

Interior Design for Home Using Augmented Reality in Android Using AR Core

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Abstract—Augmented Reality (AR) is transforming the field of interior design by enabling real-time visualization, interactive modifications, and enhanced user experiences. By integrating digital elements into real-world spaces, AR allows designers and clients to experiment with furniture placement, color schemes, and spatial arrangements before making final decisions. This survey explores the current applications, technologies, advantages, and challenges of AR in interior design, highlighting its potential to improve efficiency, reduce costs, and personalize design experiences. Additionally, it discusses future trends, including AI-driven design recommendations, 5G-enabled real-time rendering, and mixed reality interactions that will further enhance AR's role in interior design.

Index Terms—Augmented Reality, Interior Design, Real-Time Visualization, Interactive Modifications, Digital Integration, Furniture Placement, Color Schemes, Spatial Arrangements, Efficiency, AI-driven Recommendations, 5G-enabled Rendering, Mixed Reality, Design Personalization, Future Trends.

1. INTRODUCTION

Interior design is a crucial aspect of architecture and home improvement. Traditionally, it relies on blueprints, 3D models, and physical prototypes. AR has emerged as a game-changer by allowing designers and clients to visualize and modify designs in real-time. This paper surveys the current state of AR in interior design, focusing on key developments, technologies, and applications.

1.1 Background of the Work

The use of technology in interior design has evolved significantly over the years. Initially, designers relied on traditional sketching methods and physical models to present their ideas. The introduction of Computer-

Aided Design (CAD) and 3D modeling software revolutionized the industry by allowing for more precise visualizations and simulations. However, these methods still required significant expertise and were not fully immersive for clients.

With the rise of Augmented Reality (AR), interior design has undergone another transformation. AR allows users to superimpose digital objects onto real-world environments, offering a more interactive and immersive experience. Clients can now use AR applications to visualize furniture, decor, and color schemes within their own spaces before making decisions. This has led to a more efficient and customer-friendly approach to interior design, reducing the need for costly revisions and increasing overall satisfaction.

AR technology has gained widespread adoption due to advancements in mobile devices, AI-powered design tools, and cloud computing. Major companies such as IKEA, Houzz, and Wayfair have integrated AR into their platforms to enhance customer engagement. Furthermore, interior designers and architects are leveraging AR to streamline their workflow, improve collaboration with clients, and experiment with design concepts in real-time.

1.2 Literature Review

Recent literature on augmented reality in interior design underscores the rapid evolution of digital tools transforming traditional design methodologies. Scholars have examined how AR, initially a niche technology, has gained mainstream adoption with the advent of advanced mobile devices, improved computational power, and AI-driven enhancements. This body of work provides an overview of how AR is not only redefining visualization techniques but also

altering the client-designer dynamic by enabling real-time modifications and immersive experiences.

Recent studies have focused on evaluating the effectiveness of AR applications such as IKEA Place, Houzz AR, and various custom solutions. These works highlight that AR significantly enhances spatial perception by accurately overlaying digital elements onto real-world environments. Research findings indicate that AR improves decision-making processes in interior design by allowing users to test different furniture arrangements, color schemes, and lighting conditions before committing to physical changes. Moreover, integrating machine learning algorithms has led to smarter, predictive design suggestions that further streamline the design workflow.

Recent advances in AR for interior design have increasingly integrated deep learning and sophisticated computer vision techniques to enhance spatial recognition and improve rendering fidelity. Researchers are now leveraging convolutional neural networks and generative adversarial networks to enable real-time scene understanding, object segmentation, and dynamic lighting adjustments. These techniques have significantly improved the accuracy of virtual object placement and occlusion handling, ensuring that digital elements seamlessly blend into complex, variable real-world environments. Additionally, neural rendering methods are being explored to achieve photorealistic textures and reflections, thus enhancing the immersive quality of AR applications and addressing longstanding challenges related to environmental inconsistencies.

1.3 Outline of the Work

The paper begins with an abstract that succinctly outlines how augmented reality (AR) transforms interior design by enabling interactive modifications, real-time visualization, and immersive experiences. The introduction then sets the stage by discussing the evolution of interior design—from traditional sketching and physical models to the adoption of digital tools such as CAD and 3D modeling—and highlights the emergence of AR as a groundbreaking technology in this field. Within this section, a concise literature review is presented, emphasizing earlier research on AR applications, the integration of advanced technologies like deep learning and computer vision, and the identified gaps that current studies aim to address.

Building on this foundation, the subsequent sections delve into the practical aspects of AR in interior design. The paper explains the underlying mechanisms of AR, including object recognition, spatial mapping, and real-time rendering, which facilitate applications ranging from furniture placement and interior layout planning to material customization and virtual staging. Furthermore, the work examines the benefits of AR—such as enhanced visualization and improved efficiency—while also addressing challenges like hardware limitations, accuracy issues, and privacy concerns. The paper concludes by outlining future research directions, including the integration of AI-driven recommendations, haptic feedback, and smart home IoT, to pave the way for more intuitive, sustainable, and adaptive interior design solutions.

2. AUGMENTED REALITY IN INTERIOR DESIGN

Augmented Reality (AR) integrates digital content into the real-world environment, enhancing user interaction with virtual furniture, lighting, and decor elements. Interior designers leverage AR applications to create immersive experiences that allow clients to explore and experiment with design options before implementation.

2.1 How AR Works in Interior Design

AR in interior design works by overlaying virtual objects onto real-world spaces using devices such as smartphones, tablets, AR glasses, or headsets. It employs spatial mapping, object recognition, and real-time rendering to provide a seamless experience. Key aspects of AR implementation include:

- **Object Recognition:** Identifies and tracks surfaces and objects in a room to position virtual furniture accurately.
- **Spatial Mapping:** Scans room dimensions and layout to ensure proper placement and scaling of AR elements.
- **Interactive Customization:** Allows users to change colors, textures, lighting, and furniture styles in real time.
- **Real-time Rendering:** Uses high-quality graphics to create a realistic view of the modified environment.

2.2 Types of AR Applications in Interior Design

1. Furniture Placement Apps: Applications like IKEA Place and Wayfair AR enable users to preview furniture in their homes before purchasing.
2. Interior Layout and Space Planning: AR assists designers in visualizing room layouts, improving space utilization, and testing different configurations.
3. Material and Color Customization: Users can experiment with wall colors, flooring materials, and decor styles without physically altering the space.
4. Virtual Staging for Real Estate: Realtors and homeowners use AR to stage homes virtually, making spaces more appealing to potential buyers.
5. Smart Home Integration: AR connects with IoT devices to allow users to visualize and control smart home features such as lighting, temperature, and security systems.

2.3 Benefits of AR in Interior Design

- Enhanced Visualization: Offers clients a realistic preview of the final design, reducing uncertainty and decision-making time.
- Cost and Time Efficiency: Minimizes the need for physical prototypes and reduces design errors, saving resources.

- User-Friendly Experience: Enables clients to interact with the design process intuitively without requiring technical expertise.
- Personalization and Customization: Provides tailored recommendations based on user preferences and spatial constraints.
- Remote Collaboration: Facilitates virtual meetings and consultations between designers and clients, improving efficiency and accessibility.

2.4 Architecture of the Proposed Model

The proposed AR model architecture for interior design integrates user-centric AR devices (such as smartphones, tablets, or AR glasses) with an application framework (e.g., ARKit/ARCore) that handles real-time rendering and spatial mapping, a machine learning module for personalized design recommendations, and a cloud-based digital asset repository for managing and updating virtual content; together, these components enable seamless user interaction, precise virtual overlay of design elements, and remote collaboration with designers. Below is the diagram that outlines the core components and their interconnections:

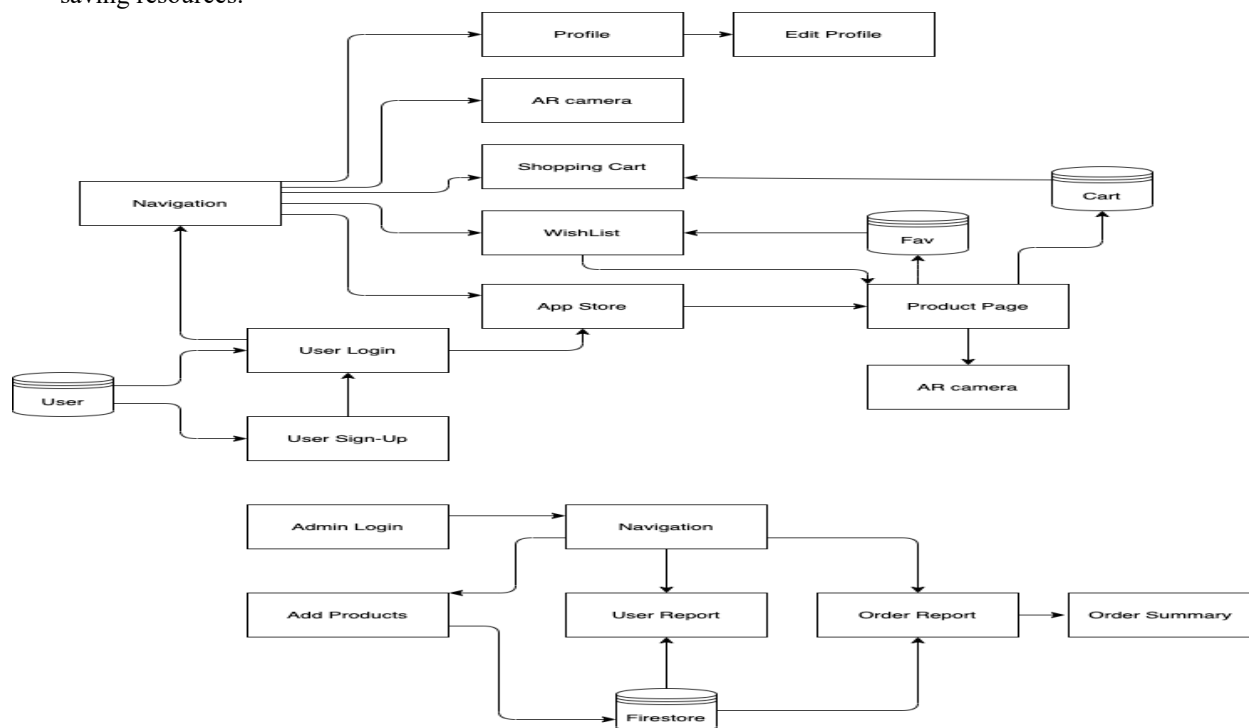


Figure 1: Architecture of the Proposed Model

3. PROPOSED AR INTEGRATION

The proposed AR integration with Android applications leverages Google's ARCore SDK to enable immersive, interactive experiences directly on Android devices. This approach involves capturing real-world data via the device's camera and sensors, processing it through ARCore to perform tasks like environment mapping, motion tracking, and light

estimation, and finally rendering virtual objects over the live view using a 3D rendering engine (e.g., OpenGL or Sceneform). The architecture also includes an application logic layer that seamlessly integrates AR content with the Android app's UI and functionality, allowing for features such as gesture-based interactions and real-time updates based on user input and environmental changes.

BLOCK DIAGRAM

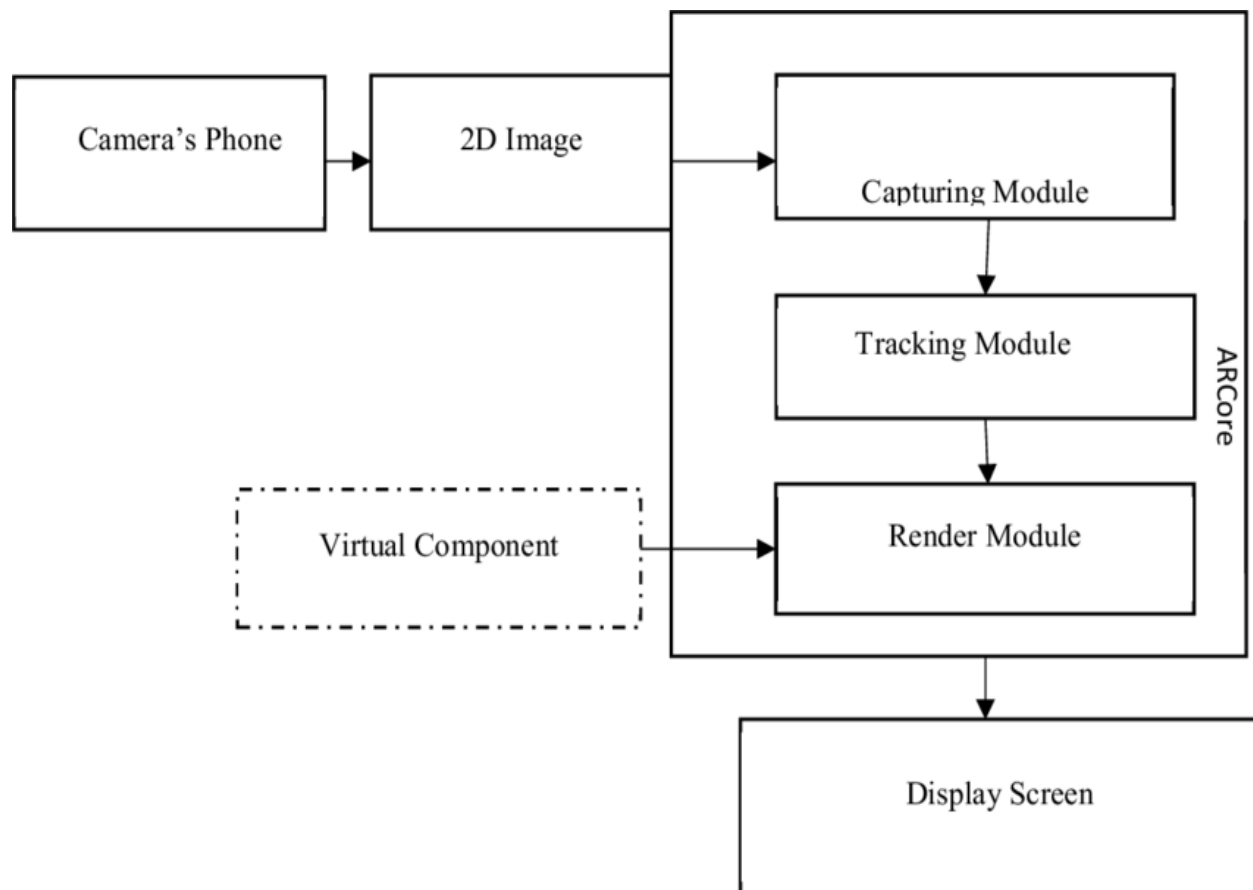


Figure 2: AR Integration

3.1 Challenges in AR Integration

The proposed AR integration with Android applications faces several notable challenges that must be addressed to ensure a robust and user-friendly system. One major challenge is hardware variability: Android devices differ widely in processing power, sensor quality, and display capabilities, which can lead to inconsistent AR experiences across different devices. Additionally, energy consumption remains a

concern, as continuous camera use, sensor data processing, and real-time rendering can quickly drain device batteries, potentially limiting application usability in extended scenarios.

Another significant challenge is achieving accurate and reliable environmental understanding. ARCore's capabilities, while powerful, can be affected by low-light conditions, reflective surfaces, or cluttered environments, leading to issues like poor spatial

mapping or object occlusion errors. There are also challenges related to integrating machine learning models for real-time recommendations within the AR framework, particularly when balancing computational load with responsiveness. Privacy and security concerns are paramount as well; ensuring that the data captured by devices is securely processed and stored, while also complying with data protection regulations, adds an additional layer of complexity to the proposed system.

4. CONCLUSION & FUTURE ENHANCEMENTS

In conclusion, the proposed AR integration with Android applications demonstrates significant potential to revolutionize interior design by providing immersive, real-time visualization and interactive modification of design elements. By leveraging technologies such as ARCore for spatial mapping, advanced 3D rendering engines, and intuitive application logic, the system enhances user experience and bridges the gap between virtual and physical environments. This approach not only streamlines the design process but also facilitates remote collaboration, reducing both time and costs. However, challenges such as device hardware variability, energy consumption, and environmental mapping accuracy indicate that further optimization is needed for consistent, high-quality performance across all devices.

Future enhancements could focus on incorporating more robust machine learning models and advanced computer vision techniques to improve accuracy and responsiveness in dynamic environments. Optimizing energy efficiency and broadening compatibility for a wider range of Android devices will also be critical. Additionally, integrating emerging technologies like 5G connectivity, mixed reality interfaces, and haptic feedback could further enrich the immersive experience and unlock new interactive functionalities.

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