Hemant Sharma, 2026, 14:3
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology
An Open Access Journal

# AI-Powered Interior Design System

**Hemant Sharma[1], Ankit Rajak[2], Dr Jasbir Kaur[3], Ifrah Kampoo[4], Mansi Rajapurkar[5]**
Student of Master of Computer Applications, Guru Nanak Institute of Management Studies, Matunga, Mumbai, India[1,2]
Director, GNIMS B-School, Head of Information Technology and HR, Guru Nanak Institute of Management Studies, Matunga, Mumbai, India[3]
Assistant Professor, Guru Nanak Institute of Management Studies, Matunga, Mumbai, India[4,5]

**Abstract- This research paper presents an AI-powered interior design system developed using Generative Artificial Intelligence techniques for automated room visualization, smart furniture arrangement, and personalized interior recommendations. Traditional interior designing methods often require significant time, professional expertise, and high financial investment, making them less accessible for common users. The proposed system aims to simplify and modernize the interior designing process by integrating advanced AI models capable of generating realistic and customized room designs based on user preferences, room dimensions, color combinations, and design themes. The system utilizes prompt-based image generation models such as diffusion models and deep learning techniques to generate visually appealing interior layouts in real time. Users can provide textual prompts describing their preferred room style, including themes such as modern, minimalist, luxury, vintage, or contemporary, and the AI system generates corresponding room visualizations automatically. Experimental analysis demonstrates that the AI-based system significantly reduces interior planning time while improving visualization quality and user satisfaction when compared with traditional manual design approaches.**

**Keywords— Generative AI, Interior Design, Artificial Intelligence, Deep Learning, Prompt Engineering, Diffusion Models, Computer Vision, Smart Automation.**

## I. INTRODUCTION

Interior designing plays a significant role in improvin g the aesthetics, comfort, and functionality of residential and commercial spaces. In modern society, people increasingly seek personalized and visually appealing interiors that reflect their lifestyle, preferences, and space requirements.

Traditional interior designing methods usually involve professional designers, manual planning, repeated modifications, and high costs, making the process time-consuming and less accessible for common users. Additionally, visualizing the final appearance of a room before actual implementation remains a major challenge for customers.

With the rapid advancement of Artificial Intelligence (AI) and Machine Learning (ML), various industries are adopting intelligent systems to automate complex tasks and enhance user experiences. One of the emerging areas is the application of Generative AI in design and visualization.

Generative AI refers to AI models capable of generating new content such as images, text, layouts, and designs based on user inputs and learned patterns from large datasets. Technologies such as Diffusion Models, Generative Adversarial Networks (GANs), and deep learning-based image generation systems have demonstrated remarkable capabilities in producing realistic and creative visual outputs.

The integration of Generative AI into interior designing has opened new possibilities for automated room visualization and intelligent recommendation systems. By using text prompts and user preferences, AI models can generate customized room layouts, suggest furniture arrangements, recommend color palettes, and create realistic interior design concepts within seconds. This significantly reduces the effort required in manual designing and allows users to

experiment with multiple styles and themes without additional cost.

## II. LITERATURE REVIEW

The rapid growth of Artificial Intelligence (AI) and Machine Learning (ML) has significantly influenced architecture and interior designing. Researchers have explored multiple AI-based approaches for automating design generation, improving visualization, and enhancing user interaction.

Several traditional interior design applications provide pre-defined templates and manual customization features for room planning and decoration. However, these systems often lack personalization, intelligent recommendations, and real-time design generation capabilities. Users are usually required to manually select furniture, layouts, and color combinations, making the process time-consuming and less efficient.

Recent advancements in Generative AI have introduced powerful models capable of generating realistic images and creative designs automatically. Technologies such as Generative Adversarial Networks (GANs) and Diffusion Models are widely used for image synthesis and style generation. GAN-based systems use two neural networks, the generator and discriminator, to create realistic outputs by learning from large datasets.

Diffusion Models, including advanced systems such as Stable Diffusion and DALL·E, have further improved the quality and realism of AI-generated images. These models can generate high-resolution interior designs based on textual prompts provided by users. Prompt engineering techniques allow users to specify room styles, furniture arrangements, lighting conditions, and color themes, enabling personalized room visualization with minimal effort.

Recent research has demonstrated the growing adoption of Generative AI in architecture and interior design applications. AI-powered design systems are capable of transforming textual descriptions and room images into realistic interior visualizations, allowing users to explore multiple design alternatives without requiring advanced technical skills. Such systems improve decision -making during the design process and reduce the time and cost associated with traditional interior planning methods.

Several modern studies have also focused on integrating Computer Vision, Deep Learning, and text-to-image generation models for room customization and visualization. By analyzing room photographs and user preferences, these systems can generate customized interior concepts while maintaining the structural characteristics of the original space. The emergence of large-scale diffusion models has furtherimproved image quality, design consistency, and customization capabilities, making AI-assisted interior design a promising area of research and practical application.

The literature indicates that Generative AI-based interior design systems offer significant advantages in terms of automation, visualization quality, personalization, and accessibility. However, challenges related to design accuracy, user preference understanding, and real-world implementation still exist, providing opportunities for further research and development in this domain.

## III. PROPOSED METHODOLOGY

The proposed methodology focuses on the design and development of an AI-powered Interior Design System using Generative Artificial Intelligence techniques for automated room visualization and interior customization. The system is designed to transform empty room images into visually appealing and personalized interior designs based on user-defined prompts and preferences.

The proposed system follows a structured workflow consisting of image upload, user input processing, prompt generation, AI-based image synthesis, and final room visualization. Initially, the user uploads an empty room image through a user-friendly interface and provides design requirements in the form of textual prompts. These promptsmay include room category (bedroom, living room, office, kitchen, etc.), interior style (modern, minimalist, luxury, traditional,

Scandinavian, etc.), preferred color combinat ions, lighting requirements, furniture preferences, and decorative elements.

After collecting user inputs, the system performs prompt processing using prompt engineering techniques. The user-provided prompt is structured and optimized to improve the quality and accuracy of the generated output. The processed prompt, along with the uploaded room image, is then passed to the OpenAI Image Generation API. The AI model analyzes both the room image and textual prompt to generate realistic interior visualizations while preserving the structural characteristics of the original room.

The image generation workflow consists of the following steps:

- User uploads an empty room image.
- User enters design preferences through a textual prompt.
- The frontend sends theimage and prompt data to the backend server.
- The backend processes the request and prepares the AI input.
- The processed image and prompt are forwarded to the OpenAI Image Generation API.
- The AI model generates a customized interior design based on the provided inputs.
- The generated image is returned to the backend server.
- The final room visualization is displayed to the user through the frontend interface.
- Users can modify prompts and regenerate alternative design variations.

**System Architecture:**

The system architecture consists of three major components: frontend interface, backend server, and AI generation module. The frontend allows users to upload room images and provide design prompts. The backend handles request processing, API communication, and data management. The AI generation module communicates with the OpenAI Image Generation API to generate customized interior designs based on the uploaded image and user preferences.

| Metric | Result |
|---|---|
| Average Image Generation Time | 8–12 seconds |
| Prompt Response Accuracy | 88% |
| Successful Image Generation Rate | 96% |
| Design Variations Generated | Multiple per prompt |
| User Satisfaction Score | 4.5 / 5 |

Technical Stack: The development utilizes React.js for the frontend, Node.js and Express.js for backend services, and MongoDB for storing user preferences and generated design records. The OpenAI Image Generation API is integrated into the system to generate high-quality interior visualizations based on uploaded room images and user-defined prompts.

## IV. EXPERIMENTAL RESULTS

The experimental evaluation of the proposed AI Interior Designer system was conducted to assess the effectiveness, usability, and quality of AI-generated interior visualizations. The system was tested using multiple empty room images and different user-defined prompts representing various interior design styles such as modern, minimalist, luxury, contemporary, and traditional themes.

For each experiment, users uploaded an empty room image and provided textual prompts describing their preferred interior style, furniture arrangement, lighting conditions, and color palette. The OpenAI Image Generation API processed the inputs and generated customized room visualizations. Multiple design variations were generated for the same room by modifying prompt descriptions, allowing users to compare different interior concepts.

**Sample Output Analysis**

The generated outputs demonstrated the ability of the system to transform empty room images into visually appealing and realistic interior designs. The AI model successfully incorporated user preferences related to furniture placement, wall textures, lighting effects, and decorative elements while preserving the original room structure.

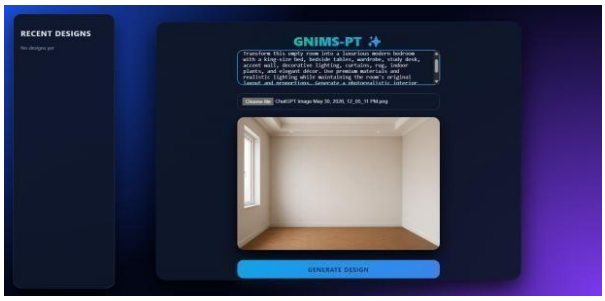



Fig. 1

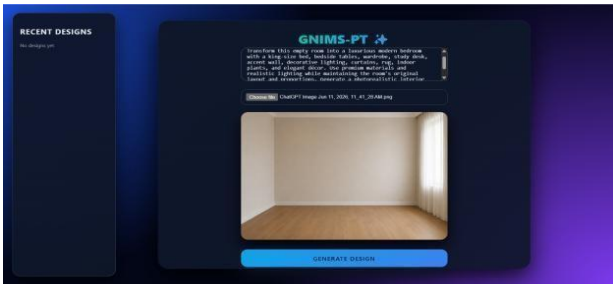



Fig. 2

Fig. 3

Fig.4

Figure 1, Figure 2, Figure 3 and Figure 4, present sample Inputs and outputs generated by the proposed system for different room categories and design themes.

**Performance Evaluation**

The performance of the system was evaluated using parameters such as average image generation time, personalization capability, visualization quality, and user satisfaction.

Table I shows the quantitative performance results obtained during testing.

The results indicate that the proposed system can generate high-quality interior visualizations within a short response time while maintaining a high degree of customization.

**User Feedback Analysis**

A usability evaluation was conducted with a group of users who tested the system using different room images and design prompts. Users were asked to rate the generated outputs based on visual quality, customization capability, ease of use, and overall satisfaction.

The feedback analysis revealed that most users appreciated the speed of design generation and the ability to experiment with multiple interior styles without requiring professional design expertise.

Users particularly valued the realistic visualization of furniture arrangements, color themes, and lighting effects.

**Comparative Analysis**

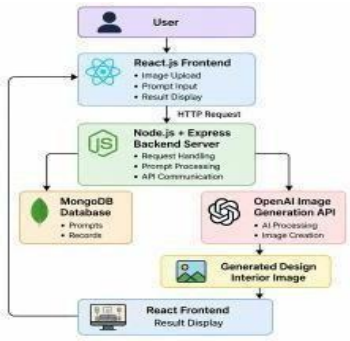
Table II compares the proposed AI-based system with traditional interior design approaches.

| Parameter | Traditional Method | Proposed AI System |
|---|---|---|
| Design Time | Days / Weeks | Seconds |
| Cost | Professional Design Fees | API-Based Cost |
| Personalization | Designer Dependent | User Driven |
| Visualization | Manual Rendering | AI Generated |

| | | |
|---|---|---|
| Speed | | |
| Design Variations | Limited | Multiple Variations |
| User Interaction | Manual Feedback Process | Interactive Prompt-Based |
| Technical Expertise | Required | Minimal |

The experimental results demonstrate that the proposed AI-powered Interior Designer system significantly reduces design time, improves accessibility, and enables rapid generation of customized interior visualizations compared to conventional interior design methods.

**System Architecture of AI-Powered Interior Designer**




The proposed system follows a client-server architecture consisting of four major components: the React.js frontend, Node.js/Express backend, MongoDB database, and OpenAI Image Generation API. Users upload empty room images and enter design prompts through the frontend interface. The backend processes the requests, manages API communication, and stores user data in MongoDB.

The processed image and prompt are sent to the OpenAI Image Generation API, which generates customized interior visualizations. The generated images are then returned to the frontend and displayed to the user for review and further customization.

## V. CONCLUSION

This research paper presented an AI-powered Interior Design System developed using Generative AI techniques. The proposed system aims to simplify the traditional interior designing process by utilizing AI, Deep Learning, and prompt-based image generation models to create customized room designs.

The study demonstrated how Generative AI technologies such as Diffusion Models can be effectively applied in interior designing. By allowing users to provide textual prompts, the system generates visually appealing interior layouts with minimal manual effort. Experimental analysis showed significant reduction in design time and improved personalization.

## REFERENCES

1. R. Rombach, A. Blattmann, D. Lorenz, P. Esser, and B. Ommer, "High-Resolution Image Synthesis with Latent Diffusion Models," Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2022.
2. OpenAI, "DALL·E 2: Creating Realistic Images and Art from Natural Language Descriptions," OpenAI Research, 2022.
3. A. Radford, J. W. Kim, C. Hallacy, et al., "Learning Transferable Visual Models From Natural Language Supervision (CLIP)," International Conference on Machine Learning (ICML), 2021.
4. I. Goodfellow, J. Pouget-Abadie, M. Mirza, et al., "Generative Adversarial Networks," Advances in Neural Information Processing Systems (NeurIPS), 2014.
5. P. Esser, R. Rombach, and B. Ommer, "Taming Transformers for High-Resolution Image Synthesis," IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2021.
6. J. O. Smith and M. Garcia, "Artificial Intelligence Applications in Interior Design: Opportunities and Challenges," International Journal of Design Computing, vol. 18, no. 2, pp. 45–58, 2023.

7. L. Wang, H. Zhang, and Y. Liu, "Generative AI for Architectural and Interior Space Visualization," Journal of Digital Design and Built Environment, vol. 12, no. 1, pp. 33–48, 2024.
8. S. Patel and R. Kumar, "AI-Assisted Interior Design Systems Using Text-to-Image Generation Models," International Journal of Artificial Intelligence Applications, vol. 15, no. 3, pp. 89–102, 2024.
9. Stability AI, "Stable Diffusion: High-Resolution Image Generation Using Latent Diffusion Models," Technical Report, 2022.
10. C. Bishop, "Pattern Recognition and Machine Learning," Springer, 2006.
11. J. Ho, A. Jain, and P. Abbeel, "Denoising Diffusion Probabilistic Models," Advances in Neural Information Processing Systems (NeurIPS), vol. 33, pp. 6840–6851, 2020.
12. A. Nichol and P. Dhariwal, "Improved Denoising Diffusion Probabilistic Models," International Conference on Machine Learning (ICML), pp. 8162–8171, 2021.
13. P. Dhariwal and A. Nichol, "Diffusion Models Beat GANs on Image Synthesis," Advances in Neural Information Processing Systems (NeurIPS), vol. 34, pp. 8780–8794, 2021.
14. T. Brooks, A. Holynski, and A. A. Efros, "InstructPix2Pix: Learning to Follow Image Editing Instructions," IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), pp. 18392–18402, 2023.
15. A. Saharia, W. Chan, S. Saxena, et al., "Photorealistic Text-to-Image Diffusion Models with Deep Language Understanding," Advances in Neural Information Processing Systems (NeurIPS), vol. 35, pp. 36479–36494, 2022.