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Original Contribution

Virtual Reality & Artificial Intelligence in Real Estate Business: A Tool for Effective Marketing Campaigns

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This article aims to discuss an investigation centered on constructing a real estate app based on developing technologies such as Artificial Intelligence and Virtual Reality. Artificial Intelligence and Virtual Reality technology in the real estate industry are investigated in this paper, along with its potential benefits and drawbacks. Both virtual reality (VR) and artificial intelligence (AI) technologies have a lengthy history in the academic world, dating back to the middle of the previous century; however, they have not been developed to the same level due to a lack of vast amounts of data and the computer capacity both technologies demand. Because the proliferation of IT technologies in recent years has helped to remove technical constraints, there has been a sharp rise in interest in virtual reality (VR) and artificial intelligence (AI) technologies in society and among the general public during the past several years. Not only the research and theoretical concepts about the virtual world but also the practicability of businesses operating in a variety of sectors are becoming an increasingly important aspect. When it comes to virtual reality, in particular, pictures that include 360 degrees are where the attention is being directed. The entire setting can be caught in a three-dimensional space using specialized cameras, and the resulting footage can be pieced together so that the spectator will feel as though they are present in the room and can observe what's going on from that vantage point. This paves the way for the presentation of many alternatives. The study's primary focus was the application of artificial intelligence and virtual reality, which is significant to the real estate field. This article explains how artificial intelligence (AI) and virtual reality (VR) technology can benefit the real estate business.

INTRODUCTION

Through artificial intelligence and virtual reality, humans can submerge themselves in the advancement of technology entirely. Contemporary technologies are continuously advancing and playing a vital role in various contexts (Lal, 2015). The primary goal is to conceal the actual world to engage with the developing virtual one. This section will provide a high-level review of the beginning of these technologies related to virtual worlds and explanations of the essential development environment (Gutlapalli et al., 2019).

Regarding the technologies already available, the Internet of Things has already made its way into many homes (Koehler et al., 2020). Conversations are taking place between users and mobile devices and services that are powered by highly sophisticated algorithms. The Internet of Things, blockchain, virtual reality, and augmented reality, more innovative devices, artificial intelligence, machine learning, extended reality, 3D printing, new energy solutions, 5G, and robotic process automation are some examples of modern technologies that have served as an accurate polygon for significant upgrades to existing ones and the development of new

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technologies that already make it easier to go about daily life (Lal, 2016).

The real estate sector is embracing technology to improve the speed, accuracy, and overall effectiveness of the buying and selling process for all parties involved (Desamsetti & Mandapuram, 2017).

Currently, the buying and selling of real estate benefits from implementing several cutting-edge technologies in the sector (Lal et al., 2018). In contrast to online property listing platforms and real estate websites, which are also gaining popularity, virtual reality and artificial intelligence are currently employed in the real estate sector to improve the buying and selling process (Mandapuram, 2016). This is being done to make the market more competitive.

In this study, we will pay attention to the analysis of research and development of technologies relating to artificial intelligence and virtual reality. Additionally, we will investigate the benefits and drawbacks of utilizing these technologies in the real estate industry.

VR TECHNOLOGY

VR has always been promising and present. Put the glasses/device on your head, join the virtual world, and escape reality—we've all seen it on film. This is when virtual reality will go beyond TV, imagination, and devices. Everyone with a game console or PC will likely have a VR headset in five years (Ballamudi, 2020).

The idea of immersing a man in fantasy is old. The first true visionary in this field, Stanley G. Weinbaum, outlines a game where people can wear glasses to watch holographic footage of virtual storytelling, including scent and touch. Weinbaum's notion was simply an idea, but Morton Heiling's 1956 Sensorama was the first reported attempt. The motorbike simulator Sensorama used visual projection, vibrations, and the smell of overheated tires to recreate today's stimulus.

Heiling's 1960 head-mounted display was his next invention, according to Pandzic. Ivan Sutherland pioneered virtual reality and computer graphics. He developed the first functional head-mounted display systems that presented virtual data through real-world images. This was one of the first expanded reality displays. Image display that tracks head position is one of its numerous innovations.

Pandzic claims Sutherland found head-mounted displays in space utilizing mechanical and ultrasonic head position successors. According to NASA Ames Simulation Laboratories, the US-trained military pilots with them in the 1970s. Eric Howlett created LEEP (Large Expanse, Extra Perspective) in 1975. Designed initially to see static 3D graphics, its optical properties are used in head-worn screens. LEEP allows images to be viewed from close-up screens with a broad perspective (Mandapuram, 2017b).

Force feedback or haptic feedback research at the University of North Carolina began in the 1960s and led to the Argonne Remote Manipulator for visualization and force return in the 1980s. Twenty years after Sutherland's pioneering work, head-mounted displays were only used in military research. NASA's Michael McGreevy created the first functional head-mounted display model, the Virtual Visual Environment Display, in 1984. His concept produced the first wide-angle stereo head-mounted display, which was commercialized (Mandapuram et al., 2020).

Virtual Programming Languages introduced the DataGlove glove and the first HMD in 1985. According to Baker, Jaron Lanier coined "virtual reality." In the 1990s, Sega and Nintendo were "launching" video game head-mounted displays. The projects needed to improve management issues and harmful software (Popovic et al., 2011).

In 2012, 19-year-old Palmer Luckey combined many technologies. His initial VR headgear was bulky and had minimal visuals, so the experience was startling. He raised $2 million on Kickstarter and began production. The Oculus Rift Development Kit 1 was produced with John Carmack. In early 2014, Facebook bought Oculus for $2 billion due to its potential. One definition of virtual reality is the melding of virtuality and reality. The word "virtually" comes from medieval Latin. Late 14th-century words "virtualis" (achievable, attainable) and "virtus" (power, excellence, courage, efficiency, ability, virtue, and masculinity). They define how physical qualities or compelling talents affect technology's fundamental properties.

Milić believed that "virtuality" referred to God's presence on earth at that time. God was supposed to be present in a non-physical, virtual fashion. In the 15th century, "virtuality" meant something with an essence or effect but not reality. Thus, virtuality has an effect. Virtuality in computer terms was proven in 1959 as something that can be created and presented by software but has no physical stability.

Dimitropoulos, Mourtzis, Rentzos, and Michalos studied virtual, augmented, and mixed reality. In virtual reality, virtuality is now a reality. However, a person is in an artificial environment that can represent real and fictional beings and things. That is, virtuality copies reality.

Howard defines virtuality as unreal. It presents an imaginary or genuine reality that human senses, including vision, touch, hearing, and smell, can experience.

Reality is the opposite of virtuality and represents something actual to humans. It is well-established that humans perceive reality through their five senses (vision, smell, taste, touch, and hearing). These are the most visible senses, although people have additional ones, like balance. Every reality a person experiences is sensed. The brain processes sensory information to create every reality experience. Since reality can only be experienced through environmental input, reality perception alters accordingly. Presenting a false reality is feasible. To humans, it appears natural, and virtual reality accurately depicts the above. Informational terms virtual reality and virtual environments (VE) might be the same. Other words like Synthetic Experience, Virtual Worlds, Artificial Worlds, and Artificial Reality are also used. These concepts have numerous definitions but share the same meaning: Real-time interactive graphics with three-dimensional models and display technology let users directly alter the modeled world. The synthetic environment contributes to illusion and external observation. Virtual reality uses three-dimensional, stereoscopic displays with movement, picture, and soundtrack. Virtual reality is multimodal.

Virtual reality is an integrated, interactive, multimodal, three-dimensional, computer-generated environment that involves many technologies. Three-dimensional real-time navigation and preview are possible in virtual reality with six degrees of freedom. Virtual reality momentarily copies reality (Jiang & Tang, 2012).

AI TECHNOLOGY

Artificial intelligence is one of the areas of computers that has seen the most significant expansion over the past few decades. Alongside this speedy expansion, the scope of this discipline's work and its demands are expanding. While some fields of computers are already deemed to be wound up and are not expecting new critical penetrations, outcomes in artificial intelligence are only expected, even though many "intelligent" systems are extraordinarily well operating (Ballamudi, 2019a). This may be because these "intelligent" systems, besides susceptible external manifestations, use principles humans do not often consider intelligent. This may explain why this phenomenon has occurred. Naturally, artificial intelligence is only growing in popularity, and fresh experiments and theoretical studies are paving the way for new applications in various fields (Mandapuram, 2017a). Since the development of artificial intelligence has always been based on the complementary linking of theory and experimentation, future development requires the expansion and consolidation of theoretical knowledge, in particular mathematical knowledge, knowledge of specific application areas, and adequate formalization. This is because the development of artificial intelligence has always been based on the complementary linking of theory and experimentation (Liu et al., 2012).

In most contexts, when we talk about intelligence, we mean the capacity to acquire, recall, and apply specific knowledge. In any event, we can assume that intelligence implies at least two abilities: the capacity to memorize information and the capability to process that information. It is impossible to have intelligence if you lack knowledge, whether a person or a machine. A human or machine with extensive "static" information or data without the ability to handle and solve relevant problems cannot be deemed intelligent. This is because "static" knowledge and data are not dynamic (Ballamudi, 2019b). There are also a variety of other facets that make up intelligence. One of them is the rate at which information is processed, which, when it comes to computers, is contingent not only on the procedure for arriving at a decision but also on the technical qualities of a particular computer. Even though it may be considered a subset of problem-solving ability, the capacity to learn is one of the most essential characteristics of intelligence because new information acquired is also considered a component of intelligence.

Within the realm of computing, artificial intelligence can be further broken down. Research into artificial intelligence (AI) aims to create programs (software) that will make it possible for computers to act in a manner that may be described as intelligent (Gutlapalli, 2016b). The initial line of investigation is connected to the beginnings of computing itself. The idea of developing machines that can carry out a variety of activities in an intelligent manner was at the forefront of the concerns of computational scientists. Throughout the second half of the 20th century, they decided to investigate artificial intelligence. Expert systems, limited-domain translation systems, human speech recognition, written texts, automated proofing theorem, and a constant interest in generating broadly intelligent, autonomous agents are the current areas of concentration for researchers in intelligence research. In a larger sense, "intelligent intelligence" refers to an artificial artifact's capacity to perform operations hallmarks of human thought (Xu et al., 2016).

"Artificial Intelligence" refers to a digital computer or computer-controlled robot's capacity to carry out activities typically associated with intelligent activities.

Four different perspectives can be taken on systems with artificial intelligence. The first category consists of artificial intelligence and computer programs that can reason (Gutlapalli, 2017b). Both of these areas are concerned with different ways of thinking and reasoning. On the other hand, behavior is the subject of discussion in the other two categories, which are systems that behave in a manner analogous to that of people and systems that behave rationally (Gutlapalli, 2017a). Categories such as human reasoning and human behavior measure performance within the framework of matching with human performance, whereas rational reasoning tests performance within the context of success compared to the ideal conceptions of intelligence that we term rationality (Gutlapalli, 2016a).

AI AND VR IN REAL ESTATE

The real estate industry is currently utilizing artificial intelligence and virtual reality to improve customers' purchasing and selling experience and the efficiency of real estate professionals (Lal & Ballamudi, 2017).

AI can analyze vast volumes of data and provide insights into various topics, including customer preferences, market trends, and property prices. This enables real estate professionals to judge based on the data and deliver customized suggestions to their customers. Real estate agents can better manage their time and resources thanks to chatbots and virtual assistants driven by artificial intelligence (AI) (Gutlapalli, 2017c). These tools improve client service and lead creation.

On the other hand, virtual reality is being used to provide immersive virtual tours of properties. These tours enable clients to explore properties in greater detail remotely. This technology has applications for both residential and commercial real estate, and it can speed up the decision-making process for prospective purchasers and cut down on the number of times they have to visit the property in person (Deming et al., 2018). Virtual reality (VR) can also be utilized for architectural visualization and design, which can assist architects and developers in showcasing their projects to prospective buyers and investors.

The current situation of artificial intelligence (AI) and virtual reality (VR) in real estate is one of tremendous growth and experimentation. Many firms and organizations are investigating new methods to employ these technologies to enhance their customers' experience and expedite their operations (Park et al., 2010).

We are currently suffering from information overload due to the vast amount of information available for decision-making. As a result, many businesses deal directly with analyzing and presenting the finest possibilities, after which they counsel us in making the best decision possible while charging a specific fee for their services. We engage in data mining when we extract knowledge (or samples) from large amounts of complex data. This is true regardless of whether we rely on people or machines. The ability of artificial intelligence systems to retain huge volumes of data from which they can derive any relationship enables them to be particularly well-suited for the activities in question. This allows the systems to build patterns, relationships, and meaningful links. Deep learning is the name given to the process through which modern algorithms harness this capability to do cognitive computing (Mandapuram & Hosen, 2018).

The introduction of artificial intelligence, a growth in the use of automation, the Internet of Things, and other combinations of these technologies all contribute to a shift in the labor market (Thaduri, 2017). Artificial intelligence enables businesses to improve their operational effectiveness by penetrating new segments of the overall market. Artificial intelligence (AI) has permeated every aspect of modern life and fundamentally reworked how business is conducted due to the vast data and processing power currently available (Reddy et al., 2020). The Industrial Revolution resulted in the gradual replacement of humans on assembly lines by machines that performed their tasks more efficiently. Even when the human being has not been entirely replaced, one gradually begins to rely more and more on machines to help him work (Thodupunori & Gutlapalli, 2018). This is because robots are more efficient. One of the jobs that robots will eventually do is that of a real estate agent.

BENEFITS OF VR RENDERINGS

3D VR Panoramic Renderings are a prime example of how the digital era has challenged reality. 3D VR (Virtual Reality) Panoramic Rendering gives viewers a complete 360-degree perspective of a simulated area, immersing them in a virtual world. This technology captures the spectator, making them feel like they're 'within' the digital scene, twisting their head and examining the environment as they would in real life (Thaduri & Lal, 2020). The field of virtual reality has advanced dramatically in recent decades. VR has evolved from science fiction into accurate technology. VR's progress from simple polygon shapes in the early

1990s to ultra-realistic simulations is groundbreaking. VR has transformed established approaches into cutting-edge experiences in gaming, architecture, education, and medicine. To comprehend the dramatic ascent of 3D VR Panoramic Renderings, go back to 3D rendering. 3D rendering first created static, three-dimensional images on two-dimensional screens. While better than 2D graphics, these visualizations could have been more interactive and engaging. They provided context but couldn't 'enter' or 'feel' the scenes. The video game industry and cinematic visual effects drove 3D rendering technology to become more complicated and realistic (Thaduri, 2018). We saw the world in 3D with vivid textures, dynamic lighting, and accurate physics. Despite these advances, the experience was primarily passive. VR began as simple headgear with minimal graphics, promising an immersive digital experience. As graphic technology and software algorithms improved, 3D rendering and VR became a natural pairing (Bodepudi et al., 2019).

3D VR Panoramic Renderings were a breakthrough. Stepping inside a 3D model was more than watching it on a screen. Panning VR was a conceptual leap, not just a technology advancement. It revolutionized how professionals viewed design, narrative, training, and more, enabling us to participate in digital environments (Popovic et al., 2017).

Immersive Experience: Immersion is one of 3D VR Panoramic Renderings' most significant benefits. The term "immersive" is often overused in digital technology, but with VR, it transforms. VR lets you experience a scene. VR's panoramic features immerse the viewer in a 360-degree virtual world, making the experience interactive. Immersive experiences have many uses. Consider property tours (Chen et al., 2019). Traditional approaches needed customers to visit or use 2D photos or videos. 3D VR Panoramic tours allow people to "walk through" a property visually, giving them a feeling of its spaciousness, layout, and aesthetic that images cannot. Immersive 3D VR has also changed virtual travel. VR panoramic graphics make historic sites, luxury resorts, and nature retreats seem real. Museums employ VR for virtual tours, letting visitors examine exhibitions from home with a sense of presence that a 2D webpage can't match (Cui et al., 2014).

Improved Design Visualization: Design visualization is greatly enhanced with 3D VR Panoramic Renderings. 3D models are limited, but architects, interior designers, and urban planners use them. While they provide a three-dimensional depiction, they don't let viewers "experience" the design. VR makes design a simulation, not just a representation. VR allows designers to navigate the virtual space as they would in real life, creating a unique sense of size, proportion, and spatial relationships (Thaduri, 2019). The capacity to "inhabit" a design before it's built has significant ramifications. Real-time modifications may be the biggest benefit. VR walkthroughs can reveal flaws, miscalculations, and places for development that 3D models missed. This improves design efficiency and accuracy, saving time and money (Ballamudi, 2016).

Additionally, clients can provide rapid feedback. The VR environment allows clients to test different flooring and wall colors in a room instantly. Immersion and design visualization are just the beginning of 3D VR Panoramic Renderings' transformational potential (Mandapuram et al., 2018). They make a strong case for why this technology is gradual and revolutionary.

Cost Savings: Traditional design and development methods sometimes require physical prototypes or mock-ups for final evaluations before manufacturing (Dekkati et al., 2016). These procedures are effective yet expensive. Material, labor, and specialized machinery are needed to make physical prototypes. Alternatives like 3D VR Panoramic Renderings can significantly reduce these expenditures. VR technology can create a completely interactive, 360-degree design perspective without a prototype. This reduces material and labor costs and speeds up manufacturing, increasing cost-efficiency. VR panoramas' intricacy and realism help designers and project managers discover design problems early on (Ballamudi, 2019c). Correcting these faults is cheaper and faster than fixing them in a physical model or during production. According to Gartner Group research, a single design problem identified in the prototype stage might be 100 times cheaper to remedy than in production (Sullivan, 2017).

Enhanced Client Engagement: Technology has changed how firms and professionals display their work to clients. Slideshows and 2D images are helpful, but 3D VR Panoramic Renderings attract clients in no other manner. VR presentations become interactive experiences that let clients explore, question, and envisage the final product or place. Deeper engagement leads to more engaged, invested, and delighted clients (Desamsetti, 2016b). Entertaining clients in a presentation helps them comprehend the product or concept, eliminating miscommunication and disappointed expectations (Desamsetti & Lal, 2019). Real estate organizations using VR in their sales have significantly boosted client engagement and satisfaction. One study found that VR tourers were 27% more likely to plan a follow-up visit and 17% more likely to make an offer than standard tourers. VR proposals in architecture have won contracts due to their immersive, interactive nature. Walking around buildings before they are built strengthens clients' emotional and intellectual connections to the project (Dekkati et al., 2019). 3D VR Panoramic Renderings' cost reductions and client engagement benefits demonstrate its practicality. VR workflow integration benefits companies and professionals technologically, monetarily, and relationally (Desamsetti, 2016a).

Interactive Features: Interactivity is a hallmark of 3D VR Panoramic Renderings. Advanced VR panoramas can incorporate interactive aspects beyond navigation, unlike renderings or basic VR simulations. Users can unlock doors, turn on lights, rearrange furniture, and change weather and time. User control makes the encounter more like an adventurous adventure than a guided tour (Thaduri, 2020). This interactive element affects user engagement significantly (Desamsetti, 2018). Imagine a potential homeowner going around a 3D-rendered home, opening kitchen cupboards, turning on taps, and coloring the walls to their liking. Interactive features give realism and personalization that a traditional presentation can't, bringing consumers more deeply into the experience and making them more invested in the outcome (Dekkati & Thaduri, 2017). Interactivity is also helpful for market research and product creation. Businesses may measure which features people use most to learn about preferences and habits and enhance designs (Prandi et al., 2014).

Accessibility & Remote Viewing: Technology that breaks down geographical barriers is invaluable in an increasingly interconnected world. Remote viewing is a significant benefit of 3D VR Panoramic Renderings. Unlike physical sites or models, VR panoramas may be enjoyed anywhere with the proper hardware and software. This capability opens up massive global collaboration and remote interaction potential. Global real estate and international development stakeholders can "tour" a property or project location remotely. Global design teams can navigate a virtual world and make real-time decisions (Desamsetti, 2020). Remote but immersive campus tours might be offered to international students. This accessibility is convenient and affordable. International cooperation can be more practical and profitable by reducing travel and time costs.

Better Training & Simulation: 3D VR Panoramic Renderings effectively train and simulate across industries, not only sales and design. Consider medicine. Before operating on patients, surgeons can rehearse complex procedures in a risk-free virtual environment with 360-degree views and interactive tools. Immersive training can boost skills and reduce errors. VR flight simulators provide more realistic training for aircraft pilots than 2D simulators. VR panoramas allow soldiers to rehearse plans and maneuvers in a safe, natural setting.VR can reduce danger and improve skills in high-stakes occupations. A virtual operating room or simulated flying error can be learned from without terrible consequences. This risk-free training environment allows for experimentation and learning that is unattainable in real life. Interactive training and simulation applications show the adaptability and effectiveness of 3D VR Panoramic Renderings. Technology promises many benefits, from improving consumer interaction to creating a safer, more productive training environment.

Emotional Connection: Technology conversations sometimes neglect the emotional aspects of an experience, which might influence decision-making. VR can provoke intense emotional reactions that standard viewing methods couldn't match due to its immersive nature. 3D VR Panoramic Renderings make the viewer an active participant, allowing for a more personal connection to the environment. Real estate purchases generally include a significant financial investment, making emotional participation crucial. VR may give customers a vibrant sense of "home," something photos and video tours cannot. They can imagine their life in those walls, making their decision more emotive. Retailers can also develop virtual showrooms where customers can "feel" the ambiance and layout, creating a brand connection that a standard web page may struggle to achieve. VR can help nonprofits bring empathy and urgency to social issues, making it more emotionally engaging than traditional storytelling. Accessibility and emotional connection are critical features of 3D VR Panoramic Renderings. They make the technology more valuable than aesthetics or interactive games, benefiting many industries (Jamei et al., 2017).

Customization & Flexibility: Adaptability makes 3D VR Panoramic Renderings appealing. Pre-rendered VR is interactive and immersive, but customization makes it magical. Users can customize their environment to suit their needs. Imagine a virtual automotive showroom where purchasers may "walk" around the vehicle and change colors, wheel styles, and interior finishes in real-time. Consider an online furniture store that lets buyers try layouts and styles before buying. Customer satisfaction and transaction success rise with this level of customization. Users can deeply engage with a product or area by tailoring it to their interests and needs. This sense of ownership over the experience must be addressed and can significantly affect a project or product's success. The speed, efficiency, and customization of 3D VR Panoramic Renderings suggest that this technology will become standard in many industries. 3D VR Panoramic Renderings go beyond high-tech visuals by simplifying procedures and personalizing experiences. Companies that use these benefits can improve internal operations and give customers and stakeholders a better experience. They raise the bar for design, presentation, and user engagement.

Speed and Efficiency: 3D VR Panoramic Renderings' speed and efficiency improvements might give businesses an edge in a time-sensitive industry. VR provides a realistic, interactive experience that helps stakeholders quickly grasp a project or product and make decisions. The time-consuming and logistically challenging site visits required for property development can be significantly reduced with 3D VR (Thaduri et al., 2016). A complete VR tour can replace multiple preliminary site visits, speeding up assessments and approvals. When clients or senior management can "see" the completed product in a realistic virtual environment, product developers can achieve faster sign-offs and fewer reviews or mock-up changes.

CONCLUSION

Artificial intelligence and virtual reality transform our economy and lifestyles. The user adapts virtual reality to his demands over time. Virtual environments allow rooms to be discovered in places normally inaccessible owing to price, security, or perceived limits. AI and VR-based real estate app development benefits real estate professionals and consumers. AI-powered real estate apps help specialists judge by predicting market trends, property valuations, etc. Real estate brokers and clients save time and money by automating property inspections and showings with AI. Real estate apps using VR can give buyers an immersive and interactive home tour. VR technology lets purchasers experience properties as if they were there, helping them decide if they want it. AI/VR technology creates virtual walkthroughs of under-construction properties to show buyers the outcome. A real estate app with AI and VR enhances the experience. An AI-powered virtual agent may help buyers identify houses that meet their criteria, while a VR-powered virtual tour can immerse them in the property. AI/VR-based real estate apps can incorporate property search and comparison, property management, and real-time market updates. AI and VR-based real estate app development improves productivity, cost savings, and buying experiences. The software developer should prioritize privacy, security, and usability. Many interactive computer environments and simulations that integrate senses to create a realistic illusion are possible now. The technology simulates stereoscopic vision and manipulates video, audio, and fragrance. We can now visit the world's most famous museums and walk the streets of the world's top cities online with virtual reality. Programming systems with automatic reading support and data estimation are the biggest real estate problems. AI can estimate real estate agreements and other papers. Reliable, intuitive learning solutions and their implementation require highly qualified personnel. In addition to functionality, users must consider data security and regulatory requirements. VR cannot replace decision-making. Decision-making is the most complex human task. The real estate sector uses AI and human decision-making to achieve this.

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