

Generative AI for AI-Based Interior Design Applications

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Abstract—This paper presents an innovative approach to interior design through the development of a React Native application, "Visualize Interior Designs," which integrates generative AI and augmented reality (AR). The app enables users to capture images of room corners and receive tailored design suggestions by analyzing spatial dimensions, furniture layouts, and user prompts. With features like 3D visualization, smart budgeting tools, and eco-friendly design options, the app provides an accessible, intuitive, and personalized solution for interior design. By leveraging advanced AI and AR technologies, the app establishes a new paradigm for user-centric design tools.

Keywords—Generative AI, Interior Design, 3D Visualization, Augmented Reality, Smart Budgeting, User-Centric Design

I. INTRODUCTION

The application of Artificial Intelligence (AI) in interior design has gained significant traction, driven by advancements in Generative AI (Gen AI). This transformative technology leverages algorithms to create, simulate, and optimize design solutions, enhancing creativity, efficiency, and personalization in the interior design process. This literature review examines the current state of research on Gen AI in interior design, focusing on its methodologies, applications, benefits, and challenges. [1,6]

Gen AI's ability to analyze vast datasets and generate innovative solutions has opened up new possibilities in interior design. It empowers designers to visualize and experiment with complex design concepts, from creating virtual room layouts to suggesting suitable color palettes and furniture arrangements.[1,6] Furthermore, its adaptive nature allows for real-time customization, enabling tailored solutions for individual preferences and functional needs. However, despite its potential, the integration of Gen AI is accompanied by challenges such as ethical concerns, the potential loss of human creativity, and barriers to accessibility. This review explores these

aspects to provide a holistic understanding of how Gen AI is shaping the present and future of the interior design industry.[4,6]

A. Need and Motivation

The need for innovation in interior design arises from the challenges of balancing creativity, efficiency, and personalization. Traditional methods often struggle to meet these demands, making it difficult to create spaces that are both functional and visually appealing. Generative AI provides a solution by rapidly generating and refining design concepts, enabling designers to explore numerous possibilities with greater precision and speed, while also reducing the time and effort required in the design process.[1,6]

Motivation for adopting generative AI lies in its ability to make design more accessible and user-centric. By offering features like real-time visualization and personalized recommendations, it empowers individuals to create tailored layouts that align with their preferences and budgets.[2] Additionally, its ability to adapt to individual needs fosters inclusivity, making it a valuable tool for a wider audience, including non-designers and small-scale businesses.[3]

Generative AI also supports global priorities such as sustainability and inclusivity. It suggests energy-efficient designs and culturally diverse options, fostering innovation while addressing broader challenges. With its potential to inspire creativity and overcome traditional design limitations, generative AI promises to redefine interior design, making it more efficient, imaginative, and accessible for all.[1,4]

A. OVERVIEW OF GENERATIVE AI

Generative AI refers to machine learning models, primarily Generative Adversarial Networks (GANs)

and Variational Autoencoders (VAEs), capable of generating new content from training data. In the context of interior design, these models can create realistic visualizations, propose furniture arrangements, suggest color palettes, and design layouts. The core advantage of Gen AI lies in its ability to simulate countless design variations rapidly, enabling designers and end-users to explore creative possibilities efficiently.[1.6]

II. REVIEW OF LITERATURE

Furtado, L. S., Soares, J. B., & Furtado, V [1] explore how Generative AI (GAI) enhances creativity in design, focusing on tasks like rendering, construction techniques, and data analytics. They propose a framework to support combinational, exploratory, and transformational creativity, emphasizing GAI's role in real-time collaboration for improved design outcomes.

Chen and Wang [2] investigate the application of AI in solving storage problems in interior design. They discuss how AI optimizes storage solutions, analyzes user behavior, and integrates smart home technology, improving user satisfaction and space utilization.

Wang, Xiang Wang, Zixuan [3] delve into the role of AI in improving virtual interior design systems, highlighting its potential to enhance user experience, increase design company efficiency, and reduce costs through automation and data analysis.

TABLE I. LITERATURE SURVEY TABLE

S R N O	RESEA RCH PAPER TITLE	YEA R	PUBLI SHER	ADVANTA GES	DISAD VANTA GES
1	A task-oriented framework for generative AI in design [1]	2024	ELSEVIER	Generative AI boosts creativity, efficiency, and cost-effectiveness by automating tasks and minimizing waste.	AI faces challenges like over-reliance, quality control, and ethical concerns.
2	Application of Artificial Intelligence Algorithm in	2022	IEEE	Generative AI improves experience, efficiency, and cost savings.	Focuses on limits creativity, needs tech, and costs more.

	Indoor Virtual Display System [2]				
3	Application of AI technology in interior design [3]	2020	Research Gate	AI optimizes space, personalizes storage, and saves time.	AI lacks creativity, needs complex tools, and costs more.

III. REPORT ON PRESENT INVESTIGATION

B. APPLICATIONS IN INTERIOR DESIGN

A. Visualization and Rendering

Generative AI takes visualization in interior design to the next level by producing stunning photorealistic images of spaces, helping clients and designers alike see their ideas come to life. Research shows that GAN-based models are particularly effective, as they can generate detailed room renderings that seamlessly integrate user preferences, architectural constraints, and material properties. This allows designers to explore multiple creative possibilities quickly and refine their ideas with greater precision. Additionally, these tools make it easier for clients to visualize and personalize their spaces, fostering clearer communication and a more collaborative design process.[6,7]

B. Personalization

AI-powered interior design tools are transforming the way spaces are personalized by using generative models to craft tailored solutions based on user inputs, such as lifestyle, cultural preferences, and budget constraints. For instance, some advanced platforms utilize deep learning algorithms to analyze user data and offer furniture and decor suggestions that align seamlessly with individual tastes. This not only simplifies the decision-making process but also ensures that the final design reflects the user's unique personality and practical needs.[5,9]

C. Space Optimization

Generative AI is revolutionizing space optimization by using advanced algorithms to suggest layouts that balance functionality with aesthetics. Researchers have explored methods like reinforcement learning

and evolutionary algorithms to create intelligent systems capable of adapting to unique spatial constraints and individual user needs. These tools not only enhance the practicality of a space but also ensure it feels visually harmonious and tailored to the people who use it.[1,8]

D. Sustainable Design

Generative AI supports sustainable interior design by simulating energy-efficient layouts and recommending eco-friendly materials. Machine learning models trained on environmental impact datasets enable users to make informed decisions regarding sustainable practices.[1,7]

IV. AIM AND OBJECTIVE

A. Aim

The aim of this project is to leverage generative AI technologies to revolutionize interior design by enhancing creativity, efficiency, and personalization through automated tools. [1]

B. Objective

The objectives include implementing AI-driven visualization techniques for photorealistic designs, providing personalized solutions based on user preferences, optimizing spatial layouts, and promoting sustainable design by recommending eco-friendly materials. These goals align to create an innovative, user-centric system that addresses traditional design limitations.[1,9]

V. PROBLEM STATEMENT

Traditional interior design methods are often resource-intensive, time-consuming, and lack scalability. They fail to provide the level of personalization, space optimization, and sustainability required in modern design. Additionally, they are inaccessible to non-expert users, creating barriers for widespread adoption. The proposed system aims to overcome these challenges by automating design processes and introducing intuitive, user-friendly tools powered by generative AI, revolutionizing how interior design is approached.[4,8]

VI. PROPOSED SYSTEM

The proposed system leverages generative AI to transform interior design by automating complex

tasks and enhancing the user experience. The system's functionality encompasses generating photorealistic visualizations, personalizing designs based on user inputs, optimizing spatial layouts, and promoting sustainable practices by recommending eco-friendly materials. By integrating advanced AI models, the system enables designers and users to achieve efficient, tailored, and aesthetically pleasing outcomes with minimal manual effort. Below are the expanded requirements:

A. Functional Requirement

The interface should be intuitive and accessible, enabling The system should generate photorealistic visualizations of interior spaces, allowing users to vividly conceptualize designs before implementation. This includes creating high-quality 3D models that reflect accurate material properties, lighting, and spatial dimensions. Furthermore, users will be able to experiment with different styles, colors, and textures to ensure alignment with their vision before making final decisions.

It should analyze diverse user inputs—including lifestyle preferences, cultural influences, and budget constraints—to deliver fully customized design recommendations. These tailored suggestions will empower users by providing options that consider personal requirements, such as ergonomic furniture for workspaces or culturally inspired decor elements. By doing so, the system ensures that no two designs are identical, offering unique solutions for every project.[6]

It must optimize room layouts by suggesting efficient use of space that blends functionality with beauty. Advanced algorithms will evaluate spatial constraints and user needs, proposing layouts that adapt to multi-functional spaces, such as converting a living area into a home office. Additionally, the system will ensure designs maximize natural light and circulation, creating environments that are both practical and aesthetically pleasing.

It should recommend eco-friendly and sustainable materials based on user preferences. This involves analyzing environmental impact datasets to suggest energy-efficient layouts and materials that align with green building standards. Users will receive insights into the carbon footprint of their choices, enabling them to make more sustainable decisions without compromising on quality or design appeal.

B. User Interface

The interface should be intuitive and accessible, enabling both professional designers and novice

users to navigate the system effortlessly. A clean, user-friendly design will ensure high adoption rates. Tutorials and guided walkthroughs will also be included to help first-time users familiarize themselves with the system's functionalities quickly. Multi-modal input capabilities—such as text descriptions, uploaded images, and voice commands—will enhance user interaction and flexibility. Users can describe their design vision verbally, upload reference photos, or type specific requirements, making the platform versatile and inclusive for various user preferences.[6]

Real-time feedback and visualization will allow users to immediately see the effects of their design choices. Interactive elements, such as drag-and-drop tools for furniture placement, will further streamline the customization process. The system will also provide before-and-after comparisons, enabling users to track design iterations and evaluate different concepts easily.

C. Non-Functional Requirement

The system must offer high reliability and performance, processing complex design computations with minimal latency. This ensures a seamless user experience, even for intricate projects. Advanced caching and optimization techniques will be implemented to handle high user loads effectively. Robust data privacy measures will be implemented to safeguard user information. The system will comply with ethical AI standards, building trust among users by being transparent and secure. Periodic audits and compliance checks will ensure adherence to the latest privacy regulations.[4]

Scalability is crucial, enabling the system to accommodate increasing user demands and the growing complexity of interior design projects. Cloud-based infrastructure will support this scalability, ensuring consistent performance across a wide range of use cases. The system will also integrate predictive analytics to anticipate user needs and allocate resources accordingly.[9]

VII. FEASIBILITY STUDY

C. Operational Feasibility

Generative AI significantly reduces manual effort in interior design by automating tasks such as rendering, material selection, and layout optimization. This operational advantage ensures that the system is practical for various users, including large design

firms, independent professionals, and individual homeowners. By simplifying these complex processes, the system broadens accessibility, making professional-quality design achievable for a wider audience. Additionally, the system's adaptability allows users to modify designs effortlessly, making it suitable for dynamic requirements and iterative workflows.[4]

Furthermore, the system's ability to handle large-scale projects without sacrificing quality ensures operational feasibility across a range of use cases. Users can seamlessly switch between small residential projects and large commercial designs, enabling scalability in their workflow. The system also supports real-time collaboration, allowing teams to work together efficiently, even across different locations, enhancing productivity.[9]

D. Technical Feasibility

The system is built upon state-of-the-art AI frameworks, including Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and reinforcement learning. These technologies provide the foundation for creating detailed visualizations, personalized recommendations, and optimized layouts. Cloud computing further enhances the system's capabilities, enabling it to handle large-scale data processing and deliver high-quality results efficiently. The incorporation of modular design will also allow future upgrades, ensuring the system remains at the forefront of technological advancements.[6]

To ensure technical feasibility, the system is designed to integrate seamlessly with existing software tools and platforms commonly used in the design industry. This interoperability allows users to import and export designs easily, reducing the learning curve for professionals already familiar with other tools. Regular updates and machine learning model improvements will ensure that the system stays compatible with emerging technologies and industry standards.[7]

E. Economic Feasibility

Although the initial investment for developing and deploying the system may be high, the long-term cost savings it offers are substantial. By minimizing material waste, reducing design iteration times, and enabling simultaneous management of multiple projects, the system lowers overall expenses for

designers and clients. These economic benefits make the system a worthwhile investment for all stakeholders in the interior design industry. Furthermore, subscription-based pricing models can be introduced to make the system affordable for small businesses and individual users.[9]

The system's ability to provide detailed cost breakdowns for different materials and layouts ensures economic feasibility by helping users stay within budget. This transparency empowers users to make informed decisions, avoiding unnecessary expenses and maximizing value. Additionally, cost-sharing options for collaborative projects can further reduce financial barriers, enabling broader adoption of the technology.[8]

F. Legal Feasibility

The system ensures full compliance with copyright laws, protecting intellectual property rights for both users and designers. Additionally, it adheres to stringent data privacy regulations, safeguarding user information from unauthorized access. Ethical AI practices are embedded into the system's framework, ensuring fairness, inclusivity, and transparency in its operations. By addressing these legal aspects, the system builds trust and fosters widespread adoption. Collaboration with legal experts will ensure that the system evolves in line with new regulations, maintaining compliance over time.[4]

Moreover, the system will include licensing agreements that define the scope of usage rights for users and designers, avoiding potential disputes. Training modules on ethical AI use and data privacy will be offered to users, ensuring they understand their responsibilities when interacting with the system. By promoting awareness and accountability, the system ensures a legally robust framework that benefits all stakeholders.[9]

VIII. CONCLUSION

Generative AI holds immense potential to revolutionize the interior design industry by enhancing creativity, efficiency, and personalization. By allowing designers to quickly generate and evaluate a wide range of possibilities, AI can unlock new creative avenues that were previously unimaginable. However, addressing challenges related to data quality, interpretability, and accessibility is crucial for realizing its full potential and ensuring that the technology can be used

effectively by all, regardless of experience or resources. The ongoing refinement of AI models, along with collaboration between designers, technologists, and researchers, will be key in overcoming these hurdles. With continued innovation and interdisciplinary cooperation, the future of AI-driven interior design applications looks promising, offering a more accessible, efficient, and imaginative approach to creating spaces. By overcoming these challenges, AI has the potential to not only change how we design but also transform the way we interact with and experience the spaces around us.[4,9]

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