Review Paper on Transformative Power of AR And VR In Construction

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Abstract- *The construction industry, one of the oldest in the world, is now undergoing a major transformation. This shift is due to the advent of digital technology, with Virtual Reality (VR) and Augmented Reality (AR) leading the charge. Not only is this technology advancing the way buildings are designed and constructed, it is also strengthening safety, simplifying training and even changing business strategies. As this technology continues to evolve, its impact on the construction industry is likely to increase even further. The construction industry, like everyone else, must adapt to these changes or risk being left behind. As the famous author William Gibson once said, "The future has arrived — it's just not quite perfect." The future of content development is here with VR and AR, and it's time for the industry to embrace it. Ultimately, adopting VR and AR in construction isn't just about staying ahead of the curve. It's about creating the best outcome for all stakeholders - from architects and construction workers to clients, homeowners. It's about building a future where construction is safer, more efficient, and more in line with the needs and expectations of those it serves. So, whether you're a builder, buyer, or homeowner, it's time to embrace digital transformation in construction. After all, as Benjamin Franklin's famous quote goes, "Tell me and I forget, teach me and I remember, engage and I learn." With VR and AR, everyone involved in a construction project can fully participate and learn from the process, leading to better outcomes for everyone. The manufacturing industry is on the verge of a digital transformation, and VR and AR are an important part of this transformation. they were in the front. This technology isn't just changing the way we design and build; They are changing the way we think about products. They open up new possibilities, break down barriers and pave the way for a future where construction is safer, more efficient and more inclusive.*

Keywords- Virtual reality;applications of virtual reality;augmented reality

I. INTRODUCTION

Advanced technology is gaining prominence across the globe, especially after the pandemic. To keep pace with this trend,

Indian companies have been adopting advanced technologies, such as Artificial Intelligence (AI), Big Data, Augmented Reality (AR) and Virtual Reality (VR), to improve efficiency and productivity. AR is a technology that superimposes an image onto the user's view of the natural world and enhances it with sound and touch. VR, on the other hand, refers to a computer-generated 3D environment that is fully digital. Complex things can be simplified by visualisation using both these technologies. A smart device and camera are required to experience AR, while VR is experienced through a proper VR headset. The global AR/VR market size stood at US$ 28 billion in 2021 and is projected to reach US$ 250 billion by 2028, according to Statista. In India, AR/VR adoption has grown across business verticals, expanding from US$ 0.34 billion in 2017 to US$ 1.83 billion in 2020 at a compounded annual growth rate (CAGR) of 75%.

II. OVERVIEW OF AR/VR MARKET IN INDIA:

According to Research and Markets, the total market size of AR/VR in India is expected to advance at a CAGR of 38.29% to US$ 14.07 billion by 2027, driven by increased smartphone penetration and widespread internet connectivity, and this trend is expected to continue. As of 2021, India had 1.2 billion mobile subscribers, of which 750 million were smartphone users. Most of the young population in Tier 2 and Tier 3 cities have high tech literacy, which has enabled companies/app providers to offer AR-based experiences. AR/VR technology is widely used in retail, education, gaming, and healthcare. Usage of AR/VR headsets has increased in the consumer segment due to the lower cost of wearables. The hardware segment dominated India's AR and VR segment with 71% share as of FY20.
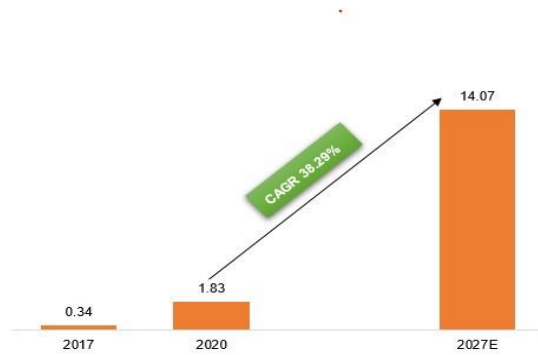
fig2.1.1 Source: Research & Markets

III. AREAS IN CIVIL ENGINEERING WHERE AR AND VR CAN BE APPLIED

• Design and Planning: Visualizing and optimizing architectural designs, urban planning, and infrastructure layout.
• Structural Analysis: Simulating and analyzing the behavior of structures under different loads and conditions.
• Construction Management: Assisting in on-site project management, progress monitoring, and quality control.
• Facility Management: Enhancing maintenance and operation processes, including asset tracking and inspection.
• Possible applications of Virtual Reality (VR) and Augmented Reality (AR) in civil engineering:
• Design Visualization: VR and AR can be used to create immersive 3D models of architectural designs, allowing engineers to visualize and analyze structures before construction begins.
• Virtual Site Visits: VR can simulate site visits, enabling remote stakeholders to explore construction sites and gain a better understanding of the project's progress.
• Safety Training: VR can provide realistic simulations of hazardous scenarios, allowing workers to undergo virtual safety training and practice emergency procedures.
• Equipment and Machinery Training: VR and AR can be used to train workers on the operation and maintenance of complex equipment and machinery used in civil engineering projects.
• Structural Analysis: VR can visualize and analyze structural designs, allowing engineers to simulate load conditions and identify potential weaknesses or design flaws.
• Urban Planning: VR and AR can assist urban planners in visualizing proposed developments, assessing their impact on the surrounding environment, and gathering public feedback.

• Clash Detection: VR and AR can be used to identify clashes or conflicts between different building systems (e.g., electrical, plumbing, HVAC) before construction, minimizing costly rework.
• Construction Simulation: VR and AR can simulate construction processes, allowing engineers to identify potential bottlenecks, improve logistics, and optimize construction sequences.
• Real-Time Progress Monitoring: AR can overlay digital information onto physical structures, providing real-time data on construction progress, quality inspections, and project milestones.
• Building Maintenance and Facilities Management: AR can assist in maintenance tasks by overlaying digital information onto physical assets, providing real-time instructions for repairs, and facilitating asset tracking.
• Energy Efficiency Analysis: VR and AR can simulate energy consumption and efficiency in buildings, helping engineers optimize energy usage and identify opportunities for improvements.
• Historical Preservation: VR and AR can recreate historical structures or sites digitally, preserving cultural heritage and allowing virtual tours for educational and tourism purposes.
• Traffic Simulation: VR and AR can simulate traffic patterns and analyze the impact of infrastructure changes on traffic flow, aiding in the design of efficient transportation systems.
• Disaster Preparedness: VR and AR can simulate disaster scenarios, enabling civil engineers to develop emergency response plans, evacuation strategies, and assess the resilience of infrastructure.
• Public Engagement: VR and AR can enhance public engagement by creating interactive experiences and virtual walkthroughs of proposed projects, allowing stakeholders to provide feedback and understand the project's impact.

These are just a few examples of the potential applications of VR and AR in civil engineering. As technology continues to advance, new possibilities will emerge, further revolutionizing the field.

IV. ADVANTAGES AND DISADVANTAGES

A. **Advantages of VR and AR in Civil Engineering**

• Enhanced visualization and understanding of complex designs.
• Improved collaboration and communication among project stakeholders.

- Increased efficiency and accuracy in construction processes.
- Enhanced worker training and safety protocols.

B. Disadvantages of VR and AR in Civil Engineering

- Initial costs associated with acquiring and implementing VR and AR technologies.
- Technical limitations, such as the need for high-quality hardware and software compatibility.
- Potential learning curve for users unfamiliar with the technologies

V. HERE ARE FEW FIRMS WORKING IN VR AND AR IN INDIA

SmartVizX: SmartVizX - We are VR® is an amazing VR firm specializing in architectural visualization and virtual reality solutions for the construction industry. They offer VR experiences for design review, walkthroughs, and immersive client presentations.

Imaginate: Imaginate XR is also another amazing firm travels ahead of technology that focuses on virtual reality and augmented reality solutions. They have a global presence and offer products and services for industries such as healthcare, education, and entertainment.

Merxius: Merxius is an Indian startup that develops AR and VR solutions for industrial applications. They have a presence in multiple countries and cater to sectors like manufacturing, engineering, and training.

Whodat: Whodat (Acquired by BYJU'S) is an augmented reality company that offers AR solutions for retail, advertising, and entertainment. They have expanded their reach globally and worked with international clients.

Simulanis: Simulanis is an Indian firm specializing in virtual reality, augmented reality, and mixed reality solutions. They provide services to clients across the globe, particularly in the manufacturing and training sectors.

VI. CONCLUSION

The conclusion is that VR and AR are very important. And there are powerful tools that are changing the construction industry. They increase imaging, improve security, simplify training, monitor and manage, encourage collaboration, and transform business dynamics. The table below summarizes the impact of VR and AR on the construction industry.

As these technologies continue to evolve, their impact on the construction industry is likely to grow even further. The construction industry, like any other, must adapt to these changes or risk being left behind. As the famous author William Gibson once said, "The future is already here — it's just not very evenly distributed." With VR and AR, the future of construction is here, and it's time for the industry to embrace it.

In the end, the adoption of VR and AR in construction is not just about staying ahead of the curve. It's about creating better outcomes for all stakeholders - from architects and construction workers to clients and landlords. It's about building a future where construction is safer, more efficient, and more aligned with the needs and expectations of those it serves. So, whether you're a builder, a client, or a landlord, it's time to embrace the digital transformation in construction.

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