

Applications of Augmented Reality & Virtual Reality in Construction Industry

Ashutosh Deshmukh¹ Tushar Avhale² Kunj Gala³ Nidhanshu Bhatt⁴ Prof. Raksha Khandare⁵

^{1,2,3,4}Student ⁵Associate Professor

^{1,2,3,4,5}Department of Civil Engineering

^{1,2,3,4,5}A P Shah Institute of Technology, Thane, Maharashtra, India

Abstract— In the construction industry, increasing the quality of construction productivity is a hot topic. According to research, the construction industry loses 30 to 40% of its productivity due to inefficient work processes, unhealthy working conditions, high labour costs, and the failure of information systems to provide the required and relevant information. Owners expect construction companies to come up with more cost-effective options to meet their needs, thus increasing project efficiency. As a result, we are employing some cutting-edge techniques and software in this project, such as BIM, BlueBim, AutoCAD and Revit, Naviswork, Augmented and Virtual Reality, and so on. So that we can imagine the building's design or how it will appear after it has been completed. So, here's some quick background on this project. Building and infrastructure designs are designed and recorded using BIM. In BIM, every aspect of a structure is modelled. The model can be used for research, exploration of design choices, and visualisations to help stakeholders visualise the building before it is completed. The Building Information Model (BIM) is a smart 3D model-based process that offers insights and tools for architecture, engineering, and managing buildings and infrastructure (AEC) professionals more efficiently and efficiently. In today's architecture, it's become a must to take care of the project's soft assets near the end of construction to ensure that there's a record for future usage. AR and VR are leading technologies that play a crucial role in the building industry, since they can be used for advertising and ensuring the safety of individuals in dangerous situations.

Keywords: Augmented reality, Virtual reality, AutoCAD, BlueBim, BIM, Naviswork, Revit

I. INTRODUCTION

As the human race and the construction industry both expand at a faster pace, there is a need for applications that will make the company run more smoothly and efficiently. As a result, augmented reality and virtual reality are critical to the construction industry's development. From smartphone applications to laser scanning and drone photogrammetry, new construction technology is quickly changing the way construction is done. Few construction sites have completely avoided the march of technology, but many businesses have fully embraced it and are reaping significant benefits. In the construction industry, virtual reality and augmented reality are becoming increasingly common. Virtual Reality (VR) is a cutting-edge technology that is revolutionising the construction industry by addressing long-standing issues. It entails a comprehensive virtual model of the project, similar to 3D modelling. Unlike 3D modelling, it puts the user directly within the simulated world, allowing them to fully immerse themselves in it. Augmented Reality (AR) is a cutting-edge technology that

allows computer-generated images to be superimposed on a real-world scene. As part of the design process, AR helps users to walk through the designs. Users can see first-hand how spaces can be used with 3D architectural walkthroughs, and then build or refine the plan from there.

We're playing the role of a VDC consultant for a client in this scenario. The client wants to construct a three-story college house. For the proposed project, we will provide the client with a complete VDC kit. It will be included in the kit. The building's architectural, structural, and MEP drawings. (Because we are the VDC consultant, we will be modelling rather than designing the structural and MEP components). We will also include a full Revit model of the building for future reference, estimation, scheduling, AR & VR, and other purposes. In addition, using navis work, we will provide the client with a clash report for the structural and architectural components. Finally, we'll use the above softwares to prepare quantity take-offs for the house.

II. LITERATURE REVIEW

Augmented and Virtual bound and in near future this application into construction industry will make our work easy and safe. Reality is the near future of this industry. Soon we will be all technology

A Brief Look at Augmented and Virtual Reality in the Construction Industry are being used to create a network that will enable people who are geographically separated to hold conferences with each other. The research could aid in the exploration of the potential fields of using AR and VR technologies in the construction industry as a cost-effective and time-saving method [1].

AR & VR technology is an undeniably unique tool with many applications, ranging from educating students all over the world to simulating safety scenarios. However, it must be combined with viable use case scenarios and real-time data collection in order to capture human activity and provide a fun VR experience [2].

AR was found to be effective in construction project scheduling, progress monitoring, worker training, safety management, time and cost management, and quality and defect management, according to this report. Virtual reality can be used as a simulation tool, a staff training tool, a protection management tool, and a quality and defect management tool [3].

Virtual Reality (VR) is a technology that has seen significant advancements in its hardware in recent years, allowing for more affordable head-mounted displays (HMD) and, as a result, greater adoption [4].

This case study demonstrates how incorporating virtual reality models and a specialised interactive display system into an integrated design process benefits a design

team by allowing for more efficient meetings and the discovery of hidden design issues [5].

III. METHODOLOGY

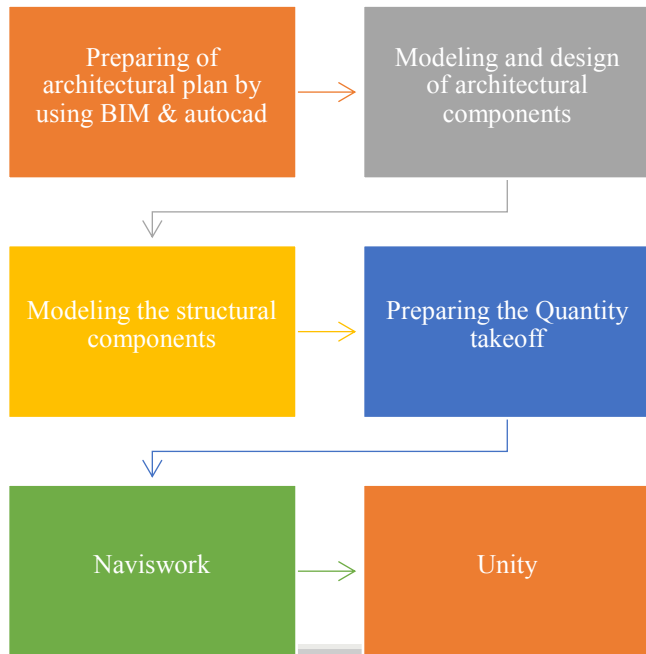


Fig. 1: Methodology

Fig. 1 shows the work flow as it progresses through the project.

A. Using BIM and AutoCAD to build an architectural plan

Using AutoCAD software, we were able to design and locate different rooms while taking into account building design norm rules and vastu.

B. Architectural component modelling and design

Bim and Revit are the programs that will be used. At this stage, the interior and exterior architectural components of the proposed building will be designed and modelled using Bim and Revit. We will create the architectural drawing sheets that will be part of our final deliverable.

C. Structural component modelling

Since we are a VDC consultant, we can simply model the structural components rather than design them. For this project, we'll use the same general beam and column sections that we've used in previous projects. We'll make the structural drawing papers as well.

D. Preparing the Quantity Take-off

After designing and modelling the architectural and mechanical components, we will construct a quantity take-off for various components using Revit and Bim software. The quantity take-off for the entire structure will be completed, and the important quantities will be included as a layer in the final deliverable.

E. Naviswork

We're going to switch our Revit model over to Naviswork. A clash detection report for the clashes in the architectural

and structural model will be created to remove any inconsistencies.

We will use unity tools to imagine AR & VR successful video and will provide video of the building for a better understanding of the building's potential visual.

F. Unity

We will bring the plan into unity programme for 3D rendering after receiving the clash detection report and detecting all clashes. We will also have a walkthrough video of the building for a better understanding of the building's potential appearance.

IV. RESULTS & ANALYSIS

As a VDC consultant, we will provide our clients with an architectural plan, structural plan, clash detection report, quantity takeoff, scheduling, and a pre-planned 3d video that shows real-time visualization of the model. We will also provide the video using AR & VR technology to provide an emergency exit plan that will aid in dealing with critical situations such as earthquakes. We prepared an architectural and structural plan, as well as a structural analysis, based on the client's requirements, and then used Naviswork to diagnose and reconcile clashes between the structural and architectural models, as shown in following fig. 2.



Fig. 2: Clash detection report

After the clashes were resolved, the plan was put through 3D rendering in Unity software, allowing us to see the 3d model we had already developed. We demonstrate what it would look like after the construction by using real-time data in the video. The following diagram depicts a portion of the video that was created with Unity software. (Fig. 3 & 4)



Fig. 3: Inside view of lab using AR & VR



Fig. 4: (Inside view of corridor) Output of AR &VR

This software enhances the model, and as a VDC consultant, we provided the client with a short video of the designed model.

V. CONCLUSION

We have presented a system that allows immersive visualization to become a natural and integrated part of the building design process. Virtual reality is not just concerned with moving about a virtual environment to gain a different view of model. It is about a true interaction that can occur with all aspects of the virtual domain. This might involve the feeling of the object, moving objects to new positions, modifying object sizes etc. Cost efficiency is also taken into consideration as it depends upon the level of detailing the customer wishes. General level of detailing is 300. It ranges from 200-600 as the level increases the price gets high. Other factors such size of project, scheduling also takes part in cost.

REFERENCES

- [1] Shakil Ahmed, Md. Mehrab Hossain, Md. Ikramul Hoque (January 2002): (A Brief Discussion on Augmented Reality and Virtual Reality in Construction Industry).
- [2] Thabet, W., Shiratuddin, M.F. & Bowman (December 2007): (Virtual Reality in Construction: A Review)
- [3] Shakil ahmed (May 2016): (A Review on Using Opportunities of Augmented Reality and Virtual Reality in Construction Project Management)
- [4] Rua Dr. Roberto Frias (2018): (Virtual reality in the architecture, engineering and construction industry).
- [5] Yifan Liu¹, Jennifer Lather¹, John Messner¹ (2019): (Virtual Reality to Support the Integrated Design Process: A Retrofit Case Study).