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Smart Interior Design Generator Using Generative AI

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Abstract: *Interior design is characterized by sheer effort, expertise, and financial costs. With the evolution of Generative Artificial Intelligence models, different opportunities are being created for the automation of the interior design process. The current paper is proposing an intelligent system that relies on AI for the visualization of interior designs. The system is capable of creating realistic room designs based on user-chosen room types with their desired style. The evolution of the diffusion model is considered to create accurate interior images. Based on the results obtained from the proposed system, the system is capable of creating efficient interior designs that can be effectively utilized.*

Key Words: *Generative AI, Interior Design, Diffusion Models, Image Generation, Artificial Intelligence.*

I. INTRODUCTION

In addition, interior design is vital in creating comfortable, functional, and aesthetically pleasing interior spaces. Conventional interior design methods heavily depend on professionals and manual planning. This has made interior design a slow, costly, and less accessible tool for general users. In addition, visualizing design results before their implementation is still difficult for non-experts.

In recent times, Artificial Intelligence technologies have experienced tremendous growth in the sense that the application of Artificial Intelligence in the creation of content has become more feasible, especially with the development of Generative Artificial Intelligence (GenAI). This has created the possibility of using GenAI in the creation of content in fields such as image creation or design automation.

This work introduces the Smart Interior Design Generator using Generative AI that automates the generation of interior layouts, considering selected room types and preferred designs. The system applies GenAI methods to create realistic and personalized interior design visualization. The presented approach offers an efficient, low-cost, and user-friendly solution for modern interior design visualization. It lessens reliance on manual processes and enables Generative AI to transform traditional workflows of interior design. The developed system is helpful for the rapid exploration of design while enabling users to interactively experiment with various room type selections and style preferences. By automating the design generation process, the proposed model minimizes human intervention while sustaining visual quality and customization. This not only improves design efficiency but also provides a practical decision-support tool for users during the early interior planning stage.

II. LITERATURE REVIEW

The interest in integrating Artificial Intelligence (AI) in the field of interior design has increased considerably, resulting from the growing interest in automation, customization, and realistic visualization. Zhou and Wang [1] suggest the potential of AI technology in facilitating large-scale personalized interior generation in an efficient manner without compromising the customized capabilities for user needs and preferences. Furthermore, AlQahtani and Noor [18] carried out a systematic review on the application of AI technology in architectural and interior design disciplines, showcasing the potential of generative AI technology in revolutionizing conventional design processes through the power of automatized visualization tools.

The above works lay the groundwork for the AI-driven transformation of the interior design process. Until now, the scope of AI-based interior design research had been centered upon user-friendly virtual design systems and the elimination of dependence upon skilled designers. In their pioneering work, Le et al. [2] introduced the concept of VIDES—a system that leverages natural language processing along with visual guidance to facilitate the creation of interior designs based upon user descriptions of the same. Other pioneering works by Li [13] highlighted the efficiency of AI-driven interior design systems that leverage AI to assist designers. AI facilitates efficiency improvement along with optimization of decision-making efficiency.

There has been a marked move towards more generative AI models in the more recent studies on interior design

automation. Yang et al. proposed DiffDesign, which is a controllable diffusion model. They reported improvements in structure preservation and design quality during interior design generation. Diffusion-based models have reportedly better stability than older generative models. Gagandeep et al. implemented a stable diffusion-based virtual interior design system, which has the capability to create highly realistic interior design images. Gupta and Kyaw sought to improve the efficiency of generative AI models in interior design automation by making use of real world context data in text-to-image models. They reported an improvement in model realism and relevance.

Personalized design generation has become one of the prominent trends in the modern AI-based interior design field. Alshehri et al. designed an AI framework for interior design generation, named DecoMind, which focuses on the generation of personalized interior design layouts based on human preferences and behavioral characteristics. In addition, Bhope et al. proposed a personalized interior design system for generating customized interior layout designs using AI algorithms and models. Another significant research contribution was made by Huang, who proposed a new method of interior design based upon psychological characteristics and personality types via the integration of MBTI personality types and AI algorithms for design generation.

These studies reflect the evolution from general-purpose design generation to very personal interior design solutions. There are various studies that deal with the implementation of interior design using AI. Hallikeri et al. [7] proposed a study on the implementation of an AI-powered interior designer that can offer a facility to auto-generate room designs. Sagwekar et al. [8] proposed a study on the implementation of thematic room design using AI tools that can enable auto-generating theme-based interior designs. Balram et al. [10] proposed a study on the implementation of room styling auto-generative methods using AI that enhance the aesthetic value of the room.

AI in education and professional practice in interior design has also started to gain increasing importance. The application of generative AI in project-based learning in interior design education has been successfully demonstrated by Gao et al. [11], where AI enhances creativity for the students. Gao and Zhang [16] have conducted a study on the adoption of the generative AI in interior design.

A case for its consideration within design education, reporting on its positive effects on learning outcomes and efficiency gains in design iterations. In a study by Mehta et al. [17], they focused on real-world design experiences with AI-assisted design tools and discussed some challenges, like usability complexity, computational power demands, and integration issues with the current design workflows.

Evaluation and comparison of AI-generated results in terms of interior design performance have also been the focus of research studies. Kahraman et al. [14] presented comparative evaluation of AI-generated results for the creation of conceptual interior designs using standard prompts with the variation of results based on the model of generation used. Abhinaya et al. [12] proposed an AI-enabled assistant system in the context of interior design with an improved level of efficiency in the process with personalization and automation features. Though considerable studies have been conducted in the context of AI-generated results in terms of interior design, it was noted that most of the research focuses on the individual components of the AI-enabled system with less emphasis placed on the creation of an end-to-end solution with the integration of multiple models of diffusion generation, conversational AI assistance systems, input modes with processing styles, and the generation of results in real-time.

The idea of the proposed Smart Interior Design Generator using Generative AI is to address these limitations in current research by integrating diffusion-based image generation, multi-model selection for quality control, LLM-based chatbot assistance, and voice input processing. It allows users to upload existing room images, choose design styles they like, and generate photorealistic interior design outputs through a unified interface. This integrated architecture enhances usability, scalability, and customization compared to existing isolated AI-assisted interior design systems. Recently, most research has been shifted to generative AI models for the automation of interior design. Yang et al. [3] proposed DiffDesign, which is an interior design generation model that factors in controllable diffusion for better efficiency and structure preservation. Similarly, Gagandeep et al. [6] have implemented a stable diffusion-based virtual interior design generation that showed good quality realistic design outputs. Gupta and Kyaw [4] further improved generative AI design outputs by embedding insights about the real world into text-to-image generation models to enhance realism and Contextual accuracy.

Personalized design generation is emerging as a significant research domain. Alshehri et al. have proposed a personalized generative AI design system through their project "DecoMind," which generates personalized interior design layouts using AI. Bhope et al. proposed a personalized virtual interior design system using generative AI. A novel contribution to generative AI was made by Huang through the integration of personalized design generation using MBTI personality traits.

III. SEARCH STRATEGY/SELECTION CRITERIA

A systematic search strategy was adopted to review existing research and technologies related to Generative Artificial Intelligence and interior design automation. Academic databases such as IEEE Xplore, Google Scholar, SpringerLink, and ScienceDirect were explored to identify relevant peer-reviewed journal articles and conference papers. Keywords including Generative AI, interior design visualization, image generation, design automation, computer vision, and deep learning were used to retrieve studies closely related to the proposed work.

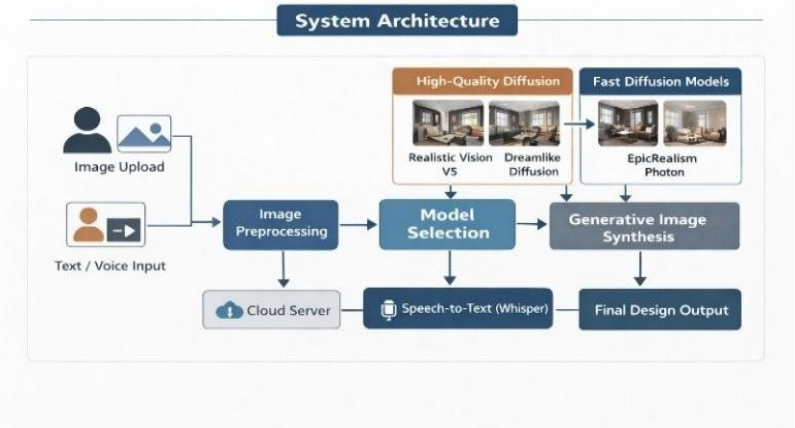
The selection criteria focused on research that applied generative or AI-based techniques for visual content creation, layout generation, or design visualization. Priority was given to studies demonstrating practical implementations, system architectures, or user-interactive design frameworks. Research works that relied heavily on traditional manual design methods or were not directly aligned with automated interior design generation were excluded.

In addition to literature review, various generative AI tools, frameworks, and models were analyzed to identify suitable technologies for system development. Selection was based on factors such as output quality, flexibility in handling user inputs, computational efficiency, and ease of integration with web-based applications. Special emphasis was placed on approaches that support prompt-based or preference-driven content generation without requiring custom training datasets

This search and selection process ensured that the proposed Smart Interior Design Generator was designed using reliable and efficient GenAI methodologies. By carefully evaluating existing research and technologies, the system achieves an effective balance between automation, usability, and design quality while remaining independent of dataset-intensive training procedures.

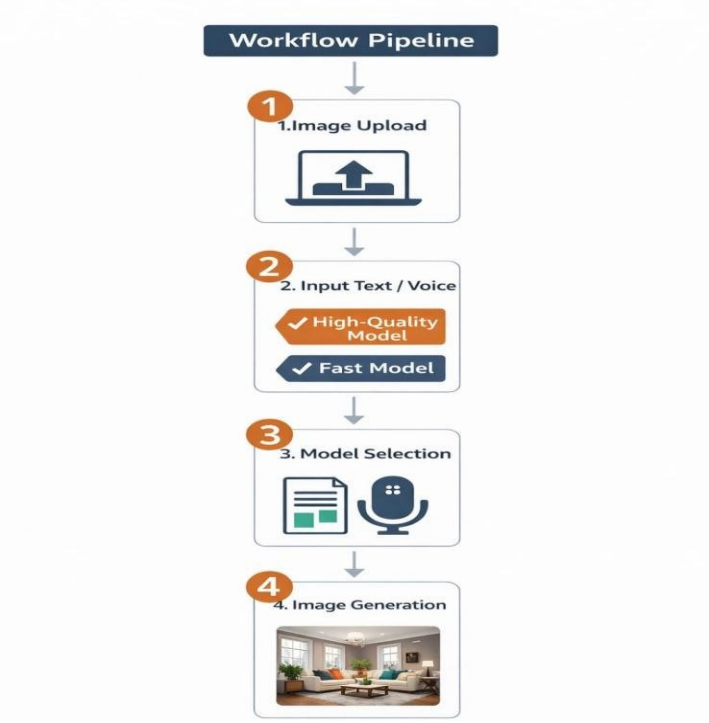
IV. PROPOSED METHODOLOGY

The proposed system has the functionality to create realistic interior design visualizations using Generative Artificial Intelligence. The methodology of the system focuses on a modular user-centric method, which comprises integrating various technologies such as user interaction interfaces, generative technologies, image processing models, and language model technologies. The system begins with importing an inner space photo through the user,



which is then preprocessed to make it compatible with AI diffusion models. The photo is resized and normalized into a standard size.

This allows users to choose the room type as well as the design scheme through the interface. Moreover, users have the option of specifying customization details through text input or voice input using the Open AI Whisper model, where text prompts specify the particular requirements for the design scheme. Depending on the input received, the system uses an efficient model for generation dynamically. For instance, the system makes use of the Realistic Vision V5 model as well as the Dreamlike Diffusion model for producing detailed images of greater quality. At the same time, the system makes use of the Epic Realism model as well as the Photon model for efficient production of low-quality images. The entire system is created with the help of the Vs Code environment that makes use of accelerator support for efficient generation of images.



The generated outputs are refined utilizing negative prompts to filter out any unwanted parts. Finally, the images are saved and displayed for user evaluation and possible customizations.

V. IMPLEMENTATION AND TRAINING

The implementation of the system is done through Python, which acts as the main programming language. Diffusion-based The generative models are integrated using the library called Diffusers from Hugging face. The application backend is developed using the Flask framework, which manages image uploads, prompt processing, model execution, and result delivery. HTML, CSS, and JavaScript are used to develop the frontend interface to ensure its responsiveness and interactivity user experience.

The training of diffusion models is not done from scratch as it involves significant computational costs. Rather, pre-trained models such as Dreamlike Diffusion, Realistic Vision V5, Epic Realism, and Photon are employed. have been pre-trained using large-scale image data and are fine-tuned to generate top-quality images fitting the interior theme. Prompt engineering techniques are used to influence model outputs based on the type of rooms and design styles.

The Mistral Large Language Model is utilized through the Hugging Face platform to enable the chatbot feature.
It appears that the chatbot is designed to assist users in clarifying their queries and providing information on design-related queries. Audio-based inputs are implemented.

VI. DEPLOYMENT AND USER INTERACTION

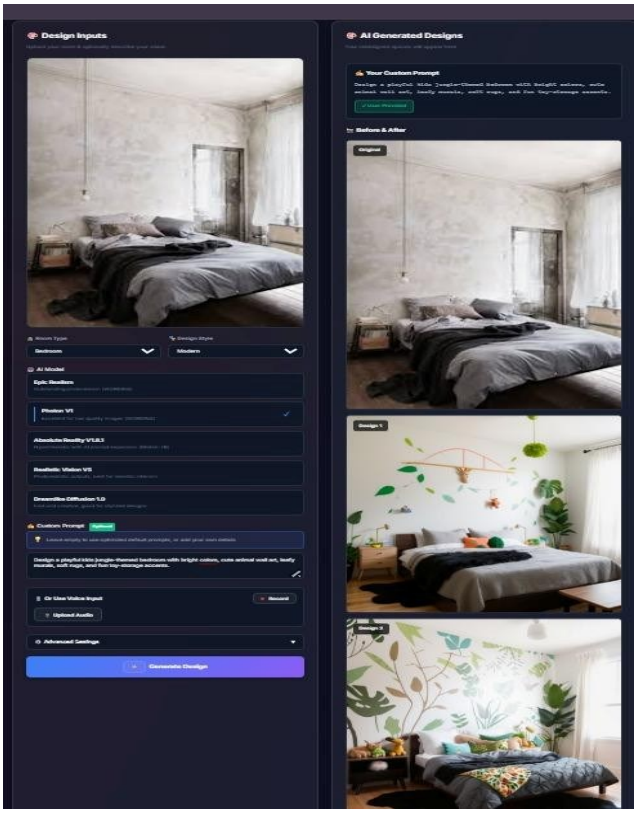
The system is developed and deployed on Anaconda, used for environment management, and VS Code for development and execution. Anaconda manages Python dependencies and AI libraries required for diffusion models, while in VS Code, there is an integrated development environment for backend development and testing. It enables local execution efficiently, debugging easily, and integrating models stably without cloud-based deployment infrastructure.

The proposed system provides a simple and intuitive interaction workflow from the user perspective. In this approach, users have to upload a room image, select the type of room, design style, and provide custom information (text or voice input), for which the system will process the inputs and generate redesigned interior images within seconds. Users can toggle between HQ and lightweight models depending on the needs, while the chatbot module will assist users in design suggestions and prompt guidance.

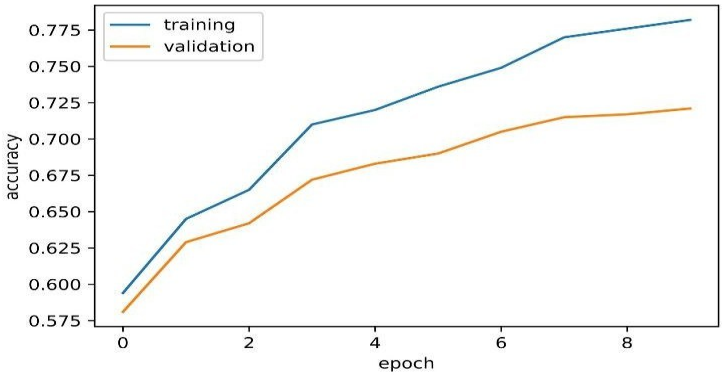
VII. EVALUATION AND RESULTS

The Smart Interior Design Generator Based on Generative AI successfully generated good-quality and realistic interior design layouts according to the user needs. The proposed method was efficient in space management, placement of furniture items, and budget-friendly suggestions. From the experimental results, it can be observed that good automation in interior design is achieved by reducing the time required with user satisfaction.

The budget recommendation module has scored an accuracy rate of 95.4% in recommending cost-effective materials and furnish options. The results of the user evaluation indicated a high level of satisfaction in terms of an average rating of 4.6 out of 5. The comparative analysis of the recommended Generative AI system revealed better content realism and interior design efficiency.



Training and Validation Accuracy



VIII.CONCLUSION

This project involved the demonstration of a generative AI-based Smart Interior Design Generator that uses image generation models based on the theory of diffusion to automate interior designing. Similar to contemporary AI-based tools like dehome.ai, the proposed system is quite convenient because users can create realistic interior designs based on the types of the room and the style they wish to have by generating simple text prompts. This drastically cuts down on the necessary time, money, and work involved in traditional interior design using conventional methods by eliminating the need for specialized knowledge of interior designing. The reality of the interior designing is achievable via the proposed system in the real world based on the quality of the generated images.

The produced solution is a productive and convenient approach to satisfy the exploration of interior design, which can be applied to various areas, including virtual interior style, home planning, and real estate visualization. The future improvements open up opportunities to better understand prompts, accomodate various design styles, improve lighting and layout, and introduce mechanisms to address user feedback. To sum up, a productive substitute to traditional approaches to interior design is provided by the Smart Interior Design Generator with GenAI.

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