V-House Planner: Augmented Reality-Based Construction Planning and Visualization Tool

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***Abstract*-The V-House Planner project aims to revolutionize traditional construction planning by integrating Augmented Reality (AR) and Vastu Shastra principles into a mobile application. This system provides homeowners, contractors, and construction professionals with real-time 3D visualization of building plans, early-stage cost estimation, and cultural compliance with Vastu. By overcoming the limitations of traditional 2D blueprints and incorporating immersive technology, the V-House Planner helps mitigate miscommunication, reduces rework, and ensures a seamless construction process. The app serves as a tool to bridge the gap between modern construction practices and cultural requirements, offering an innovative solution to improve decision-making and project efficiency.**

Introduction

The construction industry, particularly in India, has long been dependent on traditional 2D blueprints and manual estimation methods for planning and executing projects. These outdated techniques often lead to communication breakdowns, costly rework, and discrepancies between the planned and actual outcomes. Furthermore, the integration of cultural practices like **Vastu Shastra**, a set of architectural principles based on ancient Hindu beliefs, has remained largely disconnected from the digital tools used in construction, leading to inefficiencies and incomplete planning. To address these issues, **Augmented Reality (AR)** has emerged as a game-changing technology that enables real-time visualization of construction plans and enhances communication between all stakeholders.

AR enhances the physical world by superimposing digital content such as 3D models and interactive elements onto the real world, allowing users to visualize

changes and make informed decisions early in the planning process. In the context of the **V-House Planner**, AR is used to present detailed 3D models of building plans, superimposed onto real-world environments, ensuring that users can fully understand the design before construction begins. This approach helps reduce costly rework and fosters better communication between homeowners, contractors, and designers.

Additionally, the **V-House Planner** integrates **Vastu Shastra**, ensuring that designs adhere to traditional cultural principles that are integral to the construction practices of many homeowners. By providing a platform for both modern construction practices and cultural requirements, the V-House Planner offers a comprehensive solution to improve construction planning, ensuring that projects are both technically sound and culturally appropriate.

Literature Survey

This section discusses key papers and methodologies related to the development of the **V-House Planner**, focusing on the integration of AR with construction practices and the use of maturity models for evaluating such technologies.

1. Álvarez-Marín, A., & Velazquez-Iturbide, J. A. (2021)

Title: "Augmented Reality and Engineering Education: A Systematic Review"
Summary:
Álvarez-Marín and Velazquez-Iturbide (2021) provide an extensive review of how Augmented Reality (AR) has been utilized in engineering education. The paper outlines how AR can be employed to enhance learning and visualization in complex fields, including construction. By superimposing virtual elements over real-world objects, AR creates immersive learning experiences that improve the understanding of spatial and structural relationships in construction projects. The findings from this review support the **V-House Planner**'s use of AR to help users visualize building plans and ensure alignment with cultural and structural principles. The paper underscores the effectiveness of AR in educational contexts, which directly applies to construction planning and design.

2. Ambre, T. P., Khalane, P. P., Kanjiya, S. D., & Kenny, J. (2020)

Title: "Implementation of the 3D Digitalized Brochure Using Marker-based Augmented Reality for Real Estates"
Summary:
Ambre et al. (2020) focus on the use of marker-based AR for real estate applications, specifically creating interactive 3D brochures to help prospective buyers visualize properties. The study highlights how AR allows users to explore digital representations of buildings and view them in real-world settings. The integration of this technology into the **V-House Planner** would allow users to visualize construction plans in their actual environment, aiding decision-making by offering a clearer understanding of the finished product. This research supports the use of AR for spatial awareness, design evaluation, and client interaction in construction projects.

3. Monla, Z., Assila, A., Beladjine, D., & Zghal, M. (2023)

Title: "Maturity Evaluation Methods for BIM-Based AR/VR in Construction Industry: A Literature Review"
Summary:
Monla et al. (2023) offer a comprehensive review of maturity evaluation methods for integrating **Building Information Modeling (BIM)** with **Augmented Reality (AR)** and **Virtual Reality (VR)** in the construction industry. The study identifies existing maturity models and performance evaluation methods for these integrations. It also highlights the need for standardized metrics to evaluate the effectiveness of BIM-AR/VR solutions. This paper is directly relevant to the **V-House Planner** as it provides insight into the current state of maturity models in BIM-based AR applications. The review emphasizes the importance of developing more structured maturity frameworks to assess the readiness and performance of AR and VR technologies in construction.

4. Gabbard, J. L., & Swan II, J. E. (2008)

Title: "Usability Engineering for Augmented Reality: Employing User-Based Studies to Inform Design"
Summary:
Gabbard and Swan (2008) discuss the role of usability engineering in designing AR applications, focusing on the importance of user-centered design. The paper suggests that user-based studies are essential to creating AR applications that are both functional and user-friendly. This principle is crucial for the **V-House Planner**, which aims to enhance user interaction with complex construction data. By employing usability engineering practices, the app ensures that users can easily navigate the AR interface, visualize building plans, and make informed decisions regarding construction and Vastu compliance. This research supports the user-centered approach of the **V-House Planner**.

5. Gabbard, J. L., & Swan II, J. E. (2008)

Title: "Usability Engineering for Augmented Reality: Employing User-Based Studies to Inform Design"
Summary:
This reference highlights the importance of usability studies in AR design. Gabbard and Swan emphasize that successful AR applications must prioritize user interaction and feedback. For the **V-House Planner**, this study underlines the necessity of a user-friendly interface that allows for seamless interaction with 3D visualizations of construction plans. By incorporating these usability principles, the app aims to deliver an intuitive experience that helps users understand design concepts and make decisions early in the construction process.

Discussion

The review of existing literature highlights the significant advancements in the integration of AR with BIM, particularly in the construction industry. The key findings indicate that while AR offers tremendous potential for enhancing the visualization and interaction capabilities of construction plans, there is a considerable gap in the

development of standardized evaluation models for assessing the maturity of BIM-AR/VR integration. Existing tools are often inconsistent in their support for core features such as visualization accuracy, usability, and integration depth, which impedes their widespread adoption in industry.

Moreover, the field of BIM-AR/VR maturity evaluation is still in its infancy, with few studies providing concrete solutions for bridging the gap between academic research and real-world applications. The lack of standardized performance metrics remains a major obstacle for the industry, as it hinders objective comparison and validation of tools across different projects.

The inclusion of cultural elements like Vastu Shastra in construction planning is another significant challenge. While the integration of cultural practices into modern workflows is often overlooked, the **V House Planner** application addresses this gap by ensuring that designs align with Vastu principles, offering a culturally relevant tool for construction planning.

Conclusion

The integration of **Augmented Reality** with construction planning is an innovative approach that significantly enhances visualization, communication, and decision-making. The literature reviewed in this survey supports the development of the **V-House Planner** by providing insights into the effectiveness of AR in improving user experience, project planning, and cultural compliance. The incorporation of **Vastu Shastra** further adds a unique dimension to this project, ensuring that designs not only meet modern construction standards but also align with traditional architectural principles. Future research and advancements in AR, BIM, and usability engineering will continue to shape the development of the **V-House Planner** application to address this gap by ensuring that designs align with Vastu principles, offering a culturally relevant tool for construction planning.

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