An Interior Decoration System via Virtual Reality and Artificial Intelligence

Summary of the Paper:

This paper proposes an innovative interior decoration system that integrates Virtual Reality (VR) and Artificial Intelligence (AI) technologies to enhance the design experience for users. The authors have implemented the scene selection function and the house type drawing function to get the apartment type. After getting the basic apartment type, they have also provided some other basic decoration functions such as furniture placement, furniture conversion, material conversion, and light switch. These functions are operated by mouse clicking and keyboard control. In addition, they have added some AI modules to provide an additional assistant. Through the recognition of the picture, the texture can be trained, and the ideal texture has been obtained. The implementing environment of their design system is UE4, and the AI algorithm was written in Python and tensor flow.

The authors concluded that the system meets basic user needs in interior design and could be further enhanced by improving house-drawing functions and expanding the range of materials available for design.

Literature Review:

This literature review is based on the paper titled *An Interior Decoration System via Virtual Reality and Artificial Intelligence* by Xia Meng et al. (2018), which presents a system that integrates Virtual Reality (VR) and Artificial Intelligence (AI) for interior design. The concept of combining VR with interior design is not new, but the integration of AI, specifically with CycleGAN, adds a novel approach to texture and material handling in virtual environments. Several previous studies have demonstrated the use of VR in design-related fields, such as architectural visualization and product design, to enhance the interaction between users and digital environments.

CycleGAN:

The main work of CycleGAN is capture special features of an image group and assuming how these features can be interpreted into alternative image group, not in the presence of matching training examples which is also its biggest advantage. Its goal is to implement an unpaired image translation. With the help of CycleGAN, the authors can prepare a standard dataset with gray colors textures and different target datasets, such as wood material dataset or grass material dataset. Then, they can use CycleGAN to train different conversion models by feeding a different combination of datasets and import these models into UE4 afterwards.

UE4:

UE4 (unreal engine 4) is a game engine developed by epic games. The paper have tried to implement CycleGAN in UE4 to transform texture style by means of CycleGAN's strong ability of style translation. The interior decoration design system has rich functions. Users could use this system to draw the house type with any size and any structure. The user also could design the house with rich furniture. The user could place the furniture, move the furniture, and rotate the furniture. The user could also add the light to the room.

Conclusion:

In summary, this system leverages state-of-the-art AI and VR technologies to streamline the interior design process, providing a powerful tool for both professional designers and clients. Future improvements could focus on expanding the texture libraries and refining the house-drawing functions to improve user experience.

Review of "Sketch-to-Architecture: Generative AI-aided Architectural Design"

The paper titled "Sketch-to-Architecture: Generative AI-aided Architectural Design" presents a novel approach for generating architectural designs using artificial intelligence (AI). As the field of architecture increasingly integrates digital technologies, this research proposes a method that leverages generative AI, particularly focusing on three primary techniques: diffusion models, text prompts, and masking techniques. Each of these elements contributes significantly to the overall objective of automating architectural design while maintaining the necessary creative input from designers.

1. Diffusion Models

At the heart of the proposed method are diffusion models, which serve as the foundational technology for generating architectural designs. These models utilize a unique approach to create images, beginning with random noise and iteratively refining this noise into coherent design outputs. By conditioning the model on both textual and visual inputs, the diffusion process allows for the generation of high-quality architectural plans. The iterative nature of this process ensures that the final outputs are detailed and aligned with the intended design specifications.

The flexibility of diffusion models enables them to produce various design outputs, including 3D models and detailed floor plans. The ability to generate complex geometries and structures marks a significant advancement in architectural design, allowing for exploration and experimentation that would be time-consuming and difficult through traditional methods.

2. Text Prompts

The second key technique employed in this research is the use of text prompts. This feature allows users to guide the architectural design process by entering specific textual instructions. The model is designed to interpret these inputs effectively, enabling it to generate designs that reflect the user’s intentions. Text prompts can specify various architectural parameters, including style, type of building, materials, and other design elements.

The researchers utilized Natural Language Processing (NLP) tools such as Natural Language Toolkit (NLTK) and spaCy to enhance the model’s ability to understand and process user inputs. This NLP integration is critical, as it bridges the gap between human creativity and

machine learning capabilities, fostering an intuitive user experience. By enabling designers to communicate their vision through text, the process of generating architectural designs becomes more accessible and aligned with the user's needs.

3. Masking Techniques

The third innovative technique discussed in the paper is the application of masking techniques. This approach allows users to make targeted modifications to specific parts of the generated architectural designs. For instance, users can apply masks to alter materials, adjust building structures, or modify individual design elements without the need to regenerate the entire output.

This capability is particularly valuable in real-world architectural design, where iterative adjustments and refinements are commonplace. Masking techniques empower designers to experiment with various materials and structural options, enhancing the customization and adaptability of generated designs. By facilitating localized modifications, this method helps maintain the integrity of the overall design while allowing for fine-tuning and personalization.

Conclusion

The research presented in "Sketch-to-Architecture: Generative AI-aided Architectural Design" showcases a promising direction for the future of architectural design. By integrating generative AI with diffusion models, text-based interactions, and advanced editing tools, the study illustrates how technology can significantly enhance the design process. The ability to produce high-quality architectural outputs in response to user-defined parameters fosters creativity and innovation, making architectural design more efficient and responsive to user needs.