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Virtual and Augmented Realms: The Evolution of Video Games with VR and AR Technology

Ishika Tiwari

Department of Computer Science & Application

Dr. Vishwanath Karad MIT World Peace University, Pune, India

ishikatiwari0555@gmail.com

Dheeraj Solankar

Department of Computer Science & Application

Dr. Vishwanath Karad MIT World Peace University, Pune, India

dheerajdjsolanki1796@gmail.com

Dr. Rajeshree Khande

Department of Computer Science & Application

Dr. Vishwanath Karad MIT World Peace University, Pune, India

rajeshree.khande@mitwpu.edu.in

Abstract

The incorporation of virtual reality (VR) and augmented reality (AR) technologies into video games has transformed the industry. After the introduction of mobile phones and portable devices, the gaming industry saw a transformation in these new market platforms. Moreover, in recent years, another aspect, among many others, that has contributed to the enhancement of gamers' experiences is VR and AR. The growing popularity of VR and AR technologies, as

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well as developments in the technology, have resulted in a new era of gaming experiences that allow gamers to fully immerse themselves in digital settings. This research study looks at how video games have evolved with VR and AR technologies, covering the development of VR and AR devices and how they have affected game design [3][4]. Moreover, the study addresses the possible future of VR and AR in gaming, as well as their influence on the industry. We employed secondary data, such as surveys, and online data collection from numerous gamers to create this thorough study as we were dealing with such extensive subject. This research paper provides a comprehensive overview of the current state of VR and AR in video games and highlights the opportunities and challenges that lie ahead. Technology in the AR/VR space has been around for a very long time. It has changed to meet the demands of the users, offering a variety of gaming options and settings for everyone to enjoy and spend time in while embracing technological advancements that are enabling them to experience various situations. This study's conclusion is that AR/VR gaming has advanced significantly, and its future depends on a variety of aspects, including how it will impact learning and healthcare. As a result of the general public's interest in this industry and the development of numerous novel inventions to keep players engaged and craving more, VR hardware prices are lowering relatively.

Keywords — Video Games, Virtual Reality, Augmented Reality

I. INTRODUCTION

As a kind of entertainment, video games have become more and more well-liked over the past few decades. From the earliest arcade games to the current console and PC gaming period, video games have captured the attention of players all over the world.

The versatility of video games may help to explain why they remain so popular. Video games may take on a variety of forms, from intense shooters to captivating RPGs, from fast-paced sports games to puzzle-solving adventures [10]. They may be enjoyed for hours whether played alone, with friends, online, or offline. The early 1970s saw the creation of the first video games. Basic computer games like Space War and Pong were initially developed as standalone applications with just one game. The gameplay and graphics in these early games were straightforward. Video games become more and more complex as technology

developed. By the end of the 1970s and the beginning of the 1980s, the video game industry had become well-known. At the time, Pac Man, Space Invaders, and Donkey Kong were all well-liked video games [9].

In the current era of technology, the development of modern video games has been on a rapid rise. With the increasing popularity of virtual and augmented reality games, the future of video games has seen a major revolution. Virtual Reality (VR) and Augmented Reality (AR) video games provide an immersive experience that allows gamers to virtually interact with their environment and objects, rather than just playing on a flat screen. VR games offer a more realistic experience with head tracking, the ability to move around in the game and hand tracking [12]. AR, on the other hand, superimposes virtual objects in the real world, making it more interactive and engaging. These two technologies have enabled developers to create video games that bring a lifelike experience to the gamers. The future of video games holds great potential with the use of virtual reality (VR) and augmented reality (AR). Virtual reality immerses the user in a simulated world, providing an incredibly immersive experience, while augmented reality overlays virtual elements onto the real world. These technologies have allowed developers to create realistic and interactive 3D worlds for gamers to explore. In addition to gaming, VR and AR can also be used for educational and training purposes, giving the user an interactive and detailed learning experience. The use of these technologies in video games can also provide a more social experience, as multiple users can interact and play together in the same virtual environment. With the increasing capabilities and expanding platforms, it is likely that VR and AR will continue to revolution. The Augmented Reality & Virtual Reality for Gaming Market is expected to reach $72.8 billion in 2024, increasing at an 18.5% rate from 2021 to 2026. The increased adoption and integration of AR and VR technologies in mobile phones and other wearable devices is driving the industry. Augmented Reality and Virtual Reality are often regarded as the most fascinating developing technologies on the globe today. The sectors that use AR and VR technology are expected to be worth more than a trillion dollars by 2025[9].

A. Virtual Reality

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In the video game business, virtual reality (VR) has emerged as a game-changing technology, allowing players to experience games in a more immersive and participatory manner than ever before. VR technology entails building a virtual world in which users may interact as if they were physically there.

VR can provide levels of immersion and engagement in video games that traditional gaming technologies just cannot. VR can allow players to enjoy games from completely new perspectives, such as first-person or within a 360-degree virtual world. Players may interact with virtual worlds using body motions, gestures, and even vocal commands in VR, resulting in a more natural and intuitive gameplay experience. While virtual reality technology has been around for decades, it has only recently been accessible and cheap to general customers. Consumer-grade VR headsets compatible with popular gaming platforms such as PC and PlayStation have been produced by companies like as Oculus, HTC, and Sony, making VR gaming more accessible than ever before [13][14].

Virtual reality (VR) technology is intended to mimic a realistic and immersive environment that users may experience using all of their senses. VR may imitate various different sorts of sensations, including:

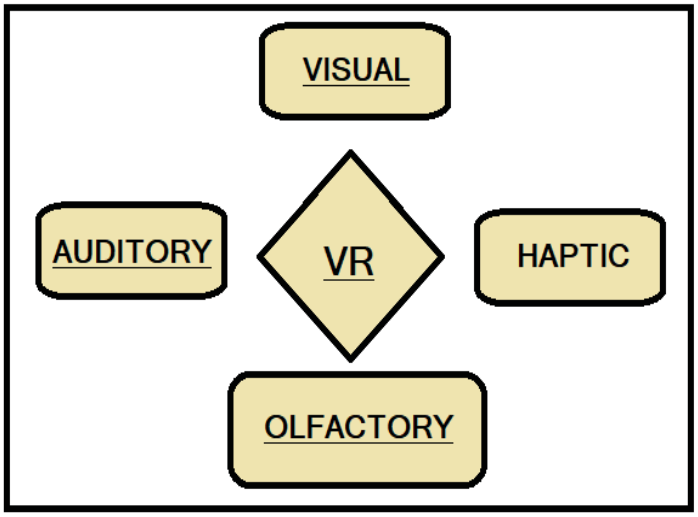

Figure 1: Senses of VR

1 *Visual:* The most noticeable and important sense in VR is vision. VR systems imitate the visual sense of being in a virtual world by using high-resolution monitors and

head-mounted displays (HMDs). Users may observe and interact with the virtual world as if they were physically there in it [14].

2 *Auditory:* High-quality audio systems are also used in VR systems to produce a realistic sound experience. 3D audio technology, for example, may imitate the direction and distance of sound in a virtual world. This allows users to hear noises relevant to their location and improves the overall sense of immersion [14].

3 *Haptic feedback* is a sort of sensory feedback that simulates physical experiences through touch and pressure. Haptic technology, such as vibration, force feedback, or tactile feedback, can be used in VR systems to recreate the sensations of touch and pressure in a virtual world. Users may now interact with virtual items and surfaces in a more realistic and tactile manner [14].

4 *Olfactory:* The sense of smell is referred to as the olfactory sense. While olfactory input is less widespread in VR technology, some VR systems use it to improve the sensation of immersion. This is accomplished by discharging aromas or odours into the air to replicate odours relevant to the virtual environment [14].

B. Augmented Reality

Augmented reality (AR) is a technology that superimposes digital features on top of real-world things, producing a hybrid environment in which virtual and real-world objects coexist. AR technology may be used in video games to create interactive experiences that mix the virtual and real worlds, allowing players to interact with digital items in real life. AR technology may also be utilised to build more educational or informational games, such as those that teach users about historical locations or museums. AR games can improve the player's comprehension and enjoyment of the physical environment by superimposing digital information over real-world locales.

AR technology often displays digital components over the user's view of the actual world using a camera and a mobile device or headgear. This technology may be utilised in the context of video games to develop games that take place in the player's real surroundings, allowing players to engage with the game world in a more engaging and immersive way.

Pokémon Go, which became a global hit in 2016, is an example of an AR game. Players in the game use their mobile devices to capture digital Pokémon animals that appear in real life. Pokémon are placed in real-world areas using location-based technologies, enabling gamers to explore their surroundings in quest of new animals to catch. Pokémon GO became an instant sensation, with over 80 million downloads in the first month after its release.

C. The Importance of study on augmented reality and virtual reality

The game business has come a long way since its humble origins. Today's gaming has broken down gender barriers and exceeded the boundaries of age and socioeconomic class to provide something for everyone. The video game business is primed for augmented reality (AR) and virtual reality (VR) applications, with such a large possibility to gain brand exposure and consumer loyalty. For the first time, the VR and AR markets have given a completely new dimension to the games industry, generating more than $7.5 billion in income by 2020, as evidenced by device sales and software investment [9][10].

Several businesses are interested in using VR and AR to create new and immersive experiences, while others want to utilise the technology to promote their games and brands. EA, the world's largest social gaming firm, has seen its stock price rise by 20% this year as a result of its investment in AR. Sony, whose gaming business is the envy of the industry, has also gone on board with AR. With the participation of additional tech corporations (including Facebook, Google, and Amazon), it appears that the market will continue to rise.

As these technologies advance and become more widely used, the study of virtual reality (VR) and augmented reality (AR) in the setting of video games is becoming increasingly significant. Understanding the possible uses and ramifications of virtual reality and augmented reality (VR and AR) in video games can help developers build more immersive and engaging gaming experiences while also opening up new opportunities for the industry as a whole.

One critical area is the potential for VR and AR to change the way we play and enjoy video games. These technologies provide a more immersive and engaging manner for players to interact with virtual settings, allowing them to feel as if they are genuinely immersed in the

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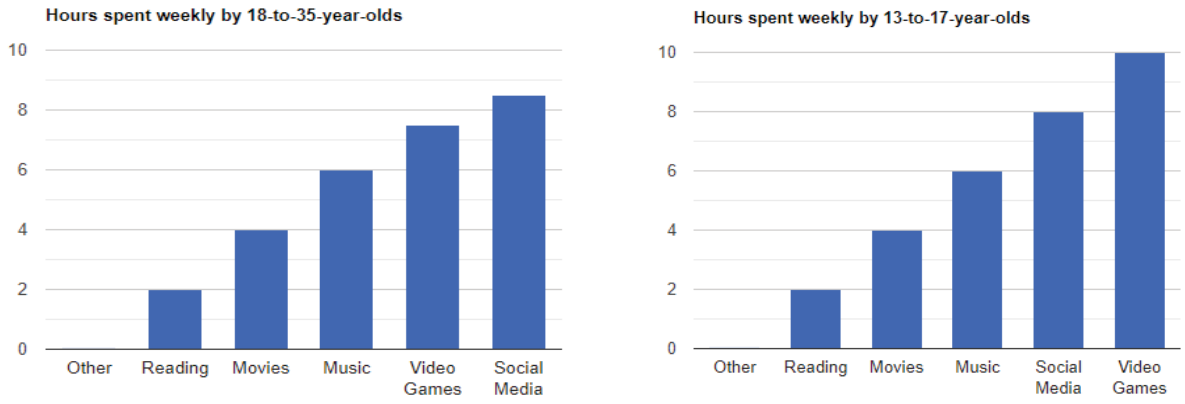
game world. This may result in a more interesting and enjoyable gaming experience, as well as attracting new consumers to the gaming business.

Moreover, research into VR and AR in video games can aid in the development of new technologies and techniques for creating more realistic and captivating virtual environments. For example, developments in haptic feedback technology can aid in the creation of more realistic sensations of touch and pressure, while advances in eye-tracking technology can aid in the creation of more natural and intuitive interactions with virtual objects. Apart from gaming, research into VR and AR can have significant ramifications for a range of areas, including healthcare, education, and training. Virtual reality and augmented reality may be used to recreate complicated or dangerous circumstances, allowing people to practise and learn in a safe and controlled setting. VR simulations, for example, may be used to teach surgeons, whereas AR can be utilised to create more engaging and interactive educational experiences [9][10].

Ultimately, studying VR and AR in the context of video games is critical for understanding the possible uses and ramifications of these technologies, both inside and outside of the gaming industry. As VR and AR continue to grow and gain popularity. It is critical to remain current on the newest advancements and trends in this constantly expanding sector. Gaming is the most popular form of media among younger gamers, but senior gamers spend almost the same amount of time on social media and music as they do on games.



Graph 1. Hours spent weekly by various age groups, Source: Statista

Younger age groups, notably toddlers and teens, are frequently the most active video game users. This is due in part to the fact that video games have become more accessible and inexpensive, but it is also due to the fact that younger age groups have more free time to play and are more willing to adopt new trends and technology. Yet, research has revealed that video gaming is also getting more popular among older age groups. Many older folks, for example, utilise video games to keep intellectually and physically active, and there is a growing interest in gaming among senior populations.

In terms of age categories, studies have shown that the most active video game players are often between the ages of 18 and 35. This demographic is more likely to have grown up with video games and be at ease with new technology, making them more inclined to adopt new gaming platforms and gadgets [9].

II. FEW FACTORS THAT MAKE IT SEEM LIKELY THAT THE PROPORTION OF OLDER AGE GROUPS ENJOYING AR/VR INSPIRED GAMES WILL RISE

If a few things are taken into account, the proportion of older gamers may also significantly increase, like [9]:

A. Enhanced Accessibility

People of all ages are finding it simpler to access and utilise AR/VR technology as it grows more sophisticated and inexpensive. As a result, people in older age groups who may have previously been reluctant or unable to use AR/VR technology may now be able to do so.

B. Growing Comfort with Technology

Older age groups are utilising smartphones, tablets, and other gadgets with growing ease as they become more accustomed to technology in general. Due to their familiarity with technology, older people may find it simpler to learn how to utilise AR/VR equipment.

C. Heath Related Information

Utilizing AR/VR technology may have positive effects on your health, including a reduction in stress and an improvement in cognitive function. A person's interest in adopting technology to enhance their general health and wellness may increase as they get older.

D. Socialization

For older persons who could be more socially isolated or have less possibilities for social engagement, AR/VR technology can offer opportunities for socialisation. Older individuals may be increasingly interested in adopting AR/VR to connect with others as more games and experiences contain social components.

People of various ages love video games, from youngsters to the elderly. Nevertheless, depending on the sort of game and platform utilised, the age groups that are most engaged in playing video games might vary.

Because of the on-going demand gaming between various age groups, the development is flooding with different aspects of AR/VR gaming. Developers are very keen on providing the players with fresh and engaging experiences with the utilisation of AR/VR technology. As an outcome, brand-new game mechanics, user interfaces, and storytelling strategies have been created that make use of the distinctive AR/VR capabilities. Additionally, the growth of AR/VR games has given developers new chances to investigate other fields including training simulations, healthcare, and education. Future approaches to learning and healthcare may be significantly impacted by the potential of AR/VR gaming to deliver engaging and lifelike experiences in these fields. Overall, the advancement of AR/VR gaming is a fascinating field with endless potential, and we can anticipate further progress and innovation in the years to come.

III. DEVELOPMENT OF AR/VR BASED GAMES BY DEVELOPERS WORLDWIDE

Game developers all over the world have made tremendous advancements in AR/VR-based games [10]. To produce immersive and compelling gaming experiences, several game creators are investing in AR/VR technologies. Here are a few instances of game creators that have worked on AR/VR-based games [9][10]:

- *Half-Life*

Alyx and The Lab are two VR games created by Valve Corporation, a company well known for titles like Half-Life and Portal.

- *Ubisoft*

It is a French video game studio that has produced VR titles including Star Trek: Bridge Crew and Eagle Flight.

- *PlayStation VR*

The PlayStation VR headset was developed by Sony Interactive Entertainment, which also produced VR titles including Blood & Truth and Astro Bot Rescue Mission.

- *Google*

The tech behemoth built the Daydream VR platform and produced virtual reality games like Tilt Brush and Earth VR also google ARCore.

- *Epic Games*

Robo Recall and Bullet Train are two VR games that were created by Epic Games, the company that also created Fortnite.

- *Microsoft*

It has made VR games like Halo Recruit and Minecraft VR and has built the Windows Mixed Reality platform.

- *Owlchemy Labs*

Game developer Owlchemy Labs is behind VR titles including "Job Simulator" and "Vacation Simulator."

- *Skydance Interactive*

Skydance Interactive created The Walking Dead: Saints & Sinners one the most popular game of all time as a virtual reality game. The Walking Dead's zombie-infested world is the setting for this game, which provides a distinctive and engrossing survival horror experience. The graphics of this game was so innovative and loved by gamers. A 11 season long series also exists based on the game.

- *Mojang*

Mojang created the augmented reality game Minecraft Earth. Players may use AR technologies in the game to construct and explore their Minecraft creations in the real world.

These are only a few of the several game developers that have worked on AR/VR-based games. We can anticipate more game companies making investments in this sector in the future as AR/VR technology continues to advance and flourish. Such continued growth of AR/VR gaming has left the developers wanting for more. There are far more developments going on [9]

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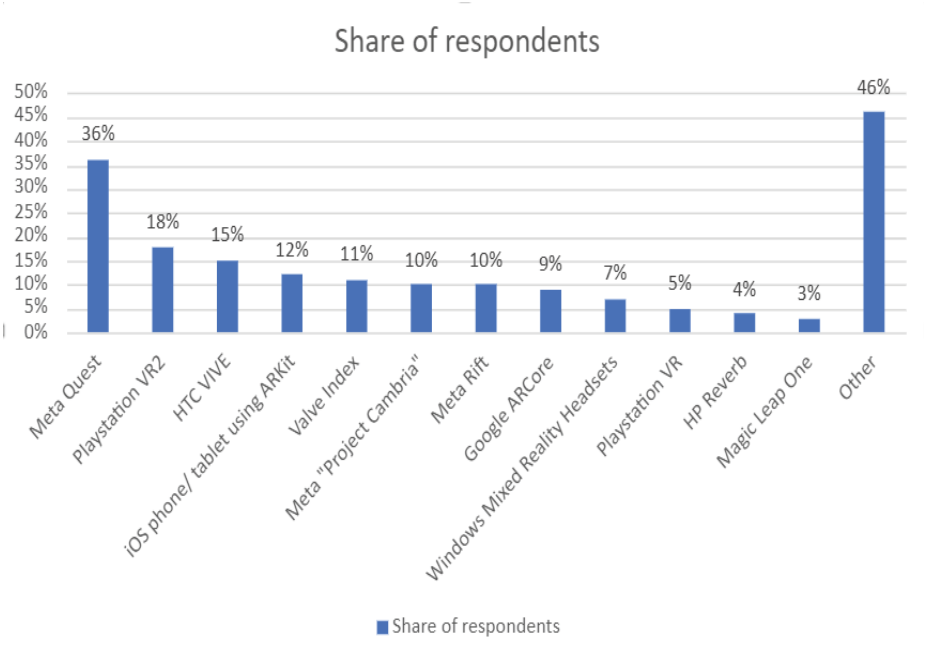

Graph 2: AR/VR gaming innovations, Source: Statista

As this shows how developers are getting on with various gaming innovations. Meta Quest is up with 36%. Meta quests may require players to achieve numerous goals or tasks in many game world places, and they are frequently intended to be more difficult and take more time to complete than standard missions. They are frequently saved for experienced or expert players who are seeking a tougher challenge, and they might be optional or required depending on the game. This is way for keeping things always interesting for the gamers [9].

In video games, completing all accomplishments, gathering every item or weapon, finding secret characters or locations, or doing a string of challenging tasks in a certain order or under particular circumstances are examples of meta quests. It has been discovered that these games have captivated players' attention and hearts. So, the developers are adding on the man hours for the completion of Meta Quest.

Additionally, when it comes to gaming, Playstation has always been in the spotlight. The virtual reality headgear known as PlayStation VR2 was created by Sony Interactive Entertainment for the PlayStation 5 gaming system. It was declared in February 2022, and a release date is anticipated [9].

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In comparison to its predecessor, the PlayStation VR2 offers enhancements such a higher resolution display, a broader field of vision, an enhanced tracking system, and redesigned controller feature. It is also simpler to set up and operate because it connects to the PS5 with just one cord. The majority of PlayStation VR headset-compatible games as well as fresh titles created especially for the VR2 will work with the VR2. Players may expect a more realistic and engaging gaming experience thanks to it, one that will make them feel as though they are actually in the game and having the adventure of their lifetimes [9].

IV. DEVELOPMENT AND COST ANALYSIS OF AR/VR GAMING IN FUTURE

As the development of video gaming is underway with so much potential and hours put by hardworking developers. Like with other consumer electronics, it's expected that as production grows more productive and the technology gains more traction, the cost of VR gear will go down over time. Additionally, as businesses compete with one another on pricing, the cost of VR headsets may decrease as a result of the competition. The creation of fresh technologies and functions may also have an influence on the cost of VR hardware. For instance, the advent of cordless VR headsets or advancements in tracking and resolution technologies might temporarily increase the price of gear [9].

Finally, the cost of VR gear will be significantly influenced by user demand. Manufacturers could be able to charge more for VR technology if there is a large demand for it, but if there is a low demand, costs might need to be reduced to promote uptake. But at the end the point becomes that this generation is tech eaters and future holds so many miraculous innovations in gaming field that will baffle the gaming community and will leave them for wanting for more.

Overall, these numerous variables are expected to cause the price of VR gear to fluctuate over time, but the long-term pattern is likely to be encouraging reduced pricing and wider use of the technology [9][10].

V. AR/VR GAMING AND ITS INFLUENCE

Gaming has been making rounds in learning sector also Technology like augmented reality (AR) and virtual reality (VR) has a lot of promise to improve learning experiences,

particularly in the gaming industry. For students to study and explore new ideas, AR/VR gaming may provide an immersive, interactive, and fun environment [2].

The ability to provide an engaging and interactive method of teaching difficult or abstract subjects is one of the main benefits of AR/VR games in the learning industry. Without the need for costly technology or physical resources, a VR game, for instance, may let students examine the human body, live through historical events, or even mimic a scientific experiment [5]. By adjusting the material and level of difficulty to meet the needs of each individual learner, AR/VR gaming may also offer a more individualised learning experience. Students' learning results may be enhanced and their ability to study at their own speed may be helped.

Additionally, AR/VR gaming can provide a risk-free setting for kids to make errors while gaining knowledge from them with no any repercussions in the real world. For students pursuing careers in high-risk industries like medical, aviation, or engineering, this can be very helpful. AR/VR technology emerging in gaming field as an educational space has the potential to completely change how we teach and learn by giving students access to an interactive, immersive, and engaging environment. Gamers might be motivated by AR/VR games that offer an immersive and engaging experience, a sense of accomplishment, personalised experiences, and opportunities for social connection. These elements may make the entire experience more entertaining and compelling, which may encourage players to play and learn more [5].

Gamers and influencers in various media outlets like YouTube, Instagram etc. who play and present these games to their audiences can have an impact on AR/VR gaming and how it affects people.

People's impressions and attitudes towards AR and VR technology can be influenced by gamers and streamers who engage in these genres of games [8]. They can affect whether people view AR/VR gaming as a cutting-edge technology with limitless promise or as a fad. Additionally, their behaviours and attitude while playing might have an influence on how people view gaming as a whole and may either support or contradict stereotypes and unfavourable opinions.

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Through their content and engagement with their audiences, streamers in particular have the power to influence people's perceptions of AR/VR games. They can give reviews and criticism, promote new games and technology to their audience, and foster a feeling of community among their fans.

Gamers and broadcasters can have a greater impact on talks regarding AR/VR gaming on social media, which means they may attract even bigger audiences. As social media may increase the effectiveness of their messaging and influence how people regard these technologies, this has beneficial effects on the gaming community.

VI. CLOUD GAMING WITH AR/VR GAMING

Although cloud gaming and AR/VR gaming are two different technologies, they can be combined to improve the game experience. In order to establish a virtual or augmented reality environment, specific gear, such as headsets or glasses, is used in AR/VR gaming[1]. Contrarily, cloud gaming entails game streaming via the internet, enabling gamers to engage with games without downloading or installing them.

By enabling players to connect to games and material whenever they want without having to keep a lot of information on their devices, cloud gaming can improve AR/VR gaming. This can be very helpful for AR/VR games, which might have high hardware needs. In addition to this, cloud gaming can provide AR/VR multiplayer experiences, enabling users to communicate with one another in a common virtual environment [6]. Students' learning environment may become more sociable and collaborative as a result of this.

In conclusion to this, cloud gaming and augmented reality (AR)/virtual reality (VR) gaming are distinct technologies, but they may be integrated to improve the enjoyment of gaming and present fresh potential for engaging and experiential learning [1][6].

VII. AI (ARTIFICIAL INTELLIGENCE) AND AR/VR GAMING

AI and AR/VR gaming are the kind of innovations that potentially combine to produce more engaging and thrilling gaming experiences. AI may be applied to improve the user interfaces, visuals, and game dynamics in AR/VR gaming. By examining a player's interests and actions, AI may be utilised to generate personalised gaming experiences. This can assist create a more

interesting and fulfilling experience by allowing the mechanics of the game, obstacles, and rewards to be tailored to each gamer's unique demands [7].

By mimicking genuine physics, behaviours, and relationships, AI may be utilised to build more plausible and convincing gaming settings. For the gamers all around, this may contribute to an encounter that proves more compelling and real.

Intelligent non-player characters (NPCs) can communicate with gamers in deeper and intriguing ways thanks to the usage of AI. For instance, NPCs may pick up on player behaviour and modify their answers and actions accordingly to make the game more dynamic and difficult [7]. AI may be utilized to adjust a game's difficulty level so that it is still tough for the player but not too demanding. As a result, player engagement may rise and frustration may be reduced.

In general, AI may be applied to AR/VR games to provide users more individualized, interesting, and difficult experiences. By utilizing AI, game designers may produce games that are smarter, more fun, more realistic, improving the whole gaming experience [7].

VIII. CONCLUSION

This paper came to the conclusion that the public's reaction to AR/VR video games has been conflicted, suggesting that there may be some difficulties in completely adopting and accepting this technology. However, the statement also emphasises that developers are working to improve the technology in order to build more interesting gaming settings. This shows that as AR/VR gaming advances, it has a lot of potential to become more broadly embraced and loved. The statement also mentions the rising popularity of AR/VR games in live broadcasts and streaming [8]. This suggests that there is a rising need for this sort of material, and that AR/VR games may provide viewers with novel chances for amusement and engagement.

The objective of this thorough study is to provide an overview which can state that the future of AR/VR gaming which is shining with multiple possibilities to captivate the gaming population as the developers are working with so much enthusiasm. As well as stating the allure of AR/VR gaming because of its involvement with various sectors like learning and healthcare which can attracts non-key demographic targets.

AR and VR can also help with social connection by allowing older persons to virtually connect with family and friends who are unable to physically visit or travel. This can aid in the treatment of emotions of isolation and loneliness, which are frequent among older persons. These technologies can give virtual experiences that mimic real-world surroundings and activities, allowing older persons to participate in things that they would not have been able to do otherwise [2][4][3].

Furthermore, the remark implies that merging AR/VR gaming with other technologies like cloud gaming and artificial intelligence might dramatically improve the gaming experience. The application of artificial intelligence to customise and modify the gaming experience to each player's preferences and learning style might be a significant advance in the field of gaming and education.

Overall, AR/VR gaming is an emerging technology with enormous promise for generating immersive and engaging game experiences, as well as new options for education and learning. Although there may be certain obstacles to overcome, developers' ongoing attempts to enhance the technology, as well as the rising demand for this sort of content, indicate that AR/VR gaming may become more generally used and enjoyed in the future.

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