

Design and Development of Smart Home Interior Animation Using the 3D Rendering Method

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Abstract

Technological advancement has led to the emergence of the smart home concept, which integrates intelligent devices into daily life. In this context, interior design emphasizes not only aesthetics but also functionality and efficiency. A common challenge arises when clients struggle to understand design concepts solely from 2D drawings or manual sketches. This study aims to develop an interior design animation for a smart home using 3D rendering methods to create a more realistic and interactive visualization. The design process involves several stages, including sketching, 3D modeling using SketchUp, texturing, lighting, and rendering with V-Ray and Lumion. The findings show that 3D animation significantly enhances communication between designers and clients, saves time and reduces costs, while providing a clearer understanding of smart technology implementation in interior spaces. The visualization focuses on several areas of the home such as the living room, kitchen, bedroom, and bathroom, with a final animation duration of approximately 3–4 minutes. This research is expected to offer an effective solution for presenting smart home interior design concepts in an engaging and efficient manner.

Keywords: Smart Home, Interior Design, 3D Rendering, Animation, Sketchup, Lumion

1. Introduction

In an era of rapidly advancing technology, the concept of the Smart Home has become an increasingly popular trend. A smart home integrates various advanced technologies such as the Internet of Things (IoT)[1], automation, and intelligent control systems to create a living environment that is more comfortable, efficient, and secure. Smart home interior design must not only be aesthetically pleasing, but also functional and responsive to the needs of its occupants[2]. According to the theory of human ecology, housing is considered a creation that reflects the interdependence and balance between the living environment system and the social environment[3]. With the growing interest in various design concepts, the development of interior design has expanded, leading to the creation of new interior styles using a range of software applications. One of the main challenges often faced by designers is the difficulty in providing clients with a clear and detailed representation of the concept to be implemented. Traditional methods, such as hand sketches or 2D drawings, often fail to adequately represent the space and complex design elements. This can result in misunderstandings between designers and clients, and may influence decision-making. However, one of the key challenges in smart home interior design is how to integrate the technology without compromising the design's aesthetics. 3D rendering techniques have become an essential tool in overcoming this challenge. By using 3D rendering, designers can create realistic visualizations of their design concepts, allowing them to see and arrange how various technological elements will look and function within a real space. 3D rendering technology enables the creation of realistic animations of interior designs, allowing clients to view visualizations that closely resemble the actual conditions of the designed smart home. By utilizing this method, designers can present more detailed elements such as lighting, textures, and spatial perspectives with high accuracy. This method also allows for real-time changes and adjustments, which is highly beneficial in a dynamic design process.

Research and development in this field continue to progress, considering the importance of integrating smart technology with harmonious interior design. Through the 3D rendering technique, it is expected that smart home designs can be created that are not only efficient and secure but also aesthetically pleasing and aligned with the preferences of the occupants[4]. lighting, color, and furniture layout can be dynamically adjusted and modified before physical implementation takes place. This not only saves time and costs, but also allows for more accurate customization according to the client's preferences. For individuals with refined tastes, the process of selecting furniture is often challenging. There are many factors to consider when choosing furniture, whether based on personal taste or functional needs. Some of these considerations are also determined by the conditions and dimensions of the space. Matching furniture size to room size is a common practice used by the general public when selecting appropriate pieces for their home.[5]. Therefore, in this research, the author has chosen the title: "Development of Smart Home Animation Using the 3D Rendering Method."

2. Research Methods

2.1. Interior design

Interior design is a creative process that combines technique, art, and science to organize the layout of interior spaces, including functionality, aesthetics, and safety. Interior design creates spaces that are functional, beautiful, and aligned with the needs of the occupants. It involves planning, designing, and implementing the space to meet the occupants' needs and reflect their lifestyle.

2.2. Smart home

A smart home is a term commonly used to describe a house equipped with advanced technology to simplify daily activities, enhance comfort and security, and make it easier to manage various household devices and facilities automatically and through connectivity. A smart home is a residence equipped with sophisticated devices and appliances, allowing all household functions to be controlled using a remote control. One of the main characteristics of a smart home is that features such as gates, doors, and windows can be opened and closed simply by using a remote control.

2.3. 3D rendering in interior design

3D rendering in interior design is the process of creating a digital 3D model of a space or home, which is then rendered into realistic images. In interior design, 3D rendering is used to visualize room designs, showcasing details such as lighting, textures, and furniture arrangements.

2.4. SketchUp in model creation

SketchUp is a 3D modeling application that is easy to use and allows designers to quickly create visual representations, including selecting furniture, making it a primary choice for designers in creating 3D designs[6].

2.5. Lumion

Lumion is a 3D modeling rendering software that can be used to create high-quality real-time 3D scenarios, designed to produce photorealistic render results in a short amount of time. It allows users to import objects and settings from other programs such as SketchUp. Lumion provides real-time visualization with 3D objects that appear lifelike, making scenes look visually complete and immersive[7].

2.6. Rendering

Rendering is the final stage in the creation of an image or animation, where software translates a digital scene into a visually viewable image or video.[8]. Rendering is also the process of generating or constructing the output file from computer animation.[9].

3. Results and discussion






3.1. Sketch

Interior sketches play a crucial role as a tool to assist in creating spaces that are capable of fulfilling user needs. Therefore, the formation and transformation of space are essential components of the interior design learning process, both in terms of meaning and practical application.

3.2. Material collection

In the 3D design planning stage, the author requires several additional materials needed for the visualization of the interior design. The images used in this process consist of those that will serve as textures.

Table 1: Material Collection Images

| No. | Gambar | Keterangan |
|-----|---|------------------------|
| 1. |  | Texture Beige Terang |
| 2. |  | Texture Pecan walnut |
| 3. |  | Texture Carrara marble |
| 4. |  | Texture warna hitam |
| 5. |  | Texture cherry wood |



3.3. Productions

The production stage is one of the most important phases in the animation design process, particularly in the creation of smart home interior objects in this research. At this stage, the design process is carried out visually with the aid of software and is executed in a structured manner according to the pre-established or planned workflow. The modeling process is the initial stage of production used to construct the overall building structure. The modeling process was carried out using SketchUp software.

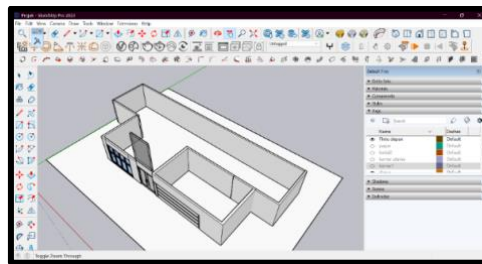


Fig. 1: View of the smart home's first-floor wall.

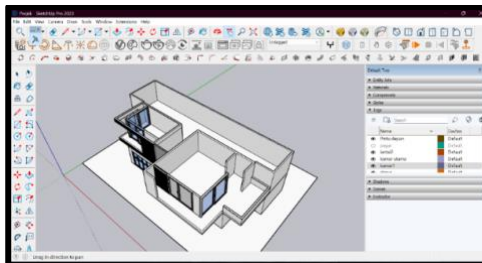


Fig. 2: View of the smart home's second-floor wall.

After the modeling process is completed, the next stage is applying textures to the objects. This process is carried out in SketchUp, then refined in V-Ray to achieve more realistic textures with proper lighting and light reflection support.

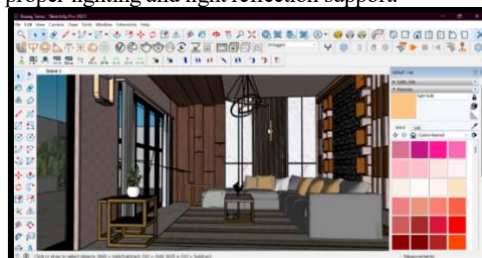


Fig. 3: Living room view modeled in SketchUp.

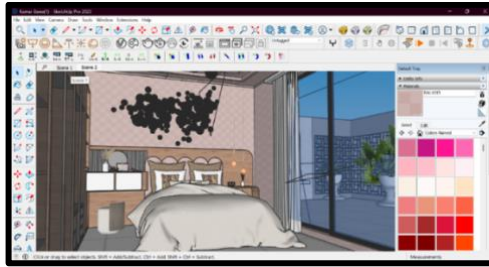


Fig. 4: Bedroom view modeled in SketchUp.

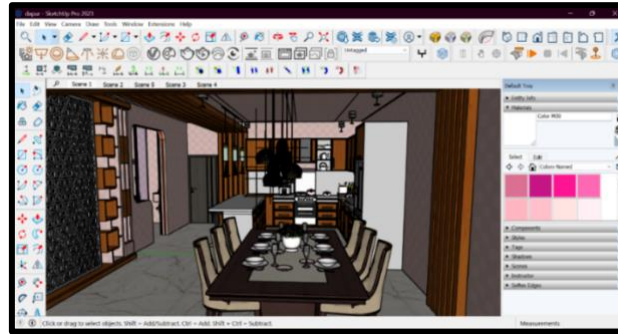


Fig. 5: Kitchen view modeled in SketchUp.

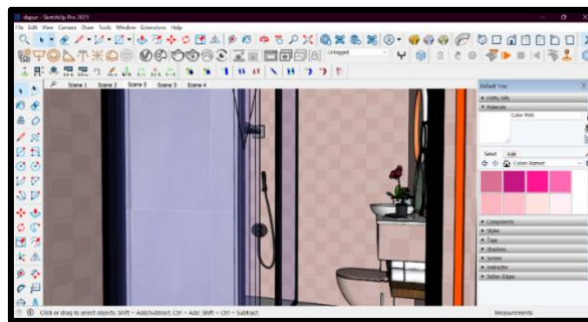


Fig. 6: Bathroom view modeled in SketchUp.

V-Ray is used to produce high-realism static images, such as exterior and interior illustrations of the house that display detailed natural and artificial lighting.



Fig. 7: Living room rendered in V-Ray (SketchUp).

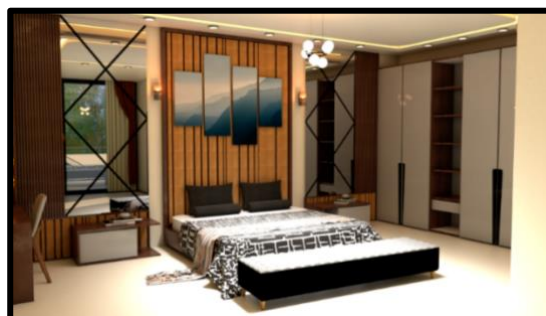


Fig. 8: Bedroom rendered in V-Ray (SketchUp).

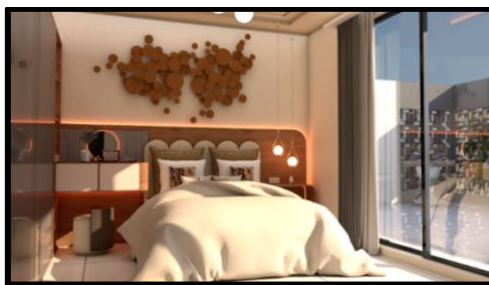


Fig. 9: Bathroom rendered in V-Ray (SketchUp).



Fig. 10: Kitchen rendered in V-Ray (SketchUp)



Fig. 11: Another view of bathroom rendered in V-Ray (SketchUp).

4. Conclusion

Based on the results of the research and the design process that has been carried out, it can be concluded that:

1. The use of the 3D rendering method in designing smart home interior animation has proven effective in creating realistic and interactive visualizations. It provides a comprehensive depiction of both the design and the functionality of smart technology within the interior space.
2. SketchUp and Lumion were effectively utilized to support the processes of modeling, texturing, lighting, and animation. Additionally, V-Ray was employed to produce high-quality renderings with detailed visual output.
3. The resulting 3D animation facilitates communication between the designer and the client, accelerates the revision process, and helps the client understand the smart home design concept more clearly.
4. The visualization focuses on several main areas of the house—such as the living room, kitchen, bedroom, and bathroom—and with a final animation duration of 3–4 minutes, it successfully demonstrates how smart home technology can be integrated into the interior.

5. Suggestions

The suggestions in this study are as follows:

This study is still limited to several rooms. Therefore, development in other areas such as workspaces, garages, or smart home gardens could become interesting topics for future studies. Further testing is needed to measure the efficiency of time and cost savings through the use of 3D animation compared to conventional visualization methods, to make the results more quantitatively measurable. It is recommended that designers pay balanced attention to both aesthetic and technological aspects, so that the integration of smart devices continues to support the beauty of the space, not just functionality alone.

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