. They are a defining feature of interactive computer entertainment games. Video games of this kind are renowned for producing realistic and immersive virtual environments.

- Three-dimensional graphics produced in three dimensions are included in this video game.
- A video game where the sense of three dimensions is enhanced by the use of stereographic depth effects.

3.2. Limitation

AR undoubtedly has its drawbacks and issues, just like any other technology. While there are many useful applications for mobile devices with AR capabilities, it's crucial to understand that technology improvements also present issues and concerns for society. Prior to AR's complete commercialization and incorporation into mainstream use, it is imperative to address a number of difficulties as it continues to develop and may even become more widely used. These concerns could involve, among other things, ethical, societal, and privacy difficulties.

- Progress in technology ought to prioritize enhancing comprehension of organic body motions, resulting in more lightweight and slender AR displays.
- Internet access is still a problem, particularly in environments where diagnosis is provided by healthcare providers and connectivity may be spotty.
- It is imperative to address the affordability of AR gadgets, since their exorbitant current costs may impede their widespread adoption, especially for those coping with health-related concerns.

4. RESULTS

A thorough survey was carried out by looking over 50 articles. Of these, 10 were found to be duplicates and were removed, and 8 were found to be irrelevant and were also removed. Of the articles that remained, 10 (33%) examined how well technologies could diagnose symptoms of ADHD, and another 10 articles (23%) examined how they could improve the process of diagnosing ADHD. The present study revealed a number of studies that used different methodologies to assess cognitive-based therapy procedures in an efficient manner. These techniques were used in a variety of games created to improve various diagnostic procedures for kids with ADHD. MR games, web-based AR, VR-CPT, VRC, and other techniques were among those found; they were all intended to treat the symptoms of ADHD.

5. CONCLUSION

The aim of this study was to use AR technology that a group of children in order to investigate the essential elements of AR systems that facilitate the identification and management of ADHD in children. Examining how well AR system manipulation exercises identify autism and enhance the lives of kids with ADHD was a major area of concern. Among other things, among the goals of the AR tasks were comprehending human emotions, conversing, and having conversations. This study thoroughly reviewed the usage of AR in ADHD therapy and investigated the advantages of incorporating AR into games created especially for kids with ADHD.

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