



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 5, May 2024

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.423

 9940 572 462

 6381 907 438

 [ijirset@gmail.com](mailto:ijirset@gmail.com)

 [www.ijirset.com](http://www.ijirset.com)

# AR/VR for Efficient Home Planning and Cost Estimation

Deepak B L<sup>1</sup>, Ananya C<sup>2</sup>, Avinash C<sup>3</sup>, Meenakshi L N<sup>4</sup>

Assistant Professor, Department of Information Science and Engineering, S J C Institute of Technology,  
Chickaballapur, Karnataka, India<sup>1</sup>

U.G. Student, Department of Information Science and Engineering, S J C Institute of Technology, Chickaballapur,  
Karnataka, India<sup>2,3,4</sup>

**ABSTRACT:** This abstract delineates the pioneering outcomes of an AR initiative aimed at revolutionizing construction and housing development methodologies. The project revolves around an inventive application harnessing AR technology to present a holistic virtual representation of a nascent house. This tool aims to facilitate precise cost estimation, streamline planning, and ensure timely project completion.

By seamlessly integrating AR functionalities, the application offers users an immersive journey, enabling exploration and interaction within a virtual rendition of the forthcoming dwelling. This encompasses visualizing structural components, spatial arrangements, and design selections, imparting a palpable understanding of the final outcome prior to physical construction commencement.

By amalgamating advanced AR methodologies with real-time data integration, this project endeavours to redefine housing development practices, culminating in more efficient, economical, and visually precise construction endeavours.

**KEYWORDS:** AR initiative , revolutionizing construction , cost estimation , streamline planning , virtual

## I. INTRODUCTION

Urban planning and housing development are fundamental cornerstones of a flourishing society, fundamentally influencing the lives, productivity, and well-being of its inhabitants. Nevertheless, the initial stages of conceiving a complete house often pose formidable challenges in accurate visualization, cost estimation, and seamless project execution. These uncertainties can not only lead to frustrating delays but also result in budget overruns, potentially compromising the final product's quality and punctuality.

Our groundbreaking project takes this issue head-on by introducing an innovative AR/VR-based application poised to redefine the paradigm of housing development. Beyond conventional visualization, our application seamlessly translates 2D blueprints into intricate 3D models, providing stakeholders with an immersive and interactive experience. This dynamic 3D rendering serves not only as a visual representation but as a platform for in-depth exploration of every architectural facet.

In addition to this, our application fosters seamless communication and collaboration among project stakeholders. Architects, builders, and clients can engage in virtual walkthroughs, discussing and refining design elements in real time. This level of interaction and feedback guarantees that the final product not only meets but exceeds the collective expectations and requirements of all involved parties.

Beyond its pivotal role in design and planning, our VR application serves as an indispensable tool for cost estimation and accurate measurements and detailed visualizations form a robust foundation for precise budgeting, drastically mitigating the risk of unforeseen expenses or budget overruns. This financial acumen contributes significantly to the project's overall success .

Through the seamless integration of 2D planning, 3D rendering, and AR technology, we offer a comprehensive solution that not only revolutionizes decision-making and enhances collaboration but ensures precision in every facet of construction. With the potential to elevate industry standards and consistently deliver projects on time, within budget,

and to the highest quality standards, our application is poised to redefine how we approach and execute housing development projects.

## II. LITERATURE SURVEY

In this section, previously performed studies on AR/VR for efficient home planning and cost estimation are done.

The paper [1] is study on benefits of digital architecture plan as well as construction field. Describe about the Significance of application increase quality of furniture arrangements uses E-Adbhuta- uses analyst programmer and user interaction Vuforia application programming interface- 2D is transform into 3D. The study highlights several advantages associated with the integration of AR and VR technologies into interior design processes. Describes the significance of the application in enhancing the quality of furniture arrangements within designed spaces.

Paper [2] uses methodology, known as LTMIG, leverages graph theory, a core concept in computer science and combinatorial mathematics. It involves deriving central points of architectural elements (walls, columns, beams) using specific formulas. These points are used to create undirected graphs, where nodes represent geometric properties and edges denote structural connections. This graph serves as a foundation for generating a 3D model.

The paper [3] discusses about a system with three layers which are ISADORA (basic image and graphics tools), graphics recognition applications (combining low-level processes), and MICA (a sophisticated user interface). It transforms architectural drawings into 2D structures using established methods for tasks like binarization, text separation, classification, and vectorization. The result is a 2D representation with symbols for building components.

In paper [4] the system employs a multi-step approach to generate virtual reality (VR) environments based on architectural floor plans. It involves detecting walls, windows, doors, and interior objects using a combination of traditional computer vision methods, template matching, and YOLO(You Only Look Once) object detection. The VR environment is then created using Unreal Engine with automated asset placement.

In paper [5] the system leverages architectural symbols for structured feature extraction. It extract features from architectural symbols. Create a graph for matching hypotheses between consecutive floors. Use maximal clique detection to find the best matches. Compute geometric transformations for floor alignment. Build the final 3D model by stacking floor models.

## III. PROPOSED SYSTEM

The system allows user to draw 2D architectural plans and facilitates seamless creation and transformation of house plans into immersive 3D models and beyond. Using YOLO algorithms, symbols on the 2D plan are recognized, enabling the construction of a precise 2D representation of the house. A number of java libraries help transitions this 2D plan into detailed 3D models with utmost accuracy, employing advanced rendering techniques and architectural principles. The resulting 3D models reflect spatial relationships and aesthetic elements faithfully. The application further enriches user experience by generating first-person perspective videos, allowing dynamic walkthroughs within the virtual house. Smooth transitions and realistic lighting enhance immersion. Integration with Augmented Reality (AR) elevates the experience, enabling users to explore the virtual house using AR interface. They can interact with elements and inspect details up close, replicating real-world interactions. Finally, the application provides cost estimation for construction, considering average construction costs and additional item expenses, completing the comprehensive design and planning process.

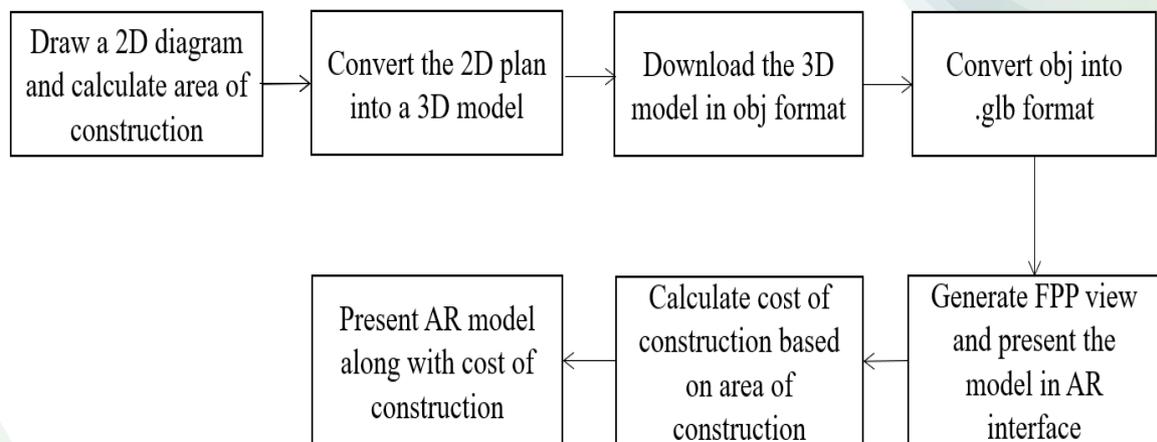


Fig 1: Architecture of the proposed system

#### IV. METHODOLOGY

##### 2D House Design Input:

- The user is allowed to draw the 2D plan according to his preference. The application also allows the user to drag and drop objects such as doors and windows.
- We use the YOLO algorithms to recognize and understand the symbols.
- Once this is done the 2d plan of the house is constructed which is used for the next steps.

##### 3D Model Rendering:

- The custom java libraries developed for this project serves as the linchpin for the transition from 2D plans to detailed 3D models. This library leverages advanced algorithms and rendering techniques to accurately convert the 2D design into a high-fidelity 3D representation using the stack on algorithm.
- By incorporating architectural principles, the library ensures that the resulting 3D model accurately reflects the spatial relationships, proportions, and aesthetic elements defined in the original 2D design. This fidelity is paramount in providing users with a realistic and immersive experience.

##### First-Person Perspective Video Generation:

- The generation of a first-person perspective video involves creating a dynamic walkthrough experience within the virtual house. Users are virtually placed within the 3D model, allowing them to navigate through rooms, corridors, and spaces as if they were physically present.
- The video generation process incorporates smooth transitions between viewpoints, mimicking the natural movements of a person exploring a physical environment. This immersive experience is enhanced by realistic lighting and shadows to create a truly authentic representation.

##### Integration with Augmented Reality (AR):

- The final step involves seamlessly integrating the first-person perspective video into a Augmented Reality (AR) environment. This integration ensures compatibility with a Augmented Reality interface.
- We present the AR model using google model viewer AR environment.

##### Adding Cost Estimation:

- This step involves estimating the costs of building the house or the structure designed with the average given construction costs and the additional costs of the items that are added or used.

#### V. IMPLEMENTATION

**2D to 3D conversion module:** For 2D to 3D conversion modules we have incorporated sweetHome 3D's open source libraries which allows user to draw the architectural plan manually according to their preference and it also allows the user to use drag and drop feature to drag furniture such as door, windows, chairs etc. It also allows user to convert the



2D drawing which they drew into a 3D model in no time and view the model in first person perspective. After a lot of research and sourcing for the perfect open source platform to integrate with our project we finalised sweetHome 3D for its versatile features it gives to the users. sweetHome 3D also allows user to download the files after drawing or converting it to 3D model. We can download the file in .obj format or download a video version of 3D model.

**Obj to glb conversion:** The 3D model after being downloaded in .obj format has to be covered into glb format. This is done by obj to glb conversion library which is available in NPM package. NPM (Node Package Manager) is a package manager for JavaScript programming language primarily used with Node.js runtime environment. It allows developers to install, share, and manage dependencies for JavaScript projects. To manage the storage and retrieval of these GLB files, we leverage the capabilities of cloud storage solutions. Specifically, we utilize a MinIO cloud bucket—a self-hosted object storage server compatible with Amazon S3—to store our GLB files securely and efficiently. This cloud-based approach enables scalable and reliable access to our 3D models, facilitating collaboration and distribution across diverse teams and environments.

**Integration with Augmented Reality:** to enrich the user experience and enable immersive visualization of our 3D models, we integrate them into a web-based environment leveraging the Model Viewer AR framework. This framework enables users to interact with 3D models in augmented reality directly within their web browsers, without the need for specialized software or plugins. By leveraging the power of web technologies and AR capabilities, we provide users with a compelling and intuitive means of exploring and engaging with our 3D models, unlocking new possibilities for visualization and design workflows.

**Cost Estimation:** To estimate the cost of the house we take into consideration, the average cost of wall construction, basement including pillars, roof construction and the material. Taking into consideration all of these we estimate a cost for square meter which will be used to estimate the total cost based on the total area of construction.

## VI. RESULTS

All implementations are carried out on Windows 10 and above having hardware configuration of Intel core i5 processor with 4GB internal RAM.

The hardware includes a mobile phone to view the 3D model in AR interface.

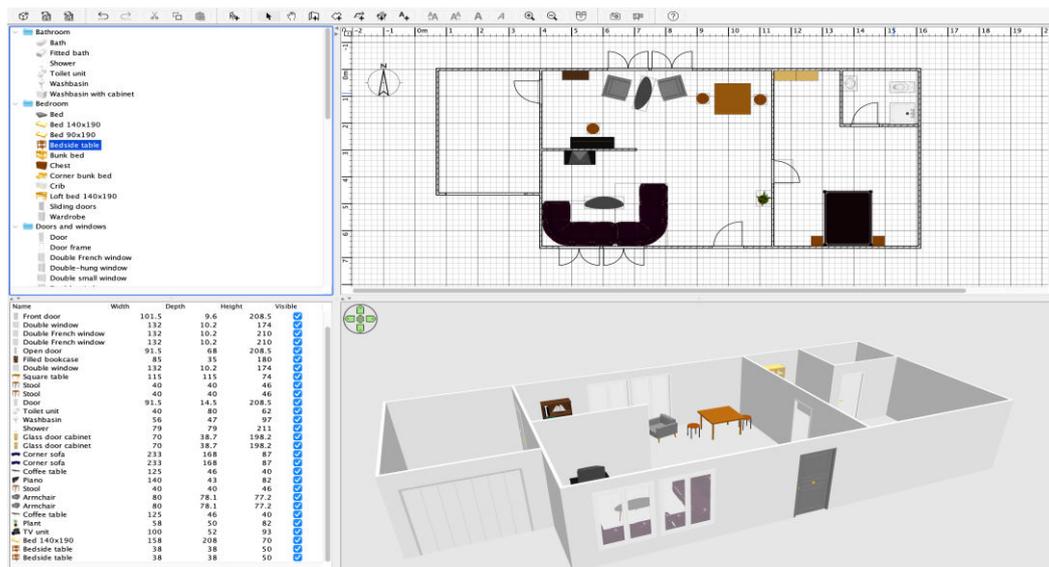


Fig 2. 2D to 3D conversion using sweetHome 3D

The above image depicts the front end of the 2D to 3D conversion of the application and also depicts a sample of the converted image. The implementation of our project has yielded promising results, demonstrating the effectiveness and feasibility of our proposed solution. We successfully generated 3D models in OBJ format, incorporating complex

geometries and material properties specified in MTL files. This ensured accurate representations of various objects and environments, laying the foundation for further processing and visualization. Furthermore, the conversion of OBJ and MTL files to GLB format was seamless, resulting in compact and optimized representations of our 3D models. This process significantly reduced file sizes while preserving the integrity of geometry and material information, facilitating efficient storage and transmission. Leveraging a MinIO cloud bucket for storage proved to be reliable and scalable, with our GLB files securely stored and easily accessible, enabling seamless collaboration and sharing across different platforms and environments. Integration of our 3D models into a web-based environment using the Model Viewer AR framework enhanced user experience and interaction. Users could explore and interact with the models in augmented reality directly within their web browsers, facilitating intuitive visualization and design workflows. Overall, these results validate the effectiveness of our approach in generating, storing, and visualizing 3D models, opening doors for further advancements in immersive and interactive visualization technologies.

## VII. CONCLUSIONS

In summary, our project represents a pioneering endeavor in the domain of home planning and visualization, offering a comprehensive and integrated solution that serves as a catalyst for transforming conceptual designs into tangible realities. By seamlessly blending cutting-edge technology with intuitive design principles, we have created a platform that empowers users to navigate the intricate journey from ideation to implementation with unparalleled ease and precision.

At its core, our platform boasts a rich array of features designed to facilitate every stage of the design process. From the initial stages of 2D planning, where users can effortlessly sketch out floor plans and incorporate essential architectural elements, to the seamless integration of intricate 3D models that offer a true-to-life representation of spatial relationships and design aesthetics, our platform provides a versatile toolkit that caters to the diverse needs of architects, interior designers, and homeowners alike.

Augmented reality (AR) functionality further enhances the experiential aspect of our platform, offering users the opportunity to visualize their designs within real-world environments and gain invaluable insights into scale, proportion, and layout. This immersive experience not only fosters a deeper understanding of the design concept but also facilitates informed decision-making by allowing users to assess the practical implications of their ideas before construction commences.

In addition to its innovative design features, our platform stands out for its robust cost estimation functionality, which leverages sophisticated algorithms and real-time data to provide users with accurate projections for their projects. This invaluable tool empowers users to make informed decisions within budgetary constraints, ensuring that their vision remains economically viable throughout the design process.

Looking ahead, our commitment to continuous improvement and innovation remains unwavering. We are dedicated to enhancing the platform's user experience and functionality in several key areas, including the enablement of multiple plan format imports to boost compatibility, refinement of cost estimation accuracy to aid in budget management, diversification of flooring and roofing material options to cater to diverse preferences, and streamlining of the editing interface to simplify the design process.

In essence, our platform represents more than just a tool for home planning and visualization; it embodies a vision for a future where creativity knows no bounds, and where technology serves as a catalyst for turning dreams into reality. With our platform as their guide, users can embark on a journey of exploration and discovery, confident in the knowledge that their architectural aspirations are within reach.

## REFERENCES

1. Z. Wang and H. Zhong, "Automatic generation of 3D models based on architectural drawings," 2021 33rd Chinese Control and Decision Conference (CCDC), Kunming, China, 2021, pp. 2302-2306, doi: 10.1109/CCDC52312.2021.9602621.
2. T. Fréville, C. Hamesse, B. Pairet, R. Lahouli and R. Haelterman, "From Floor Plans to Virtual Reality," 2021 IEEE International Conference on Artificial Intelligence and Virtual Reality (AIVR), Taichung, Taiwan, 2021, pp. 129-133, doi: 10.1109/AIVR52153.2021.00030.
3. P. Deshmukh et al., "2D to 3D Floor plan Modeling using Image Processing and Augmented Reality," 2023



International Conference on Recent Advances in Electrical, Electronics & Digital Healthcare Technologies (REEDCON), New Delhi, India, 2023, pp. 682-687, doi: 10.1109/REEDCON57544.2023.10151165.

4. Z. Wang and H. Zhong, "Automatic generation of 3D models based on architectural drawings," 2021 33rd Chinese Control and Decision Conference (CCDC), Kunming, China, 2021, pp. 2302-2306, doi: 10.1109/CCDC52312.2021.9602621.
5. P. Dosch and G. Masini, "Reconstruction of the 3D structure of a building from the 2D drawings of its floors," Proceedings of the Fifth International Conference on Document Analysis and Recognition. ICDAR '99 (Cat. No.PR00318), Bangalore, India, 1999, pp. 487-490, doi



INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details