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Architectural Visualization Buildings Based on Cinematic and Virtual Reality Using Real-Time Rendering Method

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Abstract

An engaging and interactive campus promotion is one of the key strategies to attract prospective students. However, conventional promotional methods often fall short in delivering a comprehensive visual experience. This study aims to develop an architectural visualization of the STMIK TIME Merbabu campus building using cinematic and virtual reality approaches through real-time rendering techniques. The visualization process involves creating a 3D model using SketchUp, which is then rendered in real-time using Enscape to produce a cinematic video and a VR walkthrough simulation. The final outcome of this research is an interactive promotional medium that presents the building design in a realistic, immersive, and visually appealing manner. Through this approach, educational institutions are expected to enhance their visual appeal and strengthen campus branding by leveraging innovative digital technology.

Keywords: *Virtual Reality, Cinematic, Real-Time Rendering, Architectural Visualization, STMIK TIME*

1. Introduction

Virtual Reality (VR) is a computer-based technology that simulates a 3D environment. It plays a crucial role in enhancing and shaping new imaginations. VR has become increasingly popular, especially among students, due to its ability to present a virtual world that resembles the real world. Moreover, VR provides superior visualization, making the learning experience more engaging and immersive. [1] STMIK TIME is a private higher education institution located in Medan, North Sumatra, focusing on information technology and computer education. Established in 2002, it aims to produce competent IT professionals through industry-relevant programs. Currently, campus promotion relies on activity videos and presentations, requiring prospective students to visit the campus directly. This method is less effective and time-consuming as VR and virtual exploration technology are not yet utilized. These technologies can make promotion more efficient, effective, and time-saving. Based on this background, the authors conducted a study to develop virtual reality media and a cinematic video for STMIK TIME campus titled: **"Architectural Visualization of Buildings Based on Cinematic and Virtual Reality Using Real-Time Rendering Method."**

2. Theoretical Foundation

2.1. Architectural Visualization

Visualization is a technique for creating images, diagrams, or animations to present information. In simple terms, visualization transforms data into visual forms or tables so that the characteristics of the data and the relationships among items or attributes can be more easily analyzed or presented [2]. Architecture is a discipline focused on building design, taking into account aspects of aesthetics, strength, and functionality, while also considering the surrounding environment and human needs. Humans require space for various activities, which is realized through the application of architectural science—for example, houses for living, offices for working, and hospitals as healthcare service facilities [3].

Architectural visualization or modeling is the process of creating three-dimensional representations of buildings, including both exterior and interior components. This process consists of three main stages: visualization, construction, and rendering. Through this modeling process, designers can develop a wide range of projects according to the desired scale, level of complexity, and material types [4]. Architectural visualization can be categorized into two main types, namely 2D and 3D. The categories referenced by the author are as follows:

1. **2D Visualization**
   2D visualization, commonly referred to as *motion graphics*, is frequently used in videos, websites, advertisements, and television. This type of visualization provides engaging animation effects, making the information more expressive and easier to understand.

2. **3D Visualization**
   3D visualization is animation created using specialized software to produce visuals that are more realistic and resemble real-world objects. This type of visualization is typically in the form of animations that demonstrate how a process or system works. [5]

2.2. Building

A building is a physical structure resulting from construction, permanently located at a specific site, either partially or entirely above ground, underground, or over water. Buildings serve as spaces to support various human activities, such as residences, religious practices, businesses, social events, cultural functions, or other specialized uses. [6]

2.3. Cinematic Architecture

Cinematic is a visual technique that originates from the fields of filmmaking and video games, used to produce dynamic and captivating moving scenes. Cinematic architecture is considered one of the highest forms of architectural representation. Currently, the futuristic concept is one of the most widely applied approaches because it effectively illustrates architectural forms and future environments. Cinematic architecture focuses on exploring various strategies for utilizing moving images within built environments, while highlighting the significant role of architecture and spatial elements as key components in shaping the visual experience. [7]

2.3. Virtual Reality

Virtual Reality (VR) has been known for a long time, even since the 19th century. In 1838, Sir Charles Wheatstone invented a device called the stereoscope, which used mirrors to produce three-dimensional images. This invention later evolved into the *View-Master* in 1939, a popular device for viewing 3D images. In 1956, Morton Heilig created the *Sensorama*, a simulator that enabled users to experience the sensation of riding a motorcycle in an urban environment. *Sensorama* used various stimuli such as engine sounds, vibrations, and scents to make users feel as if they were truly riding a motorbike.

Later, in 1962, Morton Heilig invented the *Telesphere Mask*, the first head-mounted VR display. This innovation attracted many investors and further accelerated the development of VR technology. NASA (*National Aeronautics and Space Administration*), the United States' space and aeronautics agency, also contributed to its advancement. In 1991, a NASA scientist named Antonio Medina began researching a VR system for a major project: remotely operating a Mars rover from Earth in real-time. NASA later named this system *Computer Simulated Teleoperation*.

Over time, communities began developing virtual machines for arcade-style VR games in the 3D gaming world. These devices became the first mass-produced VR tools accessible to the general public. VR technology has since continued to evolve and is now more affordable. With VR, our brains are tricked into believing we are truly inside a virtual world, creating an experience that feels real. VR opens the door to a world entirely different from reality, with increasing potential for innovation and benefits in the future. [8]

Virtual Reality (VR) in visualization refers to a computer-generated synthetic environment that is entirely separate from reality. VR enables users to feel as though they are present in a different world and allows them to interact with virtual objects around them in ways that resemble interactions in the physical environment. [9]

2.4. Realtime Rendering

Realtime rendering is the process of rapidly generating images using a computer, enabling the creation of interactive experiences. Images appear immediately on the screen, and when the viewer provides input or actions, the computer instantly updates the visuals in response. This process occurs so quickly that viewers do not perceive the images as separate frames, but rather as a continuous and dynamic flow.

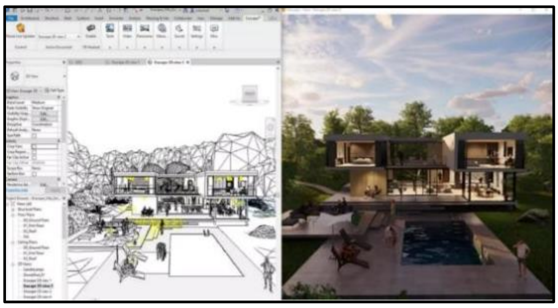

Fig. 1: Real-time rendering method in building visualization [15]

The speed of image display is measured in frames per second (fps) or Hertz (Hz). At 1 fps, the level of interactivity is very low, as users can distinctly perceive each frame. At 6 fps, the interactive experience begins to feel more realistic. Meanwhile, at 15 fps, the speed is considered sufficient to create a real-time experience in which users can focus on actions and responses. Speeds above 72 fps do not produce a significantly noticeable difference due to the limitations of human perception. [13]

2.5. Rendering Software

Rendering software is an advanced tool designed to convert three-dimensional models into realistic images or animations. These tools function like virtual cameras, applying lighting, materials, and textures to produce final visuals that appear natural and visually accurate. [16]

3. Research Method

3.1. Data Collection Methods

In collecting the data required to design the building visualization using the real-time 3D rendering method, the author employed several techniques as follows:

1. **Literature Review**
   To obtain more accurate and objective data, the author conducted a literature review by searching for various references, books, and journals related to relevant research and technologies.
2. **Observation**
   At this stage, the author directly observed the STMIK TIME building to be visualized, in order to collect necessary data that supports the research.
3. **Interview**
   The interview method, conducted at the end of the research, proved useful particularly in understanding the needs and preferences of the campus marketing team regarding the visualization outcomes. This helped formulate a more effective promotional content strategy.
4. **Questionnaire**
   A questionnaire was distributed at the end of the study to assess the experiences, challenges, and perceptions of respondents regarding the VR visualization of the STMIK TIME campus building designed by the author.

3.2. Design Phase

The initial design phase includes planning and requirements gathering to produce a visualization of the STMIK TIME campus buildings. This stage involves identifying hardware and software needs, collecting design references, creating preliminary sketches, and planning the design workflow. The purpose of this step is to ensure that all necessary elements are available so that the production process can proceed effectively and efficiently.

Fig. 2: Sketch of building a, STMIK time campus

Figure 2 shows an exterior sketch of Building A. The author created comprehensive front and side perspective sketches to illustrate the campus environment.

Fig. 3: Exterior sketch of buildings b and c

Figure 3 presents exterior views of Buildings B and C. Building C extends horizontally, with its entrance located in the middle corridor of Building B's lobby.

Fig. 4: Application of HDRI dome light in the 3d campus model

Figure 4 displays the application of a dome light, which enhances sky lighting and cloud realism. The author applied materialization to achieve high-quality visual results**.**

Fig. 5: Raw rendered exterior of buildings b and c

Figure 5 presents a raw rendered exterior view of Buildings B and C. Building C has an elongated horizontal layout, with its main entrance located at the center of the corridor connecting to the lobby of Building B.

Fig. 6: Material assignment on the front building

Figure 6 illustrates the application of textures, which transforms the 3D objects from plain colors to more realistic appearances. At this stage, the author began adding furniture and 3D assets into the model of Building A on the STMIK TIME campus.

Fig. 7: Material assignment on the rear building

Similar to Figure 6, Figure 7 illustrates the application of textures that transform the 3D objects from plain colors into more realistic visuals. At this stage, the author began placing furniture and 3D assets into the models of Buildings B and C of the STMIK TIME campus.

Fig. 8. Virtual reality plugin display in enscape

Figure 8 illustrates the Virtual Reality plugin used for campus exploration, accessible via Meta Quest 3 and HTC Vive Pro 2 devices. Several optimizations were applied to the campus model to ensure Enscape software could process rendering settings from Draft to Ultra quality.

3.3. Research Results

The results of this research include an architectural visualization of the STMIK TIME campus buildings in the form of a cinematic video and a virtual reality walkthrough. The cinematic video showcases various building angles using dramatic lighting effects and smooth camera movements, accompanied by AI-generated narration, providing a deeper visual impression.

Meanwhile, the integration of virtual reality allows users to explore the building environment in real-time, delivering an experience close to reality. Whether using VR devices or not, users can still access the virtual tour interactively. The rendering process, performed using Enscape, produces visuals that closely resemble the real environment through accurate textures, materials, and lighting that enhance the atmosphere of the STMIK TIME campus.

Fig. 9: Outdoor Visualization of Building A

Figure 9 shows the outdoor visualization of Building A using real-time rendering. It highlights the main building with a modern design, student promotional banners on the sides, and surrounding elements such as shop houses, vehicles, and the main gate. Additional elements like hot air balloons and morning lighting contribute to a compelling cinematic ambiance.

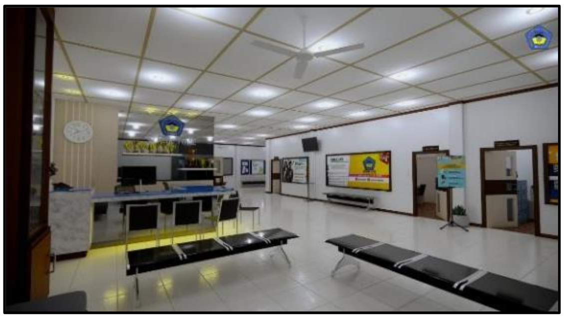

Fig. 10: Lobby Visualization of Front Building

Figure 10 presents the interior lobby of Building A, including a reception desk, rows of waiting chairs, and decorative elements such as trophies, a wall clock, and the institution's logo. The space appears neat and modern, with bright lighting that conveys a professional and welcoming atmosphere for both visitors and students.

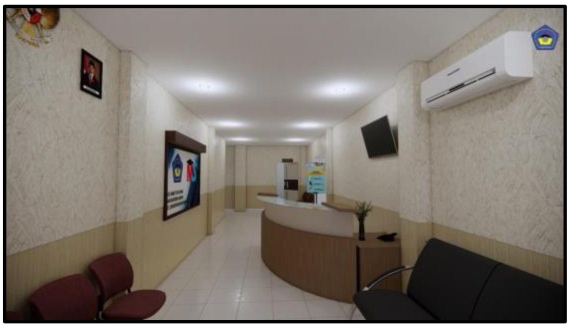

Fig. 11: Lobby visualization of rear building

Figure 11 depicts the lobby area of Building B, which conveys an elegant and welcoming atmosphere. The space is designed with warm lighting, comfortable seating arrangements, and a central reception desk that serves as the main information point for campus visitors.

Fig. 12: Visualization of building b and parking area

Figure 12 depicts the area around Building B and the campus parking lot. Rows of trees add a fresh ambiance, while neatly arranged paving blocks form walkways. Several parked motorcycles indicate the area is actively used. The soft morning sunlight enhances the comfortable and inviting visual impression for campus visitors.

Fig. 13: Cinematic exploration of stmik time campus scene

Fig. 14: Rear building exploration scene

Fig. 15: Campus's main entrance scene

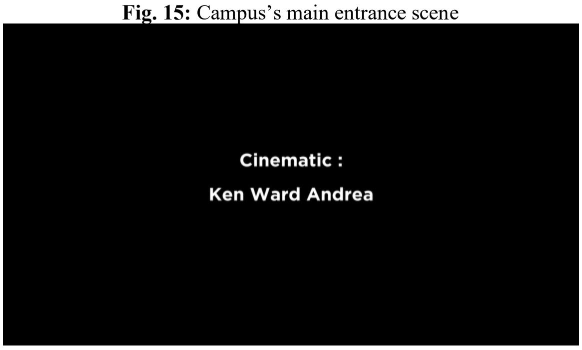

Fig. 16: Author information ending scene

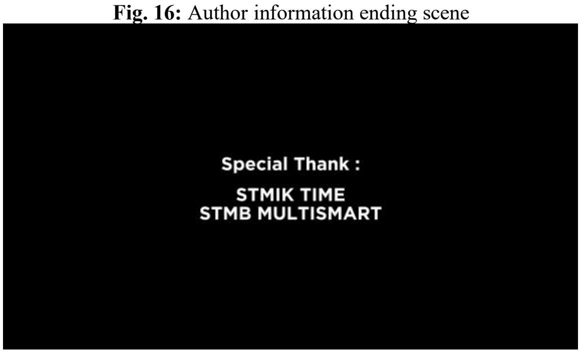

Fig. 17: End credit scene

The cinematic video was produced using CapCut Pro and Enscape software, with a total duration of 14 minutes. The video showcases a camera movement flow carefully designed in accordance with the visualization scenario described in Chapter III. The narration was created by the author using Artificial Intelligence (AI) and recorded as a voice-over to provide in-depth explanations and to support the overall visual atmosphere.The sequence begins at the front yard of the STMIK TIME Merbabu campus, with the camera gradually moving through the lobby area, classrooms, and other key locations such as the garden and parking area featured at the end of the video. To enhance the visual quality, various cinematic techniques were employed, including depth of field, smooth transitions between scenes, and soft camera paths, all aimed at creating a realistic and visually engaging experience for viewers.

The final video was rendered in MP4 format using the H.265 codec at 4K resolution (3840x2160 pixels), making it suitable for display across various multimedia platforms, both online and during live presentations.

4. Conclusion

Based on the design and implementation of the architectural visualization media for the STMIK TIME Merbabu campus buildings A, B, and C—using cinematic and virtual reality approaches through real-time rendering techniques—the following conclusions can be drawn:

1. The cinematic-based architectural visualization media presents the STMIK TIME campus buildings in a more engaging and informative manner through a video that depicts both the interior and exterior of the buildings comprehensively. The cinematic video provides an immersive experience as if the viewer is physically present on campus.
2. The virtual reality visualization media allows prospective students who live far from the campus location to gain a complete understanding of the campus environment without the need for an in-person visit. Utilizing virtual reality technology in campus promotion saves time, cost, and effort for both prospective students and the institution, making it a more efficient and targeted promotional strategy.

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