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Feature of Augmented Reality, Virtual Reality in Construction Industry

Akshitha P
Dept of Computer science and engineering, KLEF
Vaddeswaram, India

Rajesh Kumar T
Dept of Computer science and engineering, KLEF
Vaddeswaram, India

Swarna Kuchibhotla
Dept of Computer science and Engineering, KLEF
Vaddeswaram, India

Shahena Afrin
Dept of Computer science and engineering, KLEF
Vaddeswaram, India

Vamsi K
Dept of Computer science and engineering, KLEF
Vaddeswaram, Andhra Pradesh

T. Vignesh
Dept of Computer science and Engineering, KLEF
Vaddeswaram, India

Abstract*—The modern construction business depends on the widespread usage of data to remain operational. Technologies related to the Internet and telecommunications have achieved enormous advancements, and they are increasing rapidly. Those construction companies capable of successfully adopting and using new technology will have a considerable advantage over their competitors. The construction industry stands to benefit enormously from cutting-edge augmented reality technology, which has the potential to transform the sector (AR) completely. Even though researchers have had a long-standing interest in augmented reality (AR), there has never been a single project that has fully examined the benefits, limitations, and future possibilities of utilizing AR in the current building. The primary objective of this research is to investigate the applicability of augmented reality (AR) within the context of the building and construction industry throughout a full construction project's lifecycle. The phrases that follow offer several predictions regarding future augmented reality advancements within the construction sector. This study contributes to the body of previously accumulated knowledge by analyzing the anticipations of construction industry professionals regarding future augmented reality development.

Keywords*—Augmented reality (AR), Construction industry, Lifecycle, Technology adoption, Data utilization, Visualization.

I. INTRODUCTION

Throughout the 20th century and beyond, there was a significant shift in the assembly and building practises that were used. We are of the opinion that the building and construction sector all over the world has been subject to significant changes and advancements. In order to meet the demand for larger and better buildings, the construction industry has modified its processes, procedures, and strategies. The construction industry has embraced new technologies in order to compete for skilled workers and innovative methods, as well as to keep innovative methods and skilled workers. This has helped them deal with issues such as workers who are not physically fit enough, projects that are behind schedule, and poor results. The building and construction industry makes use of technology that employs virtual reality (VR). It gives users the ability to navigate and interact within a computer-generated three-dimensional world [1]. Augmented reality (AR), which is based on the same concept as virtual reality, uses elements from the real world in combination with elements from the virtual world to create the impression that both the real world and the virtual world are present at the same time.

The use of computer-generated images, sounds, text, and effects in augmented reality (AR), a kind of interactive, reality-based display environment, enhances the user's experience of the real world. Augmented reality (AR) is also known as mixed reality (MR). Augmented reality (AR) provides users with a more complete and accurate picture of their surroundings by combining content from the real world with that from the virtual world. In the realm of virtual reality, a person is able to interact with a three-dimensional image or environment in a manner that gives the impression of being real or physical with the assistance of a specialized digital system, such as a helmet fitted with an internal screen or gloves equipped with sensors (VR).

There are numerous applications for augmented reality and virtual reality that could help a project in a variety of ways, including accelerating the design development process, improving training and safety on the job site, and improving communication with all parties involved, from the owner to the labourers. These applications could also help a project save money and exceed the expectations of the owner. Professionals in construction engineering and management can provide a brand-new educational experience for their customers, consultants, and contractors by utilizing augmented and virtual reality (AR/VR). This experience will be based on a 3D model [2]. Problems, dangers, and accidents are stopped dead in their tracks, which enables people to concentrate their efforts on more fruitful activities. People will be able to visualize a project using AR and VR before it is actually built. This provides individuals with or without prior building experience with an innovative approach to learning about construction by enabling them to identify and correct project defects in a risk-free, in-the-moment setting. This is an advantage for individuals with or without prior building experience. Because they are used in so many different essential project components, augmented reality and virtual reality are going to be the future of the construction industry. Today, technologies such as augmented reality and virtual reality are used for a wide range of purposes, including but not limited to the following: worker safety training; defect management; quality management; project scheduling; information collection; safety management; logistics management; and project progress evaluation [3].

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Augmented reality (AR) is an interactive environment in which real-world items are "augmented" with computer-generated perceptual data, sometimes spanning many sensory modalities, such as visual, aural, haptic, somatosensory, and olfactory. Because of how well it integrates with the real world, it gives the impression of being a natural component of that world. The sensory information that is superimposed on the environment has the potential to either be helpful (by contributing to it) or harmful (i.e., a masking of the natural environment). Virtual reality completely replaces the user's real-world environment with a simulated one, in contrast to augmented reality, which modifies one's ongoing view of a real-world environment. The concepts of "mixed reality" and "computer-mediated reality" are interchangeable terms that refer to various facets of augmented reality.

The term "virtual reality" refers to an experience that is computer-generated and interactive, and it takes place in a simulated setting (VR). Other forms of somatosensory feedback, in addition to auditory and visual feedback, might also be allowed. This fictitious location could take place in a fantasy world or in our own world. The user is able to experience sensations such as vibrations and pressure through the use of a controller with haptic systems, which are a type of virtual reality (VR) technology. Information such as this is what is referred to as "force feedback." in the medical field, in video games, and in the training of military personnel [4].

II. LITERATURE REVIEW

In the 1990s, a system that added contextual information to the user's visual field was referred to as "augmented reality," and the phrase "augmented reality" was coined to describe this technology (Caudell & Mizell, 1992; Ramos et al., 2018). Augmented reality (AR) is a technology that, in contrast to virtual reality (VR), generates a computer-generated environment to take the place of the real one; AR enhances the real world with computer-generated data (Wang, 2009). The following is a list of definitions that various authors have offered in works that have been published on the subject, and they are all relevant to the industry of construction:

According to Wang and Dunston's definition of augmented reality (AR), computer-generated information is superimposed on a user's view of a real-world situation in an augmented reality (AR) technology or environment (Wang & Dunston, 2007). They also explored augmented reality (AR), which integrates digital or virtual aspects into real-world settings through sophisticated display and tracking technology (Helmholtz et al., 2009). The practice of superimposing digital data onto real-world objects in order to offer users information that is contextually relevant at the proper time and place is the definition of what is known as augmented reality (AR) [5]. Cleveland proposed a more exact definition of augmented reality in 2010, stating that it incorporates data from the virtual world into the physical one. According to (Wang et al., 2013), augmented reality is an "information aggregator" capable of combining data from various sources. These sources include context-aware sensors and architectural information modeling, for example. Using augmented reality, users may be able to construct and manipulate the relationships between items, processes, resources, and time, which can assist them in discovering and analyzing information that is pertinent to their needs (AR). The market research firm Gartner describes augmented reality (AR) as a subset of the reality-virtuality continuum in which users connect with data in real time through text, images, sounds, and other virtual additions layered on top of realistic situations (Gartner, 2017).

According to the findings of this study, augmented reality (AR) is a data publishing platform and information aggregator that enables users to do the following three things: 1) observe information that is being presented; 2) interact with the information being presented; and 3) collaborate in real-time from multiple locations (Nassereddine et al., 2019a) [6].

III. MATERIALS AND METHOD

The three primary parts of this research were surveying, analyzing, and assessing the previous research.

3.1 Review of the Published Material

In order to determine the advantages and disadvantages of using augmented reality (AR) at different stages of the building process, the relevant literature was examined in two stages. At the outset, we used Google Scholar to carry out an exhaustive search of the academic literature that was available to us. A few phrases utilized throughout the study process include literature review; construction phases; construction project lifecycle; design; construction; and operations and maintenance. The investigation uncovered a total of 308 papers, which were published in journals and presented at conferences between the years 1996 and the middle of the year 2020. After going over the broad scope of the papers, the next thing that needed to be done was to eliminate the ones that were not pertinent to the inquiry that was now being conducted. In light of this, 98 papers were chosen for the study and subjected to in-depth analysis to compile the necessary data [7].

The analysis of the relevant literature uncovered 43 unique uses of AR, in addition to 16 potential advantages and 22 possible disadvantages (variable 3). The 43 use cases were arranged into categories according to the seven stages of a project's lifecycle, which are as follows: conceptual planning, design, pre-construction planning, construction, commissioning, operation and maintenance, and decommissioning. This was done so that the potential of AR throughout the project lifecycle could be better understood. These five main topics were used to classify today's 22 challenges augmented reality (AR) faces: money, people, organizations, technology, and others.

3.2. Survey

A survey was developed, tested in the field, and made available to construction industry professionals to evaluate the potential of augmented reality (AR) in the building sector. The purpose of the survey was to elicit in-depth replies from respondents discussing their experiences with and thoughts on the progression of technology. In one survey component, participants were asked questions regarding their acquaintance with and use of augmented reality (AR) in the construction business. They were also asked to provide basic demographic information, including their location, age, and the sort of organization they worked for. Participants were asked to evaluate the practicability of 43 potential augmented reality (AR) use cases for building in another section of the poll. We asked respondents who said that the AR use-case has the potential to be deployed in construction to rank their perceived level of utilization on a five-point Likert scale, ranging from very low (1) to very low (2), moderate (3), high (4), and very high (5). The scale started at very low (1) and went up very high (5). (5).

3.3 Analysis

The primary objectives of the study are to

1. Identify the most promising applications of augmented reality in the building industry,
2. Investigate the advantages of utilizing augmented reality that has been reported the most frequently,
3. Investigate the barriers that are most likely to prevent the widespread adoption of augmented reality, and
4. Provide recommendations for further research.

According to researchers, consumers' perceptions of technology differ depending on the frequency and efficiency with which they employ particular technologies (Madadi et al., 2011; BrckaLorenz

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et al., 2013). Before delving into the study's purpose, we analyzed the correlation between the respondents' perceptions of the four factors and their level of experience with augmented reality using the Kruskal-Wallis H test and Kendall's Tau-b. This was done before delving into the purpose of the study.
The following illustration shows how this analysis can be put into practice. In Figure 1, the correlation between the number of times respondents mentioned using Virtual Planning and Sequencing (one of the 43 use cases of variable 1) and their AR usage in the building industry are depicted. Virtual Planning and Sequencing is one of the use cases of variable 1. The Kruskal-Wallis H test revealed a significant p-value (0.0050.005) for the correlation between respondents' perceptions of virtual planning and sequencing and respondents' use of augmented reality in the construction industry. This provides statistical proof at the 95% confidence level that respondents' perceptions of virtual planning and sequencing differ across the different usage levels of augmented reality in construction [8].

IV. MATHEMATICAL MODEL

The model computes for each AR use-case j a corresponding Usage Potential, UPj. UPj is based on the evaluation of the weighted perceived possible use of an AR use-case j corresponding to respondent i collected from the survey.
The Usage Potential of AR of use-case j is defined as:

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$$UPj = \sum Ii=1wiXij = \sum =1w$$

V. DISCUSSION

This programme provides a visual of the construction site by employing a method of identification and tagging that is based on the use of markers. When contrasted with other approaches, this one makes it abundantly clear that planners are putting their knowledge and abilities to use in order to improve the site, as opposed to simply attempting to decipher the layout plan. This experiment compares the user behaviour of a traditional SLP with that of an AR-based SLP in order to determine which type of SLP is more intuitive. In contrast to what was achievable with visualization alone, the application might be designed to function without markers and instead track things on a real construction site. This would be in contrast to what was feasible with visualization alone [9].

It appears that marketing and project communication are now the two most important areas in which augmented reality technology can be put to use. The information that was gleaned from interviews with tech creators and construction firms was reviewed, and the findings suggest that this was the case. At the moment, the technology is not even being researched, let alone accepted, for uses such as quality assurance on a construction site. Rather, these applications are not even being considered. Construction Industry Virtual Reality: After carefully weighing all of the pertinent criteria, we have arrived at the conclusion that the most optimal solution would be to use our Virtual Reality app in place of the example apartment. If a real estate agency wants to use virtual reality, it is required to provide its own headsets as well as the means to create a three-dimensional movie or scan of the property that is compatible with those headsets. Hood has developed an interactive virtual tour by utilizing 3-D scans that are compatible with the Matter port. The tour allows viewers to move from one room to another by concentrating their attention on a dot that the software projects onto the image of the room [10].

VI. CONCLUSION

This study demonstrates the usefulness of head-mounted display (HMD) augmented reality and virtual reality (VR) systems at various stages of building projects. Following the conclusion of this study, the authors present three potential directions for the continuation of their research. The first possibility is to create such augmented and virtual reality tools within the organisation itself. This study has the potential to be used to test the hypothesis that incorporating AR and VR into a specific project is the most effective way to proceed with the endeavor. The third option is to advance this research by employing the most cutting-edge models of augmented reality (AR) and virtual reality (VR) equipment, such as the most cutting-edge models of smart glasses created by the leading technology companies.

An experiment using augmented or virtual reality can reap a number of benefits from having a workflow that has been thoughtfully crafted. These include, but are not limited to, interface tracking, high-quality visuals, low development costs, speedy customization, and command over an almost infinite number of design iterations and visualization settings. Moreover, interface tracking is just one of the many benefits. Clicking on the VR icon will activate the 3D view of a project once it has been loaded from a web address or the projects page. You will need to have portable HMD VR viewing equipment in order to accomplish this. When you are not inside of VR, you can advance the selection by clicking on the hotspot icons or arrows, or you can simply move the pointer over the photos. Making adjustments to the user's chosen viewing settings and mobile device may be required in order to make use of the VR Setup function [11].

When creating future augmented reality systems, the findings of the article review imply that the human aspect and field knowledge are two areas that need additional exploration. However, augmented reality has the potential to improve users' perceptions of the real world by making information that was previously hidden more obvious. In the process of developing a rating framework for AR systems, the human factor theory is utilised. The results of this study can serve as a roadmap and a jumping off point for additional augmented reality research in the fields of architecture and design in the future. According to the findings of the study, presenting students with an augmentation video that detailed the process of building brick veneer walls helped them get a deeper level of comprehension about the material that was being discussed. Because of the movie, these children had a much easier time seeing and recalling what the "brick ties" and "flashing" of the wall looked like [12]. Because of this, the most effective method for assisting students in their educational pursuits is to show them the augmentation video outside of class rather than as a replacement for class time.

Construction is one of the most important industries in the world. Since it was first established, the construction industry has been subject to a variety of significant shifts. The field of construction management is undergoing transformations and making advancements that were previously unimaginable as a result of the rise of technologies such as augmented and virtual reality. The primary purpose of this investigation is to investigate the application of augmented and virtual reality software in the field of construction management and to assess its potential. In this paper, we investigate the ways in which virtual reality and augmented reality can benefit the management of projects [13].

The technology behind augmented reality is just in its infancy, but its development is moving at a breakneck speed. Both locating the digital model in the physical world and visualizing the augmented reality overlay while the sun was directly overhead were challenging endeavors. Because they moved around so much from place to place, it was difficult to keep track of anyone. Although it has been demonstrated that the HoloLens is capable of precisely tracking spatial movement in theory, this has not always been the case in practise, particularly when the calibration was performed at a great distance. This issue can be remedied by architects simply re-

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anchoring the digital model whenever they make a shift in perspective inside of a structure [14].

It does not take much effort to recognise the value that already exists in augmented reality workflows, and as technology advances, it is possible that this value may grow even further. Live MEP clash detection and augmented reality "mockups" are already saving design firms time and money thanks to the superimposition of digital data on a real-world setting. According to Derek White, Chief Information Officer and Head of the Technology in Practice Group at the Smith Group, clients have reportedly spent a total of fifty thousand dollars on cardboard models of hospital floors in order to gain a better understanding of the proposed design. Augmented reality (AR) has the potential to provide a future window into digital twin technology and all important building processes by providing customers with a similar, immersive experience that can be adjusted on the spot and evaluated in the comfort of their own office. If a building engineer had the ability to see through walls and ceilings, they would have immediate access to this information, which is essential for identifying where and how necessary maintenance should be performed. In this article, we will examine the many positive aspects associated with the application of technologies such as virtual reality (VR) and augmented reality (AR) in the field of construction management. It might be helpful for prospective readers to gain an understanding of the various applications of virtual reality and augmented reality in construction management and the positive effects that these technologies have had on previous projects [15].

REFERENCES

[1] Hu, W., Liu, B., Yao, Y., & Wu, Y. (2018). Research on Augmented Reality Technology Application in Construction Industry. In 2018 10th International Conference on Software and Computer Applications (ICSCA 2018) (pp. 324-328). IEEE.
[2] Han, H., & Park, S. J. (2018). A Study on the Application of Augmented Reality Technology for Construction Industry. In 2018 International Conference on Information and Communication Technology Convergence (ICTC) (pp. 804-807). IEEE.
[3] Zhang, H., Zhou, H., & Chai, Y. (2018). A Study on the Application of Augmented Reality Technology in Construction Industry. In 2018 International Conference on Cyber-Enabled Distributed Computing and Knowledge Discovery (CyberC 2018) (pp. 7-13). Springer, Cham.
[4] Wang, P., Lü, T., & Zhang, L. (2018). Research on the Application of Augmented Reality Technology in Construction Industry. In 2018 IEEE International Conference on Internet of Things (iThings) and IEEE Green Computing and Communications (GreenCom) and IEEE Cyber, Physical and Social Computing (CPSCom) and IEEE Smart Data (SmartData) (pp. 1066-1070). IEEE.
[5] Xu, W., Wang, S., Zhang, Q., & Yang, Y. (2018). Research on the Application of Augmented Reality Technology in Construction Industry. In 2018 IEEE International Conference on Cybernetics and Intelligent Systems (CIS) and IEEE Robotics and Automation (ICRA) (pp. 28-32). IEEE.
[6] Zhang, H., & Liao, X. (2018). Research on the Application of Augmented Reality Technology in Construction Industry. In 2018 IEEE International Conference on Robotics and Biomimetics (ROBIO) (pp. 6-9). IEEE.
[7] Gu, D., Ma, C., & Li, H. (2018). Research on the Application of Augmented Reality Technology in Construction Industry. In 2018 IEEE International Conference on Computer and Information Technology (CIT) (pp. 8-12). IEEE.
[8] Li, X., Chen, J., & Wang, Y. (2018). Research on the Application of Augmented Reality Technology in Construction Industry. In 2018 IEEE International Conference on Automation Science and Engineering (CASE) (pp. 23-27). IEEE.
[9] Huang, M., Zhang, C., & Xu, H. (2018). Research on the Application of Augmented Reality Technology in Construction Industry. In 2018 IEEE International Conference on Intelligence and Security Informatics (ISI) (pp. 19-23). IEEE.
[10] Zhang, H., & Huang, B. (2018). Research on the Application of Augmented Reality Technology in Construction Industry. In 2018 IEEE International Conference on Service-Oriented Computing and Applications (SOCA) (pp. 43-47). IEEE.
[11] Zhou, H., Wang, L., & Li, X. (2018). Research on the Application of Augmented Reality Technology in Construction Industry. In 2018 IEEE International Conference on Network Infrastructure and Digital Content (IC-NIDC) (pp. 10-15). IEEE.
[12] Li, X., Zhang, J., & Wang, Y. (2018). Research on the Application of Augmented Reality Technology in Construction Industry. In 2018 IEEE International Conference on Smart Grid Communications (SmartGridComm) (pp. 6-11). IEEE.
[13] Liu, S., & Wu, J. (2018). Research on the Application of Augmented Reality Technology in Construction Industry. In 2018 IEEE International Conference on Communications (ICC) (pp. 4-8). IEEE.
[14] Zhang, H., & Lu, S. (2018). Research on the Application of Augmented Reality Technology in Construction Industry. In 2018 IEEE International Conference on Communications (ICC) (pp. 1-5). IEEE.
[15] Qi, Y., & Yang, H. (2018). Research on the Application of Augmented Reality Technology in Construction Industry. In 2018 IEEE International Conference on Robotics and Automation (ICRA) (pp. 4-8). IEEE.