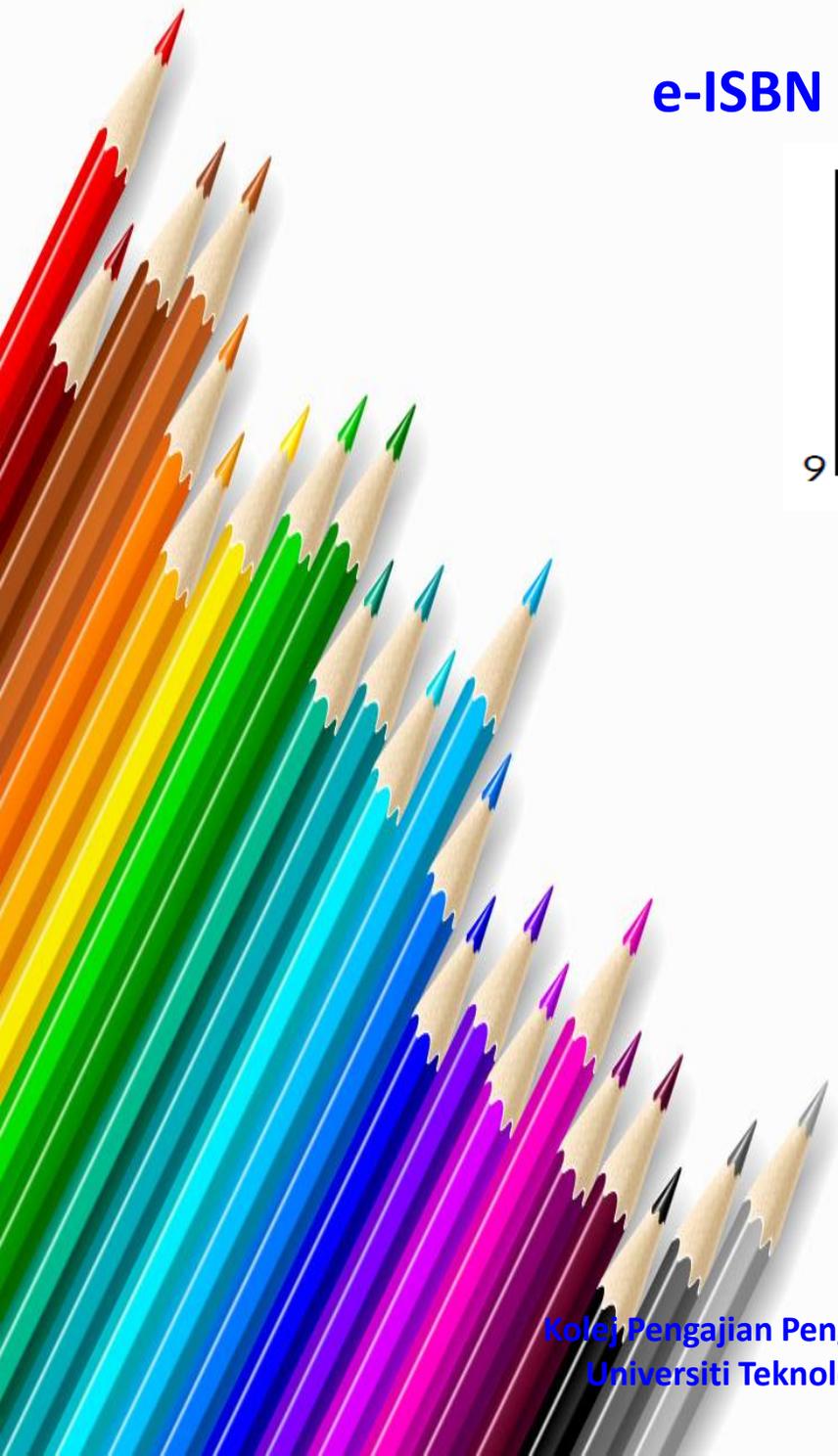


ENHANCING INNOVATIONS IN e-LEARNING FOR FUTURE PREPARATION

Volume 5, 2023

e-ISBN : 978-967-25608-8-3



SIG CS@e-Learning
Unit Penerbitan
Kolej Pengajian Pengkomputeran, Informatik & Media
Universiti Teknologi MARA Cawangan Pulau Pinang

THE EXISTENCE OF AUGMENTED REALITY TECHNOLOGY IN VIDEO GAMES

Nur Farah Dalila Zulkifli¹, Tengku Syed Nabil Al Qudry², Nur Fatin Umairah Abu Bakar³ and
*Jamal Othman⁴

2022458312@student.uitm.edu.my¹, 2022828456@student.uitm.edu.my²,
2022859276@student.uitm.edu.my³, *jamalothman@uitm.edu.my⁴

^{1,2,3}Faculty of Applied Science,
Universiti Teknologi MARA Cawangan Perlis, Malaysia

⁴Jabatan Sains Komputer & Matematik,
Universiti Teknologi MARA Cawangan Pulau Pinang, Malaysia

*Corresponding Author

ABSTRACT

Augmented Reality (AR) is a technologically augmented representation of the recreated by using digital visual elements, music, or other sensory stimulation. However, the expenses of making an AR are so high. AR can make people's lives easier by introducing virtual information. It can also enhance the user's missing senses through sensory substitution. Games with greater augmented reality capabilities may create worlds that change based on the user's location. AR may display real-time data from items and allow people to operate them via mobile devices. Touchscreen, voice, or gesture are all options. AR might potentially reveal real-time data coming from items. Pokémon Go and Minecraft Earth are examples of games that have AR elements. Next, AR can increase the knowledge and understanding of users. On the other side, AR can give a negative impact on users. For instance, the tendency in increasing the user's screen time. One of the differences between AR and VR is their visibility. Augmented Reality has great promise and almost unlimited capabilities. The use of augmented reality has the ability to alter the design dynamic. This paper will discuss the implementation of AR in the gaming industry.

Keywords: *Augmented Reality, Pokémon Go, Minecraft Earth, Implementation, Gaming Industry*

Introduction

Augmented reality (AR) is a technologically augmented representation of the recreated by using digital visual elements, music, or other sensory stimulation (Hayes, 2022). Augmented reality has progressed from a science-fiction concept to a scientific reality. Until recently, the expenses of augmented reality were so high that designers could only dream of working on design projects that included it. However, times have changed and augmented reality is now available on mobile handsets. In 1957, a cameraman named Morton Heilig found some success with augmented reality. He created the Sensorama, which provided the spectator with images, audio, vibration, and scent. Louis Rosenberg's AR system, built at USAF Armstrong's Research Lab in 1992, was most likely the first fully functional AR system. This was known as Virtual Fixtures, and it was an extremely complex robotic system developed to compensate for the early 1990s' lack of high-speed 3D graphics processing capacity. It allowed for the overlay of sensory information on a workspace in order to boost human productivity (Augmented Reality - The Past, The Present and The Future, 2020).

Augmented reality is created using a range of technological breakthroughs, which can be used alone or in combination to create augmented reality. Augmented Reality seeks to make the user's life

easier by introducing virtual information not just to his immediate surroundings, but also to any indirect view of the real-world environment, such as a live-video feed. AR has the ability to augment all senses, including smell, touch, and hearing. AR can also be used to enhance or substitute users' missing senses through sensory substitution, such as supplementing the sight of blind or low-vision users with audio cues or augmenting hearing for deaf users with visual cues.

Augmented reality begins with a camera-equipped device loaded with AR software, such as a smartphone, tablet, or smart glasses. When a user aims the gadget at an object, the program recognizes it by analyzing the video stream using computer vision technologies. AR may display real-time data from products and let users operate them via touchscreen, voice, or gesture. A user, for example, might touch a stop button on a digital graphic overlay within an AR experience or just say the word "stop" to send a command to a product over the cloud. An operator interacting with an industrial robot using an AR headset may see overlay data on the robot's performance and have access to its controls.

The cost of making an AR application may vary depending on the complexity and specialist rate in every country. For example, a simple AR application will cost at least \$7000-\$50000 meanwhile the most complex application will take at least \$250000. For the specialist rate, they will charge per hour. For instance, specialists from the USA or Canada will charge \$100 to \$250 per hour but in Asia, they will charge cheaper, which is \$55 per hour. AR app development is utilized in the game industry to build a playing zone within an existing artificial environment. When played on smartphones, tablets, or gaming systems, this technology is known to overwhelm people. The yellow-colored "first down" line that emerged in a football game in 1998 was the first commercial deployment of AR technology (Summer, 2023).

Implementation of AR in Gaming Industry

The term "augmented reality" refers to a display environment that is based on the real world and leverages the capabilities of a computer or smartphone to offer the user a display, sound, text, and effects that enhance their experience of the real world. After the introduction of virtual reality in the real world, augmented reality (AR) emerged as a creative and immersive experience that enables users to feel happy after interacting personally with the digital environment. This was made possible by Augmented Reality's ability to immerse users in the experience. In the game business, augmented reality is used to create play zones within artificial landscapes that already exist to dominate people when it is played on mobile devices such as smartphones, tablets, and game consoles. Since the development of interactive experiences of real-world surroundings, in which every real-world object has been added, this technology has had a huge impact on the gaming business.

Augmented reality also refers to the practice of simulating artificial elements inside a real environment. The user's perspective of the real world is supplemented with computer-generated pictures using 3D graphics, which are superimposed on top of the user's view of the real world. This is feasible

due to the fact that computers employ sensors and algorithms to ascertain the orientation of a camera. The world is not unfamiliar with the concept of 3D film viewing. Due to the outrageous cost, it has not acquired the targeted degree of public popularity. However, 3D has gained popularity in certain fields, such as the film "Avatar".

The second area of concern is tied to the gaming industry, where 3D effects offer the player an enthralling experience and serve as the game's backbone. When looking at applications in the real world, augmented reality can provide a link that is otherwise missing between the digital and physical surroundings. Augmented reality has the potential to completely transform the way players engage with interactive mediums. On the other hand, augmented reality (AR) technology in gaming relies on the player's senses to help them locate themselves within the virtual environment. Another key consideration is the context in which augmented reality technologies are used, with a particular emphasis on mobile devices, head-mounted displays (HMDs), and smart glasses that come with AR software already installed. The program is able to recognize an object when a user aims at the device and looks at it because it does an analysis of the video stream using computer vision technology.

Augmented reality integrates the visual and auditory content of the game with the environment that the player is in at the same time. Augmented reality games make use of an already existing setting and superimpose a playing field within it while virtual reality games frequently call for a dedicated room or other enclosed location in order to successfully create an immersive world. A common feature of augmented reality games is the superimposition of user-generated environments on top of the user's actual surroundings. Games with a higher level of augmented reality capability can construct environments that are depending on the user's location. AR may display real-time data from products and let users control them via touchscreen, voice, or gesture. AR might also provide a glimpse of real-time data streaming from products.

A user, for example, may send a command to a product by clicking a stop button on an augmented reality experience's digital visual overlay, or they could just say the word "stop." The cloud would then relay the command to the item. When dealing with an industrial robot, an operator using an augmented reality headset may see overlay data about the robot's performance and have access to its controls. A player's avatar in such a game, for example, might be able to walk across a digital bridge to get from a coffee table to a couch. When the user moves, the augmented reality display adjusts its size and orientation to fit the new surroundings. New graphical or text information comes into view while other information passes out of view. The process of creating a setting is one of the most time-consuming aspects of developing a video game.

Despite this, there is a constant desire for new scenery since players will synchronize the states of hundreds of millions of users located all over the world, as well as the virtual objects that interact with those users. switch to new scenes once they have fully explored the one, they are currently in. This augmented reality game expands the playing area even further by incorporating a range of real-world

locations to ensure that the game appears fascinating to the player (Tech Target Contributor, 2016). Niantic, Inc. is an augmented reality (AR) firm that makes use of technology to bring the concept of augmented reality into the actual world. Niantic's Augmented Reality technology has been successfully implemented in a variety of the company's products, including Field Trip, Ingress, and Pokémon GO, amongst others. In order to create a metaverse that is based in the real world, it is necessary to Add, it is necessary to precisely attach those users and objects to the real world. On the Niantic Lightship platform, Pokémon GO was the very first game to ever exist. This indicates that millions of users will be able to build, modify, and interact with digital items that are present in the realworld while preserving a consistent and shared experience (Hanke, 2021).

Advantage and Disadvantage of AR

There are wide advantages of Augmented Reality, but Augmented Reality also has its own disadvantages that can give an impact toward mankind. The first advantage of Augmented Reality is the capability of it to enhance and encouraging user physical activities. User has a chance to experience a better quality of life by using Augmented Reality technology. These includes in navigation and gaming. For illustration, most of modern car nowadays are included with Augmented Reality in its system. Tesla is one of the big companies that implementing Augmented Reality in their cars. Augmented Reality helps to predict or estimate the possible consequence that may be happen. According (Lang, 2020), Tesla has implementing Augmented Reality in their cars for autopilot driving. The car can analyze its surrounding for a better driving experience. The second advantages of Augmented Reality are by increasing the knowledge and understanding of user. IKEA is a furnishing company that has applied Augmented Reality in their application which allow the user to organize and coordinate the layout of their customer personal space. By downloading IKEA apps, the user can boost up their understanding and information about the size, the location, and the possible look of their house according to the user preference. Besides IKEA, NIKE company also grab the chance to implementing Augmented Reality in their apps. The user can calculate their foot size by pointing their smartphones at their feet. This technology has increased the customer understanding of the size of their foot before purchasing the item. Next advantage of Augmented Reality is it helps the user in exploring new area. Nowadays, many gaming 5 company has set up Augmented Reality in their gaming application such as Pokémon Go. This gaming gives the user experience in exploring new area to completing the quest.

Augmented Reality also equally has its own disadvantages. The first drawback of Augmented Reality is its tendency in increasing the user screen time. Even though Augmented Reality helps boosting the user life but on the other hand the user tends to be focused more on-screen time which could lead to many problems such as lesser affection of attention on user life. Lack of attention or communication among the user can cause less mutual touch or loss of mutual relationship in their circle. According to experts, excessive of screen time can affect a parent-child relationship (Turner, 2019). The child may pay more attention on the gaming and screen time which leading to less communication

among the family members. Communication among the family members is vital to help in growing more love and understanding of each family member life problem. Another disadvantage of Augmented Reality is the costing to implement this technology in the system. As claimed by the experts, simple Augmented Reality such as Marker Based AR can start from 1000 USD to 2000 USD in the making. If it involves more complex Augmented Reality, the cost can jump to 10,000 to 200,000 USD (Bhatt, 2022). Usually, a big corporate is more afforded to spend on this big budget such as Niantic company (Pokémon Go game), Inter IKEA Systems B.V. (IKEA Place application) and Alphabet Inc. (Google Maps navigation application). The last drawback of Augmented Reality is it can affect the user mental health in a long run. As stated, Augmented Reality can enhance the user surrounding but if the user is too depending on the advance, the user can develop a tendency of seeing things that untrue. For instance, Pokémon Go gaming can disturb the user eyesight in a long run. The user will begin to seek for Pokémon at their neighborhood even though it was not there. Augmented Reality also can disturb the user mental health by depending too much on the technology which creating lesser survival skill.

Pokémon Go



Figure 1: Logo of Pokémon Go

The ever-evolving technological landscape has opened the door to the possibility of revolutionary new experiences that can be had through the use of augmented reality and virtual reality. The gaming business is one that stands to benefit tremendously from the application of augmented reality technology. In addition to this, there is a clear trend in the market towards mobile gaming (Mignogna, 2018). The introduction of the augmented reality (AR) game Pokémon GO in 2016 was a seminal event that brought to light the possibilities of AR in the gaming industry. Niantic, in conjunction with Nintendo and The Pokémon Company, has distributed this game for mobile platforms such as iOS and Android as part of the Pokémon franchise. The continuation of the use of augmented reality technology was significantly impacted by Nintendo's second-ever release for mobile devices, which was a major game changer. Mobile devices equipped with GPS are required to play Pokémon Go, which allows users to hunt down, capture, train, and battle fictitious animals known as Pokémon. The player's actual location is not represented in the game, despite the fact that it seems to be there.

The Pokémon video game series has drawn inspiration for its fantasy settings from real-world locations such as New York, Paris, Japan's Hokkaido and Kanto regions. The game is free to play and

uses a premium business model with local advertising and in-app purchases for additional in-game items. The game also started with about 150 Pokémon species, which increased to about 700 by 2021. This game has enticed more people to download the application and play by themselves. It is credited with popularizing location-based and augmented reality technology.

Gameplay Pokémon Go

Niantic's approach to the Pokémon series was incredibly forward-thinking, using AR in its gameplay almost in totality. In Pokémon GO, users catch different Pokémon and power them up to combat. Pokémon Go integrates the actual world into its virtual reality by using Google Maps. GPS technology is used to map these Pokémon to real-world locales. PokeStops at various real-world sites help with this by delivering items for collecting and battling Pokémon. The game's two most known interfaces are the Map View and the Wild Pokémon Encounter Screen. The Map View is the game's main screen, from which you may access the majority of the game's aspects. The screen displays a map of the trainer's real-world surroundings as well as game components such as Pokémon, PokeStops, and Gyms.



Figure 2: Map View

The use of augmented reality in Pokémon GO is an important component of the game because it enables the virtual world to connect and engage with the real-world surroundings of the player. The game makes use of augmented reality in order to position Pokémon in the player's immediate environment. The Pokémon GO app needs to have permission to use the player's camera in order for augmented reality to work, and it also uses gyroscope sensors in order to figure out where the player is holding their mobile device. It is still possible to access augmented reality even if the player's mobile device does not have a gyroscope or if the gyroscope is not functioning properly. However, the experience will be significantly diminished because the Pokémon will appear in a fixed position and only its background will use camera feed.



Figure 3: How gyroscope sensors aiming the Pokémon

When searching around the neighborhood for PokeStops, it probably saw plenty of Pokémon. Pokémon is random. Some are more likely to appear in certain places. Track nearby creatures using the Nearby function at the bottom right of the screen. By clicking on a Pokémon, the game will show its location. Pokémon GO's sightings feature gives hints about nearby Pokémon but doesn't give directions.



Figure 4: How in-game world looks when detect location a Pokémon

Pokémon GO is a mobile AR game, so it catches Pokémon in real life. Need to throw a PokeBall at the Pokémon to capture. If done correctly, the PokeBall will catch the Pokémon. A new technology and applications are being created with augmented reality thanks to Pokémon GO, which succeeded in popularizing it. In Pokémon Go, users may wander around the actual world while pointing their phone camera in all directions. As doing this, fictitious creatures like Pokémon and other things will appear on the phone's screen, giving the world a completely new dimension.



Figure 5: How to catch Pokémon in real life

Minecraft Earth



Figure 6: Logo of Minecraft Earth

In this day and age of advanced globalization, there are many different kinds of games that have been developed for all different kinds of users. Among the sandbox games that use augmented reality and are based on geolocation, one of those games is Minecraft Earth. Mojang Studios is responsible for the creation of this game, and Xbox Game Studios is the company that published it. The use of a GPS-tracked world map makes Minecraft Earth not only an augmented reality game but also a location-based game. This is because the game uses a world map. A free-to-play version of one of the most popular games ever created, Minecraft Earth is reimagined around the concept of augmented reality for mobile devices like the iPhone and Android. The game is available for both platforms. It's a lot like Pokémon Go, which was the game that got everyone excited about augmented reality gaming. But, unlike that game, Minecraft Earth is entirely dedicated to the concept of augmented reality. Users not just bump into a random Pikachu on the street, but construct complex Minecraft constructions that everyone can see. In addition to this, it utilizes the user's smartphone as a gateway to the online world. Since its release in 2019, Minecraft Earth has progressed from being a PC game driven by the community to being playable on consoles and virtual reality headsets. The video game industry is undergoing a sea change thanks to Mojang, the developer of the popular game Minecraft. The popular computer-generated world of Minecraft is now available as a mobile game called Minecraft Earth, which allows players to interact with their actual environments in addition to experiencing the game's simulated ones (Microsoft News Centre UK, n.d.).

The original Minecraft game was reimaged as an augmented reality experience in the form of Minecraft Earth, much like Ingress and Pokémon Go before it. The Bedrock engine was used to develop the actual game itself. It featured many gameplay elements that were entirely original as well as interactions that were similar to those in the main game. The objective of Minecraft Earth is to transform augmented reality gaming from an experience limited to a single player into a dynamic, breathing digital world that can be explored by a group of people simultaneously. "Tappable" are similar to "Pokestops" in Pokémon Go; however, in Minecraft Earth, these "tappable" are randomly dispersed throughout the world around players. These are designed to give users small rewards that allow to build things, and try to collect as many of these as they can in order to get resources and items that can be used to build expansive structures in the building mode. The location-based gameplay in this game was powered by OpenStreetMap which includes annotated and inferred data regarding districts, private property, safe and dangerous locations and Microsoft Azure Spatial Anchors that gives shared mixed reality experiences on HoloLens, iOS, and android devices a common coordinate frame that keeps track of all the players. This technology created a seamless experience by syncing the position of build plates in multi-player by referencing objects in the real world, making the experience more immersive.

Gameplay Minecraft Earth

Minecraft Earth has two modes of games which are Adventures and Build plates. Minecraft's adventure mode lets players explore other players' maps. In adventure mode, creators can construct a story-based game. Players may fight mobs, find items not available with tappable, and gain rewards in an adventure.

The adventure location displays quest information when tapped. When the Play button was pressed in the adventure build plate, the device's camera was turned on, and the game's graphics were shown on top of the real-world image. The player needed to put a build plate in a safe place so that the game could be played. On the build plate, structures both underground and above ground were made. Most adventures had structures like cobblestone, grass, and fences, as well as animals on the ground and in the air. However, some adventures looked like a hole in the ground.



Figure 7: Build Plate that need to be put at safe place and structures both underground and aboveground

In Minecraft Earth, more than one player can go on the same adventure at the same time. During the adventure, the tools that other players hold show what they look like. When a player looks at another player, they can see both their real-world image and the tools that player is holding. As shown in the picture below, another player appears holding the object he was holding at the time in the real world.



Figure 8: Another player appears holding the object in the real world

Next, a build plates mode was an area in Minecraft Earth where the player could construct structures (Swatman, 2016). The new player has an 8×8 build plate available by default. The player selects a surface in the real world to place the build plate on, and once placed, the player sees the build plate superimposed on the real-world camera view. An open space and a flat surface are required to place the building plate. Players can also interact with items or mobs in their build plate. Players can physically move around the build plate to see it from different angles and to build structures (Warren, 2019). Build plates can be used anywhere and work like a private realm. They use Bedrock Engine, so red stone, physics and other game elements are the same as in Bedrock Edition. Players can invite friends to build with them locally, and then they can share the world with others by sending them a link.



Figure 9: Image of build plate demo on flat surface



Figure 10: Image when inviting friends to a build plate

Differences of Augmented Reality (AR) and Virtual Reality (VR)

Augmented Reality and Virtual Reality may sound near but in reality, both of it has a totally different meaning and function. The first difference between Augmented Reality and Virtual Reality is Virtual Reality used up to 75% visuality while Augmented Reality only used up to 25% visuality. This is due to Virtual Reality creating a whole new whole for the user such as it does in gaming, but Augmented Reality only helps enhance the view of user's physical world. Next, the most vivid difference between Augmented Reality and Virtual Reality is Virtual Reality need up the usage of headset devices. This is contrary with Augmented Reality because Augmented Reality does not need the usage of headset to function. Augmented Reality can be applied inside a smartphone or any other object but not fixed at the headset unlike Virtual Reality. Besides, Virtual Reality providing an immersive experience to the user while Augmented Reality enhancing a real-world scene. To illustrate, Virtual Reality able to create a whole unrealistic world to the user just like it does in gaming, but Augmented Reality helps to enhance and adding information to the user realistic world. In the end, the difference between Virtual Reality and Augmented Reality is Virtual Reality holds the control of user view depending on the system and game, but Augmented Reality are in contact with realistic and physical world.

Augmented Reality for Future Gaming Industry

The gaming industry is one of the largest industries since it constantly improves the games it produces. The production of video games has undergone a significant transformation as a result of the advancement of modern technology, which encourages businesses to adopt new technologies to make the game more distinctive than before. Aside from that, the Coronavirus crisis has resulted in major growth in the gaming industry. In situations where people are unable to leave their homes or should avoid physical interactions, video games have become a major source of entertainment.

According to a market research firm, global gaming revenue could reach \$203.1 billion in 2022, up from \$139 billion in 2020. Furthermore, Asia has the world's largest video gaming market, with approximately 1.48 billion players, followed by Europe, which has over 715 million players. Globally, an estimated 3.24 billion people will play video games by 2022. Not to mention, with so many people spending their time online, it is easy to see how this will become a growing trend, not just for entertainment purposes, but also for the monetary incentive that this one-of-a-kind opportunity provides. According to data analysis, the global gaming market is expected to reach \$268.8 billion by 2025, up from \$178 billion in 2021.

Augmented Reality games combine a realistic image with noises and other sensations to provide fictitious experiences that stimulate the player's physical presence in the area. As the user's expectations rise and they seek ever more immersive gaming experiences, they will discover through AR a complete virtual world that substitutes that real one and is controlled by body gestures.

As a result, this is an excellent start for AR technology. The online gaming business has grown enormously in recent years, hitting a record of \$175 billion in sales with over 2.7 billion gamers globally, and is anticipated to grow even more in the future (Spaziani, 2022).

In augmented reality, players do not need to spend much money to enjoy the same amount of enjoyment. It may soon take over from traditional gaming, where virtual reality games never managed to succeed. As technological advances and other complementary technologies such as 5G become available, the experience will improve by allowing for more dynamic scenes and the incorporation of more advanced mobile games such as AR shooter games, which can bring more fun to the AR gaming world. Various large manufacturers have introduced numerous augmented reality applications over the years, providing gamers with new ways to interact with the real world. The steady increase in the number of mobile gamers has boosted the demand for augmented reality games. They anticipate that this tendency will continue over the next five years. The primary demand drivers for this industry are currently China, the United States, and Japan (Eastern Daylight Time, 2022).

Augmented reality has enormous potential and appears to have limitless capacities. Games like Pokémon Go have already shown its effectiveness on smartphones. This is especially essential as an increasing number of gamers want to play games on their phones and tablets. According to Newzoo's Global Market Report Service, mobile gaming income will account for more than half of total gaming revenue. This just goes to show that the mobile gaming market is massive and only going to get bigger. As a result, it is not a huge leap to say that mobile gaming will have a significant impact on the future of gaming. Teddy bears, board games, colouring books, and action figures may all be layered with augmented reality. Essentially, augmented reality may breathe new life into old and weary toys that were on their way out with the arrival of mobile gaming. For example, AR allows a teddy bear to come alive by aiming a smartphone at it, giving the user the experience of a best friend, they can talk to or a pet they can care for. Apple, Google, and practically every other corporation in Silicon Valley are working to push AR to the forefront, allowing AR experiences to feel more realistic and engaging. AR also allows children to be children again, jumping up and down in their own homes or running around their neighborhood instead of sitting and staring at a screen all day. That is how the future of gaming appears, and what AR promises (Datar, 2019).

For instance, JamShoot is one of the most recent games to hit the market, giving a completely new form of AR gaming experience. It's the first arcade shooter game with a dynamic scene and augmented reality aspects, which means you can play it anywhere for an immersive mobile gaming experience. The JamShoot AR mobile app is a fantastic game for both children and adults, giving a world-changing shooter game for anyone who enjoys gaming and is curious about how AR will impact shooter games in the future (Is Augmented Reality the Future of Gaming? , 2022).

Conclusion

As a conclusion, AR can be viewed as a new communication medium or tool in an early stage due to several important technical and societal obstacles, as well as the fact that it involves information technology. The cell phone is a device for AR applications, which could pave the way for widespread AR deployment. In light of the increasing ubiquity of information and interactivity via smart devices and sensors, AR will give personalized, perceptual, and location-based information. The augmented reality market will continue to increase in the coming years, particularly as technology becomes more accessible to consumers. With a growing emphasis on metaverse technology, many firms are looking to AR as the next step. It has already been shown that Augmented Reality can improve the way we create for people. It has been demonstrated that by utilizing the AR feature, people may better perceive and appreciate design. With all of the supporting information and analyses, I must conclude that AR has the potential to change the design dynamic by making the process more transparent and comprehensive between the creator and the community engaged.

References

- Augmented Reality - The Past, The Present and The Future.* (2020). Retrieved from interaction-design.org: <https://www.interaction-design.org/literature/article/augmented-reality-the-past-the-present-and-the-future>
- Datar, S. (2019, 8 20). *AR - The Future of Gaming.* Retrieved from medium.datadriveninvestor: <https://medium.datadriveninvestor.com/ar-the-future-of-gaming-dba9bdf2cf9>
- Eastern Daylight Time. (2022, May 31). *The Worldwide Augmented Reality Gaming Industry is Expected to Reach \$38 Billion by 2027 - ResearchAndMarkets.com.* Retrieved from Business Wire: <https://www.businesswire.com/news/home/20220531005453/en/The-Worldwide-Augmented-Reality-Gaming-Industry-is-Expected-to-Reach-38-Billion-by-2027---ResearchAndMarkets.com>
- Hanke, J. (2021, August 10). *The Metaverse is a Dystopian Nightmare. Let's Build a Better Reality.* Retrieved from Niantic Labs: <https://nianticlabs.com/news/real-world-metaverse?hl=en>
- Hayes, A. (2022, 10 29). *Augmented Reality (AR) Defined, with Examples and Uses.* Retrieved from investopedia: [https://www.investopedia.com/terms/a/augmented-reality.asp#:~:text=Augmented%20reality%20\(AR\)%20is%20an,and%20business%20applications%20in%20particular.](https://www.investopedia.com/terms/a/augmented-reality.asp#:~:text=Augmented%20reality%20(AR)%20is%20an,and%20business%20applications%20in%20particular.)
- Is Augmented Reality the Future of Gaming?* (2022, 1 28). Retrieved from industrywired: <https://industrywired.com/is-augmented-reality-the-future-of-gaming/#:~:text=AR%20gaming%20is%20a%20fantastic,needed%20for%20AR%20mobile%20gaming.>
- Lang, F. (2020, December 16). *Tesla Hacker Uncovers Augmented Reality View in Autopilot.* Retrieved from Interesting Engineering: <https://interestingengineering.com/innovation/tesla-hacker-uncovers-augmented-reality-view-in-autopilot>
- Microsoft News Centre UK. (n.d.). *Beyond the blocks: how the latest technology made Minecraft Earth a reality.* Retrieved from Microsoft News: <https://news.microsoft.com/en->

gb/features/beyond-the-blocks-how-the-latest-technology-made-minecraft-earth-a-reality/

- Mignogna, J. G. (2018). *Pokemon Go, Augmented Reality Games, and How the Insurance Industry Will Help Protect a Distracted Society from Becoming Even More Distracted*. *Rutgers University Law Review* (70(3)), pp. 675-715.
- Spaziani, M. (2022, June 27). *What is the impact of Augmented Reality on the games industry?* Retrieved from Inglobe Technologies: <https://www.inglobetechnologies.com/augmented-reality-games/>
- Summer. (2023, January 1). *How AR and VR can transform the gaming industry?* Retrieved from Mageplaza: <https://www.mageplaza.com/blog/how-ar-vr-transform-gaming-industry.html>
- Swatman, R. (2016, August 10). *Pokémon Go catches five new world records*. Retrieved from Guinness World Records: <https://www.guinnessworldrecords.com/news/2016/8/pokemon-go-catches-five-world-records-439327>
- Tech Target Contributor. (2016). *What is augmented reality gaming (AR gaming)? | Definition from TechTarget*. Retrieved from TechTarget: <https://www.techtarget.com/whatis/definition/augmented-reality-gaming-AR-gaming>
- Turner, R. (2019, June 7). *How Screen Time Affects the Parent-Child Relationship* . Retrieved from Margaret Mary Health: <https://www.mmhealth.org/news-and-events/news/how-does-screen-time-affect-infant-and-toddler-development/#main>
- Warren, T. (2019, May 17). *Minecraft Earth goes a step beyond Pokémon Go to cover the world in blocks*. Retrieved from The Verge: <https://www.theverge.com/2019/5/17/18627341/minecraft-earth-ios-android-free-ar-game-features-pokemon-go>