Virtual Reality Technologies and Real Life Applications
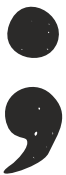

Dina Darwish
Editor

Virtual Reality Technologies and Real Life Applications

Dina Darwish

Vice dean, faculty of computer science and information technology, Ahram Canadian university, Egypt.

DeepScience

Preface

Virtual Reality, sometimes known as VR, is a technology that helps you feel as though you are completely submerged in a virtual world. It provides a genuine sense of presence in the virtual realm, which is a feeling that is quite distinct from the sensation of playing a game or navigating a 3D environment on a static 2D monitor. One of the most common ways to accomplish this is by using a virtual reality headset, which brings one or two displays very close to your eyes while also tracking your position so that it may be transformed into the virtual world. Over the course of the last ten years, the technology has seen tremendous development and advancement, with the most advanced virtual reality headsets incorporating displays with an extremely high resolution, motion controls that are becoming increasingly complex, and even the capability to be used wirelessly.

The goal of virtual reality technology is to manufacture a three-dimensional image or environment that is so realistic that it may be seen as real by a human being and even interact with in a manner that is realistic. Although the level of immersion we are experiencing is not comparable to that of the Matrix, the most recent generation of headsets, games, and virtual experiences can feel remarkably genuine. In spite of the fact that you are aware that you are in a virtual environment, it is still a lot of fun to interact with the world by using the natural motion of your body. Motion controls can track your hands, fingers, and even facial expressions with certain headsets.

In order for virtual reality to function, a small screen, which is commonly an LCD or OLED panel with a high resolution, is brought within a few inches of your eyes. This is then coupled with stereoscopic lenses, which distort the image in such a way that it appears to be three-dimensional. When you move your head around, the headset will track your location and orientation. It will then alter the visuals within the game to reflect your motions in the real world. This will ensure that your movements in the virtual world are the same as they are in the actual world.

The fact that you can see your motion-tracked hands or other appendages, in addition to the all-encompassing vision of the headset, gives you the impression that you are genuinely present in the virtual environment that you are experiencing. This is a very different concept from augmented reality (AR), which is a technology that superimposes virtual items onto the real world. Your eyes are able to track and navigate via augmented reality thanks to the strong fixed points of reference that are there. Virtual reality (VR) is

a technology that simulates the entire world, making it more difficult to achieve a realistic experience.

However, in the consumer market, virtual reality is often restricted to vision, hearing, and the ability to handle simple things. However, cutting-edge virtual reality projects are working with tactile sensations and even scents. The things that can be accomplished with just these senses, however, will astound you.

In the realm of virtual reality in the present era, the virtual reality headset is the most essential component. The screens that show the virtual world, the lenses that make it appear three-dimensional to your eyes, and some kind of audio solution, whether it be speakers or headphones, are often included in this piece of gear. There is a comfy strap system that allows you to put the headset on your head, and some headsets come equipped with built-in cameras that allow for tracking. Facial trackers and additional ports for the integration of accessories are among the others.

Some headsets, such as the Valve Index, are wired and require a direct connection to a powerful gaming personal computer in order to function. On the other hand, other headsets, such as the Meta Quest 2, are designed to function independently and come equipped with a built-in battery in addition to their own powerful processing capabilities. Although there are virtual reality headsets that were meant to interact with mobile phones in the past, these headsets are now considered obsolete and are largely underutilised.

In many instances, the headset is the only piece of gear that is strictly necessary for you to enjoy virtual reality. However, the majority of virtual reality systems additionally utilise other components in order to make the experience function, or at the very least, to make it work better.

Tracking parts: On some headsets, the tracking system is referred to as "inside-out" tracking. This method involves the incorporation of depth-sensing cameras within the headset itself in order to determine its position. On other headsets, however, the tracking system is external and must be put in the corners of the play space. On the other hand, some kind of accelerometer and gyroscope is incorporated into each and every headset in order to monitor the tilt and orientation of the headset.

Controls: Virtual reality headsets that are very simple allow for basic exploration and interaction with nothing more than a few buttons located on the headgear itself (particularly older VR headsets that are operated by smartphones). More modern virtual reality headsets come equipped with controllers that resemble handheld wands, while the most powerful virtual reality systems feature controllers that are more subtle and can follow individual fingers. There are virtual reality (VR) settings that are capable of

monitoring hands and fingers without the need for any form of hardware controller. Some of these systems even offer full-body tracking, which allows you to use your legs and feet as additional inputs.

Virtual reality games and experiences require a significant amount of computing power in order to depict them in a realistic manner, even in headsets that are considered to be of lower quality. In order to achieve this goal, a virtual reality headset must either have its own processing capabilities built in or be connected to a powerful machine. In the case of the PlayStation VR and PSVR2, this can be a PlayStation console, but it can also be a desktop computer or a laptop.

The specifications of each of these headsets are different, independent of the purpose for which they were designed. In a variety of ways, they can have an impact on the virtual reality headset as well as the users' overall experience:

Resolution: This refers to the number of pixels that are displayed on the display(s) that are utilised in the headset. It is expressed as an equation that is composed of the horizontal pixels multiplied by the vertical pixels. Visuals that are presented to the user by headsets with a higher resolution are more clear and have fewer jagged edges. The text is easier to read, and objects that are further away can be recognised with more ease. Virtual reality headsets of the first generation, such as the Oculus Rift and the HTC Vive, have combined resolutions of 2160 x 1600 for both eyes. On the other hand, the most recent generation of VR headsets, such as the Pimax 5K Super, have a resolution of 5120 x 1440. The graphics processor is put under a greater amount of strain as the resolution of the headset is increased; nonetheless, there are headsets available with higher resolutions.

Refresh rate: This refers to the number of times that the display can change what it displays in a single second, and it is expressed as a Hertz (Hz) value. A higher refresh rate can result in animations that are more fluid, but it can also enhance immersion and lessen the likelihood of experiencing motion sickness. A refresh rate of at least 90Hz is supported by the majority of virtual reality headsets; however, some headsets can handle 120Hz, and some can support up to 180Hz.

Field of View: The term "field of view" refers to the extent to which the view is provided by the headset itself. While the majority of virtual reality headsets only offer up to 110 degrees of field of view, the human eyes have a natural field of view that ranges from approximately 200 to 220 degrees. It can be deduced from this that there are some black bands running along the sides, as well as the top and bottom of the view, however these bands are primarily on the borders. Although it is uncommon, some headsets are capable of supporting up to 200 degrees. Your ability to feel more immersed in a game or event can be enhanced by having a larger field of view.

Lenses: There are a fantastic variety of stereoscopic lenses available to choose from. There are some of the most common Fresnel lenses, although they have been criticised for having a relatively small "sweet spot," which is the point at which the virtual reality visuals are at their sharpest. Additionally, they have been criticised for producing light bloom in situations with a high contrast. Many virtual reality headsets of the most recent generation make use of pancake lenses, which are not only more compact and lightweight but also reduce the glare that is typically associated with Fresnel lenses. In contrast, they do not transfer light to the viewer as effectively, which can result in visuals that are less vibrant or necessitate a significantly greater level of brightness from the display in order to compensate for this.

Audio: Different headsets offer a variety of audio solutions, with some headsets providing on-ear headphones and others providing generic speakers that allow you to keep your ears open. The second option may make it simpler to hear what is going on around you, but it does not provide the same level of immersion. Alternatively, some headsets just come with a 3.5mm headphone socket, which allows you to connect any earbuds or headphones that are compatible with the device. Different headsets can have a significant impact on the quality of the sound they produce, with the Valve Index headphones in particular receiving praise for performance.

Every headset has its own face plate, its own weight, and its own head strap design, which all contribute to the overall comfort of the device. Because of this, the levels of comfort that each headset offers are radically different. While some headsets are lightweight and well-balanced, allowing you to play for hours on end, others may cause your face to become sore before there is enough time to play. It is generally true that lighter headsets are more comfortable, although there is no assurance of this.

What is the difference between wired and wireless headsets?

Some headsets, such as the Valve Index, are wired, which means that they require a tethered connection to a gaming PC or console as well as a power source. Some of them, such as the Meta Quest Pro, are completely self-sufficient and function through wireless transmission. A wireless kit can be used to upgrade other devices, such as the HTC Vive Pro 2, which is still available. Wireless headphones, on the other hand, provide more mobility and a greater sense of immersion in every circumstance; but, they do have to worry about battery life, which can restrict the amount of time you can spend playing. It is also common for them to be heavier. It is true that wired headsets are more convenient and can provide higher quality, uncompressed graphics; but, the wire can serve as a

reminder that you are not in a virtual environment, which prevents you from being fully immersed in the experience.

What Virtual Reality (VR) Can Do to Help Transform the Gaming Industry

Virtual reality (VR) technology has ushered in a new age for the gaming industry, providing gamers with a level of immersion and interactivity that has never been seen before. By utilising high-definition images, three-dimensional audio, and controls that are easy to use, virtual reality (VR) produces a gaming environment that is so immersive that it is difficult for traditional gaming platforms to compete with it. Not only does this technological advancement improve the user experience, but it also paves the way for game developers to explore new and unique routes, pushing the boundaries of storytelling, gameplay mechanics, and player engagement.

In addition, the incorporation of virtual reality (VR) into gaming has had a huge impact on the market, resulting in an increase in demand for virtual reality headsets and accessories. This development is indicative of a shift in consumer expectations, including the fact that gamers are increasingly looking for gaming experiences that are more immersive and realistic. The gaming industry is undergoing a revolution as a direct consequence of this, with developers and companies making significant investments in virtual reality (VR) in order to stay ahead of the curve. Creating huge, interactive worlds and providing training simulations that impart real-world skills are just two examples of the immense potential that virtual reality (VR) has in the gaming industry. The role of virtual reality (VR) in gaming is expected to grow increasingly more significant as technology continues to advance, which will have a significant impact on the market's future.

The Impact of Virtual Reality on Education and Training as a Game-Changing Technology

The adoption of virtual reality technology has brought about a shift in the manner in which educational content is administered and experienced. Students have the ability to engage with content in a hands-on manner through the use of virtual reality (VR), which dramatically improves their comprehension and retention rates. VR creates a learning environment that is fully immersive. When it comes to disciplines that require a high degree of practical training, such as medical, engineering, and aviation, this novel method has shown to be extremely beneficial. In these fields, the ability to simulate complicated scenarios without the associated dangers or expenses is of great value.

Furthermore, the utilisation of virtual reality (VR) in training programs across a wide range of industries has showed a statistically significant rise in the level of employee engagement and performance. Companies are able to better prepare their staff for the problems that they will face in their employment by providing them with realistic job previews and interactive skill-building exercises. Consequently, this not only results in a workforce that is more knowledgeable and self-assured, but it also greatly cuts down on the amount of time and resources that are typically necessary for training purposes. Considering the fact that virtual reality technology is both scalable and adaptable, it has become a vital instrument in the contemporary educational and training landscape.

What Virtual Reality Is Doing to Transform the Healthcare Industry

Virtual reality (VR) is making tremendous achievements in the healthcare industry, altering patient care, medical training, and therapy procedures. These advancements are becoming increasingly important. By imitating real-life circumstances, virtual reality technology gives medical personnel the ability to perform diagnostic procedures and surgical operations without putting actual patients in danger with their practice. When it comes to training practitioners for real-life operations, this hands-on experience is extremely useful since it ensures that they are well-equipped with the necessary abilities and their confidence is boosted. In addition, virtual reality is being utilised in the field of patient rehabilitation. This technology provides patients suffering from strokes, brain injuries, and movement challenges with environments that are both engaging and under their control. The utilisation of these applications not only enhances the standard of care but also hastens the treatment and recuperation process.

In addition, virtual reality has a wide range of business applications in the healthcare industry, including the following:

Improved Medical Training: Virtual reality (VR) simulations allow medical professionals and students to obtain experience in a wide variety of treatments without the need for actual patients. This eliminates the risk and expense that are involved with traditional training techniques.

Better Patient Care Virtual reality (VR) applications in therapy and rehabilitation are delivering unique solutions for pain management, mental health, and physical recovery. These applications provide patients a treatment choice that is more engaging and less invasive.

Remote Consultations: By utilising virtual reality technology, healthcare providers are able to give remote consultations that are more accessible and efficient. This eliminates

the obstacle of geographical distance, hence making healthcare more accessible to people that are underserved and living in rural areas.

These developments are not only improving the efficacy and efficiency of healthcare services, but they are also opening up new doors for the expansion of businesses and the development of innovative ideas within the sector.

Improving the Shopping Experience for Customers Through Virtual Reality in Retail

Virtual reality (VR) technology is being rapidly utilised by retailers in order to provide immersive shopping experiences. The goal of this technology is to bridge the gap between internet shopping and traditional buying with physical stores. Not only are businesses increasing customer engagement through the use of virtual try-ons, 3D product visualisations, and interactive shop environments, but they are also drastically lowering the percentage of customers who return previously purchased items. For example, IKEA's virtual reality kitchen experience enables clients to digitally rearrange their kitchen space in order to visualise how things will fit and look before making a purchase. Taking this forward-thinking strategy not only improves the overall experience of the customer but also increases sales and strengthens customer loyalty. According to recent studies, a comparison between regular online shopping and virtual reality (VR) augmented shopping experiences reveals a significant improvement in customer satisfaction and conversion rates. Virtual reality (VR) users demonstrate a thirty percent increase in conversion rate and a twenty-five percent reduction in product returns.

What Virtual Reality Means for Real Estate and Architecture's Future

The technology known as virtual reality (VR) is causing a change in the way that the real estate and architecture industries function. It provides a revolutionary method of visualising and experiencing spaces before they are ever constructed. Virtual reality (VR) helps potential buyers and investors make more informed decisions, which in turn streamlines the sales process. VR technology enables potential buyers and investors to take virtual tours of properties. Not only does this technology improve customer interaction, but it also dramatically cuts down on the amount of time and money that is connected with traditional property displaying. The capability of virtual reality (VR) to present a realistic depiction of architectural plans before to the beginning of construction is extremely significant. This enables adjustments and enhancements to be made in an expedient manner, that in turn reduces the danger of costly alterations occurring during the actual building phase.

Additionally, the implementation of virtual reality (VR) in the fields of architecture and real estate has resulted in a design process that is more collaborative and participatory. Architects are now able to collaborate closely with their clients to make adjustments to designs in real time, which guarantees that the final product will be in perfect accordance with the client's specifications and vision. Because of this level of involvement, clients are able to virtually walk through their future houses or structures, experiencing the space from every angle. This helps clients develop a greater knowledge and appreciation of architectural principles. The result is quite clear; virtual reality technology is not merely a tool for visualisation; rather, it is a game-changer for client engagement, design correctness, and project efficiency in the real estate and architecture industries.

In the past few years, the field of virtual reality (VR) has experienced a boom that has never been witnessed before, and it is anticipated that the global market will reach extraordinary heights in the not too distant future. This revolutionary technology, which was once a figment of science fiction, has now become a practical reality, and it is not just reshaping the way in which we play video games or consume media; it is also revolutionising a variety of different businesses. Virtual reality (VR) appears to have an infinite amount of possible applications, ranging from boosting the learning experience in educational sectors to improving patient care in healthcare. It is becoming increasingly clear that virtual reality technology is not only transforming our current reality but also setting the way for future improvements. This is becoming apparent as we look deeper into the history of virtual reality technology and its fundamental components.

The influence of virtual reality extends far beyond the realm of simple entertainment; it is a driving force behind transformation in a variety of commercial sectors alike. Virtual reality (VR) has the potential to revolutionise traditional processes in a variety of industries, including real estate, where virtual tours can add a new dimension to the process of viewing properties, and retail, where it can be used to create personalised shopping experiences. As an additional point of interest, virtual reality's application in training and education demonstrates its capacity to improve learning outcomes through the use of realistic simulations. It is becoming increasingly apparent that the potential of virtual reality is only just beginning to be unlocked as we continue to investigate the transformational role that virtual reality plays in industries such as healthcare, where it is utilised for surgical training and patient rehabilitation. We need to explore the current landscape of virtual reality and its significant implications for the future of business and beyond. The VR technology is being utilised to promote growth and efficiency across a variety of businesses and industries.

Virtual reality (VR) stands out as a technology that has the potential to revolutionise organisations as they continue to investigate novel approaches to enhancing customer

engagement and streamlining administrative processes. There is a tremendous amount of potential for it to revolutionise a variety of different industries, with applications ranging from increased consumer experiences to immersive training environments. Key trends in virtual reality for business include the following:

Enhanced Training Simulations: Virtual reality's capacity to mimic complicated scenarios is expected to be of great service to a variety of industries, including the healthcare industry, the aviation industry, and the manufacturing industry. By doing so, not only are dangers mitigated, but also the outcomes of learning are enhanced.

Virtual Meetings and Conferences: As the need for remote work becomes more prevalent, virtual reality (VR) provides a platform that is more dynamic and engaging for virtual meetings. This platform helps to reduce travel expenses and time while simultaneously promoting a sense of presence.

Enhanced Customer Engagement: Virtual reality (VR) is being utilised in the retail and real estate industries to provide customers with a more comprehensive understanding and experience of the product or space. This is accomplished through the provision of virtual tours and try-before-you-buy experiences.

In addition, the combination of artificial intelligence and machine learning with virtual reality is expected to make it possible to create even more personalised and adaptable experiences by customising virtual surroundings to the tastes and actions of each individual. Not only will this synergy improve user engagement, but it will also give businesses with highly important information into how customers interact with their products and services. As the virtual reality (VR) technology continues to advance, it is anticipated that its adoption will increase across a variety of industries. This will result in the acceleration of innovation and the creation of new prospects for growth and competitive advantage.

This book represents a good start for people who want to know more information about Virtual Reality. This book is focusing on several topics, beginning from Virtual Reality important concepts, essential foundations, technologies and real life applications, Recent Advances in Virtual Reality Applications, Challenges, and Future Directions and Future Trends in Virtual Reality.

Dina Darwish

Contents