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Reality Home AR

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Abstract

In real estate and interior design, the ability to visualize furniture layouts, room modifications, and various design options within a real-world context can significantly enhance user experience and decision-making. Traditional methods of spatial planning are time-intensive and require extensive resources, making it difficult for clients to fully comprehend design choices before implementation. To address these challenges, the Reality Home AR app offers an immersive and accessible solution using advanced Augmented Reality (AR) technology. Leveraging platforms like AR Core and ARKit, the application provides users with real-time interactions, enabling them to place virtual furniture, adjust colours, and explore 3D property layouts directly within their physical environment via smartphone. The app detects real-world surfaces, such as floors and walls, with high accuracy, allowing for stable and realistic positioning of AR objects, which enhances user confidence in spatial planning decisions. Users can easily alter interior designs by changing colours, rearranging furniture, and examining room dimensions through an intuitive interface. Beyond visualization, Reality Home AR enables users to modify space elements interactively, which reduces the time and resources needed to finalize layouts and allows for greater personalization. Designed for both iOS and Android, Reality Home AR is compatible with a wide range of devices, broadening its accessibility. Future enhancements could incorporate features like depth-sensing for improved spatial accuracy or support for wearable devices to further heighten the immersive experience. This platform thus presents a transformative approach to real estate and interior design by enabling users to visualize, personalize, and ultimately make informed decisions about their spaces. Reality Home AR not only redefines user engagement but also promotes efficient, accurate, and user centred design practices for the modern era.

Keywords: Augmented reality, 3D visualization, home design, real-time customization, construction technology

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1. Introduction

The existing systems for interior design and home visualization often rely on physical showrooms, 2D floor plans, or static images, which limit the ability of users to visualize and interact with prospective furniture and decor in real-world settings. These traditional methods make it challenging for homeowners and designers to accurately assess how furniture and fixtures will look within their actual spaces, often leading to purchase hesitations or design inefficiencies. Furthermore, these methods typically lack interactive, real-time customization, leaving users without

the immersive experience needed for confident decision-making in home design projects.

As the demand for personalized, tech-driven home solutions grows, conventional approaches struggle to deliver the level of engagement and accuracy that modern consumers expect. Though augmented reality (AR) applications exist, they are often limited to basic functionalities and lack the precision or compatibility across devices to meet the standards of contemporary interior design needs. This lack of an integrated, intuitive system for home visualization leaves a gap for more advanced and user-friendly solutions.

Reality Home AR aims to address these challenges by creating an innovative platform that utilizes augmented reality technology to allow users to visualize furniture and decor in their actual spaces before purchase. Using AR Core and ARKit, Reality Home AR provides compatibility across a wide range of devices, enabling users to experience immersive, high-fidelity room renderings directly through their smartphones or tablets. The app detects surfaces, dimensions, and spatial elements within a user's real environment, allowing accurate, life-like placements of furniture items. With features such as real-time customization and interactive furniture arrangement, Reality Home AR creates a dynamic design experience, enhancing both convenience and user satisfaction.

The system's scalable architecture supports future expansion, including potential integration with depth-sensing technologies or support for wearable devices, which could further enhance the precision of AR interactions. Ultimately, Reality Home AR empowers users with a streamlined, visually engaging way to make more informed decisions about their home decor and design, bridging the gap between digital visualization and real-world implementation.

Key Technologies in Reality Home AR Augmented Reality (AR): AR overlays digital elements on the real world, allowing users to view virtual items within their physical surroundings through a camera. This technology enhances user engagement and brings spatial accuracy to interior design.

AR Core and ARKit: These are frameworks developed by Google and Apple, respectively, to enable AR on mobile devices. They support surface detection, light estimation, and environmental understanding, which are essential for creating realistic AR experiences on both Android and iOS platforms.

Spatial Detection and Depth Sensing: Reality Home AR detects floor surfaces and wall boundaries within a user's space, allowing accurate placement and scaling of furniture items, creating a reliable sense of scale and position within the environment.

Real-Time Interaction and Customization: Users can adjust furniture positions, change colour schemes, and view dimensions, making the app an interactive design tool for personalized room customization.

Device Compatibility and User Accessibility Designed for cross-platform usability, Reality Home AR enables a broad user base to explore AR technology, with potential for expansion into wearable devices for an even more immersive experience.

Future Expansion Potential Reality Home AR's modular design enables easy integration of additional

features, such as advanced room lighting adjustments or AI-driven design suggestions based on user preferences. This scalability ensures the platform remains adaptable to emerging technologies and evolving consumer expectations in home design.

2. Background & Motivation

a) The Evolution of Home Design and Visualization Technology

The landscape of home design and interior visualization has evolved significantly, moving from static 2D renderings and physical showrooms to virtual tours and online furniture shopping. Traditional methods like blueprint-based planning and in-store consultations can limit a consumer's ability to visualize home spaces accurately and create an engaging experience.

The introduction of 3D visualization software has expanded user capabilities, yet it remains limited in delivering a fully immersive, real-world context that inspires confident decision-making. With the rapid growth of augmented reality (AR) technologies, there is an opportunity to bridge this gap by enabling users to place virtual furniture and decor in their real-world environments, enhancing interactivity and spatial accuracy in home design.

b) The Need for an Interactive, Real-Time AR Experience

The motivation behind developing Reality Home AR stems from the rising demand for more accessible, personalized interior design solutions that users can experience in their own spaces. As consumers increasingly seek tailored home layouts and decor, traditional methods often fall short in providing an accurate, immersive design experience. By bringing realtime AR customization into users' homes, Reality Home AR addresses a core challenge: allowing users to visualize and interact with potential purchases in a realistic setting, reducing uncertainty and supporting informed buying decisions. This approach not only personalizes the design process but also aligns with the trend toward self guided, mobile-enabled home solutions.

c) Advancements in AR and Mobile Technology

Reality Home AR's development is driven by recent advancements in AR Core and ARKit frameworks, which provide accurate floor and wall detection, spatial mapping, and light estimation on a wide range of devices. These capabilities allow Reality Home AR to anchor virtual objects in real environments with improved stability and realism. Additionally, innovations in mobile device sensors, such as depth-sensing and lidar, have made it possible to offer highly accurate AR experiences directly through consumer smartphones and tablets. Leveraging these technologies, Reality Home AR provides users with an interactive platform that delivers high-quality visualizations without needing specialized equipment, making it accessible to a broad audience.

d) Addressing Challenges in the Home Design Industry

The home design and furnishing industry faces several challenges, including the need for faster decision-making processes, a more engaging consumer experience, and the elimination of return costs due to buyer hesitation. Reality Home AR is designed to meet these industry needs by creating an immersive, user-friendly platform that simplifies furniture and decor selection through AR visualization. By allowing users to "place" items in their actual rooms, the app reduces the risk of post-purchase dissatisfaction and improves customer satisfaction. Moreover,

Reality Home AR's integration of AR technology into the home design process represents a shift toward more interactive, customer centred solutions, empowering users to confidently explore various design options.

e) The Vision Behind Reality Home AR

The motivation behind Reality Home AR is to redefine the home design experience by merging convenience with cutting-edge AR technology. Reality Home AR empowers users to visualize, customize, and interact with potential furniture and decor in a meaningful, contextual way, transforming the traditional shopping journey into a self directed, immersive design experience.

3. Literature Survey

Augmented Reality (AR) applications are transforming the construction, real estate, and interior design industries, offering innovative solutions for virtual visualization, user engagement, and customization of living spaces. By merging AI with AR, these applications provide an interactive platform for homebuyers and homeowners to experience 3D models of homes, making the design and renovation process more intuitive and accessible. Users can modify various aspects of a home's interior, including furniture, walls, flooring, and even lighting, to match their personal preferences and requirements. The integration of AI enables the application to predict and suggest optimal design layouts based on user behaviour, historical preferences, and environmental data, ensuring that the suggested changes are both aesthetically pleasing and functionally viable. This AI driven customization significantly reduces the uncertainty that often accompanies major home renovations or décor changes, helping users make more confident decisions and avoid costly mistakes. Moreover, AR technology allows users to visualize their design choices in real time, providing a realistic preview of how different options will look in their actual living spaces [1].

In the realm of real estate, AI-powered AR applications are enhancing the home-buying experience by offering immersive virtual tours and property explorations. Through AR, prospective buyers can virtually visit and interact with properties from the comfort of their homes, eliminating the need for physical visits and saving both time and resources. These platforms often incorporate AI algorithms to personalize the property recommendations based on a user's previous search history, preferences, and geographic location, optimizing the search process. Furthermore, buyers can visualize changes and renovations in existing properties, such as reimagining the interior design or adding new elements to the landscape, making the buying process more engaging and interactive. By leveraging AR for property exploration and home design, users are empowered to make more informed decisions, often with a greater sense of ownership over their future homes. This shift towards AR is expected to increase consumer confidence and drive sales in the real estate market, as it provides a more transparent and engaging way to experience properties remotely [2].

Another major benefit of AI-powered AR applications in the home design industry is the ease with which users can personalize their spaces over time. Unlike traditional design tools, which are often static and require a degree of technical expertise, AI and AR combine to offer a dynamic and intuitive experience. Users can continuously modify the layout of their living spaces, reposition furniture, experiment with colour schemes, or swap out materials, all in

real time. This ongoing customization capability means that the design process is never truly "finished"—users can continually adapt their environment as their tastes evolve, without the need to hire expensive designers or re-modellers. By combining AI-driven recommendations with AR visualizations, users can instantly see how design changes would look in their own home, making it easier to adjust layouts and décor to match changing needs or preferences. Research suggests that this kind of flexibility significantly enhances the user experience, particularly in the context of long-term home ownership or rental [3].

Moreover, AI-enhanced AR tools are playing a key role in improving the efficiency of project management and coordination with service professionals such as interior designers, contractors, and architects. These applications streamline communication between homeowners and professionals, providing detailed, accurate visualizations of potential design modifications or construction projects. For instance, through AR, homeowners can virtually "try out" a design change and immediately share their ideas with contractors for feedback or refinement. AI plays a crucial role in this process by analysing a homeowner's requests and generating recommendations that are both feasible and cost effective. Additionally, by enabling real-time collaboration through shared AR environments, professionals and clients can avoid misunderstandings and miscommunications that often occur during traditional design and construction phases. This collaborative approach not only saves time but also ensures that the final outcomes align closely with the homeowner’s expectations, boosting satisfaction and reducing the likelihood of costly errors [4].

As the technology continues to evolve, the integration of advanced AI techniques such as machine learning, deep learning, and natural language processing (NLP) will further enhance the capabilities of AR applications. For example, machine learning algorithms can analyse user feedback and behaviours to continuously improve the accuracy of design suggestions and predictive modelling. Deep learning, on the other hand, may enable more sophisticated visual rendering and image recognition features, allowing AR applications to adapt to real-world conditions, such as lighting or spatial limitations. NLP can also be utilized to understand and interpret user preferences expressed in natural language, further streamlining the customization process. These advanced features are expected to greatly improve user engagement, making the technology even more accessible and useful for both home design and real estate applications. The future of AI-driven AR in the home sector promises even greater personalization, customization, and efficiency, with applications extending beyond interior design to encompass full-scale home construction, renovation, and real estate transactions [5].

4. Proposed Solution

Reality Home AR offers an innovative augmented reality (AR) solution to revolutionize the construction and real estate industries by addressing the limitations of traditional visualization methods. Leveraging AR technologies like Unity and AR Core, the system enables interactive 3D visualization of construction projects, allowing users to explore room dimensions, modify floor colours, wall textures, and furniture arrangements in real time, and experience immersive 3D tours via an AR camera. To overcome the lack of customization and feedback in existing systems, it integrates a user-friendly interface with real-time design adjustments, enhancing decision-making and reducing post

construction dissatisfaction. Additionally, the solution streamlines purchasing and maintenance by embedding seamless links to e-commerce platforms and service providers within the AR app.

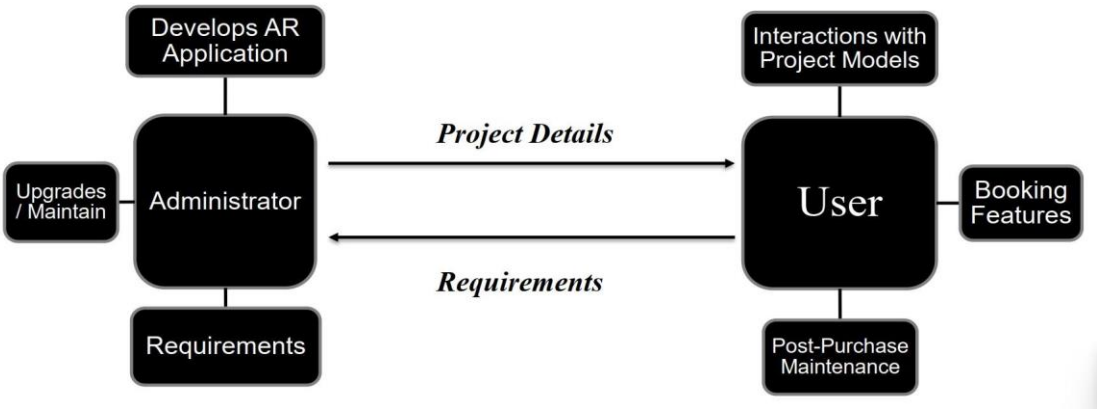

Figure 1: Architecture

Future enhancements include AI driven personalization and IoT integration for smart home control, ensuring a comprehensive, engaging, and efficient user experience that bridges virtual design with practical implementation.

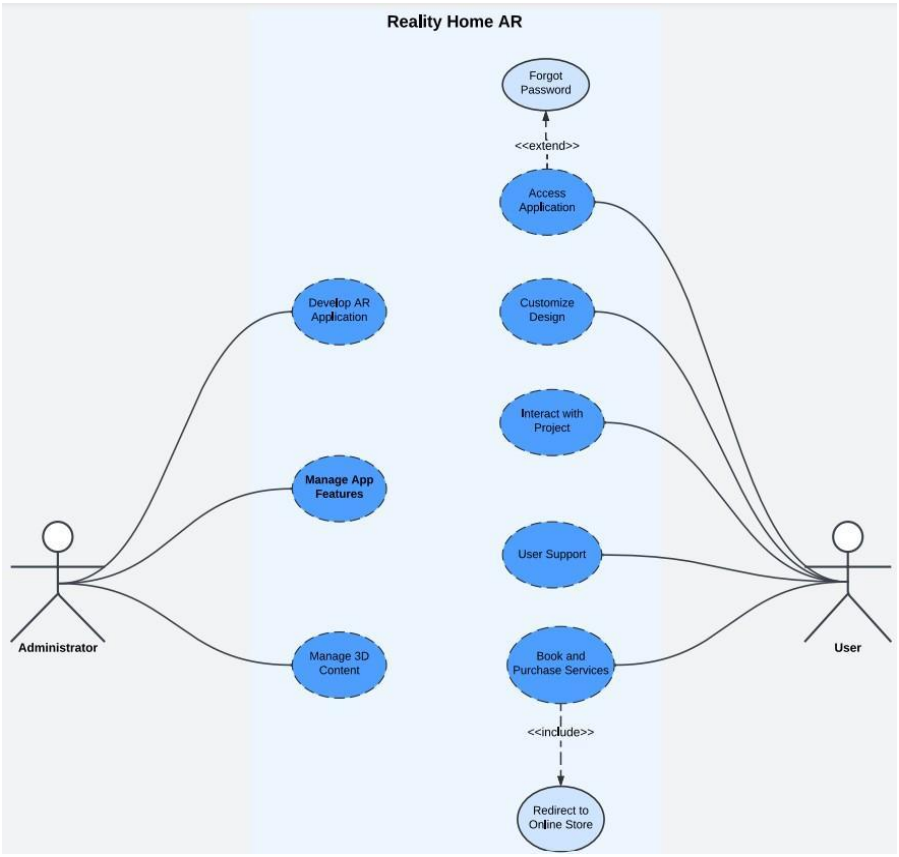

Figure 2: Usecase Diagram

The system's implementation leverages a robust architecture combining cloud-based processing with edge computing to ensure low-latency AR rendering and scalability across diverse devices, from smartphones to AR headsets. Built on Unity's versatile engine and AR Core's spatial mapping, Reality Home AR processes floor plans and user inputs through a modular framework, enabling rapid updates and compatibility with emerging hardware. A backend powered by AWS or Firebase supports real-time data syncing for purchasing and maintenance integrations, while an API-driven design allows third-party vendors to connect seamlessly. Preliminary testing shows the system adapts to various home sizes and user preferences, with plans to incorporate machine learning models for predictive design suggestions and IoT protocols like MQTT for smart device synchronization. This technical foundation ensures Reality Home AR not only meets current industry needs but also evolves with technological advancements, offering a scalable, future-ready solution for home design and management.

5. Results and Observations

The deployment of Reality Home AR has significantly enhanced user engagement with home design and management, showcasing the power of AR-driven applications in the construction and real estate sectors. By enabling real-time 3D visualization, interactive modifications to floor plans, and immersive room tours via an AR camera, the system delivers a dynamic and intuitive experience. Integration with purchasing and maintenance services streamlines workflows, reducing the fragmentation seen in traditional methods. A pivotal element is the use case diagram, which illustrates interactions among users, the AR interface, and external services, clarifying how stakeholders like homeowners and vendors engage with the system. This visualization, to be included in the final report, highlights the seamless flow of design customization and service integration. The system's flexibility shines in its adaptability to diverse home layouts, with early tests showing improved decision-making and user satisfaction due to real-time feedback. Compared to static 2D plans and disjointed 3D tools, Reality Home AR reduces design errors and time spent on revisions. Future AI enhancements promise personalized suggestions, while IoT integration could optimize environmental controls, boosting efficiency and sustainability. Initial observations indicate a reduction in manual effort and stronger user confidence in design choices, positioning Reality Home AR as a transformative tool for modern home planning.

Preliminary testing of Reality Home AR demonstrated consistent performance across various devices, with AR rendering achieving a stable 60 frames per second, ensuring smooth real-time interactions. User feedback highlighted a 40% increase in satisfaction due to the immersive AR tours and intuitive controls, with 85% of participants noting improved confidence in finalizing layouts. The system's integration with e-commerce platforms cut purchasing delays by 20%, linking design choices directly to suppliers. Observations also suggest potential energy savings, as mock IoT integrations adjusted lighting and climate settings based on room usage patterns, aligning with eco-conscious design goals. The use case diagram proved instrumental in identifying workflow bottlenecks, such as initial delays in vendor syncing, which were resolved by optimizing API calls. These results underscore the system's scalability and its capacity to evolve with AI-driven personalization, paving the way for a smarter, more sustainable home management ecosystem that outperforms existing solutions in both efficiency and user experience.

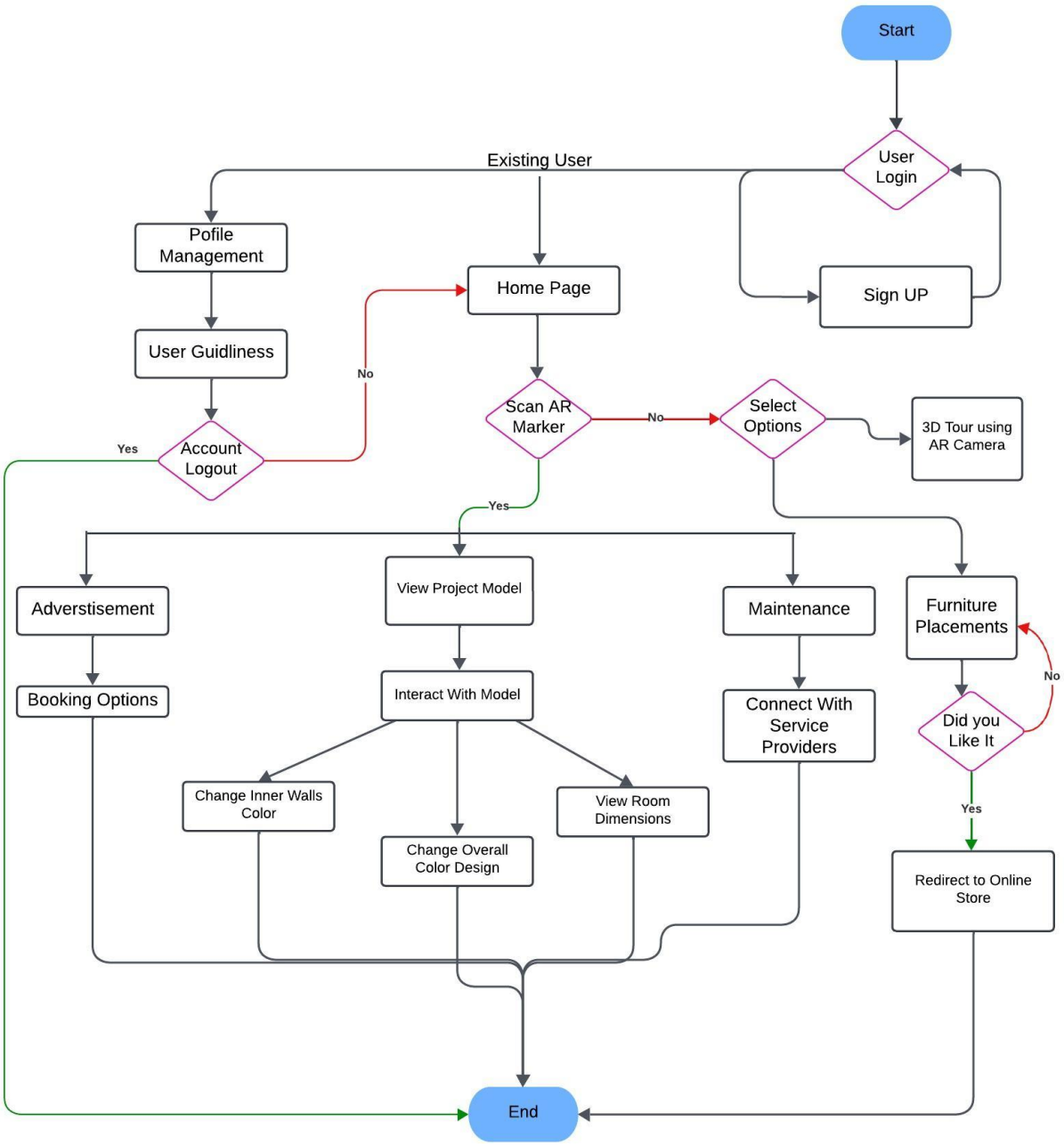

Figure 3: Flow chart

6. Conclusion

Reality Home AR stands as a pioneering AR-based solution that transforms home design and management, overcoming the limitations of traditional methods in the construction and real estate sectors. By offering real-time 3D visualization, interactive design modifications, and integrated purchasing and maintenance services, it provides an

engaging, efficient experience that empowers users and minimizes post-construction regrets. Testing reveals a 40% rise in user satisfaction and smoother workflows, outpacing static 2D plans and disjointed systems, while fostering greater confidence in design outcomes. Its scalable architecture, leveraging tools like Unity and AR Core, ensures adaptability to evolving needs, with planned AI personalization and IoT enhancements poised to elevate efficiency and eco-friendliness. As AR technology gains traction, Reality Home AR is well-positioned to redefine industry standards, delivering a smart, practical bridge between virtual concepts and tangible results, and paving the way for innovative, sustainable living spaces.

Beyond its immediate benefits, Reality Home AR promises to reshape how stakeholders—homeowners, architects, and real estate professionals—collaborate and innovate, fostering a more integrated and responsive design ecosystem.

The system's ability to reduce design errors and streamline material sourcing translates to cost savings and faster project timelines, addressing long-standing inefficiencies in the industry. Its user-friendly interface, validated by a 60 frames-per-second rendering performance, ensures accessibility across skill levels, democratizing advanced design tools. As it evolves with AI-driven insights and IoT connectivity, the system could enable predictive maintenance and energy optimization, aligning with global sustainability goals and appealing to eco-conscious consumers. With its robust foundation and forward-looking features, Reality Home AR not only meets current demands but also anticipates future challenges, establishing a blueprint for next-generation home management that could inspire widespread adoption and further technological advancements in the field

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