Journal of Artificial Intelligence and Engineering Applications

Website: https://ioinformatic.org/

15th October 2025. Vol. 5. No. 1; e-ISSN: 2808-4519

Development of a 3D Model of the STMIK TIME Campus Building Using the Photogrammetry Method

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Abstract

Photogrammetry is a mapping method that utilizes photographic images to generate three-dimensional (3D) models. In this study, the photogrammetry method is used to create a 3D model of the STMIK TIME campus buildings to document and visualize the structures digitally. The process of creating the 3D model begins with image acquisition using a digital camera, followed by processing with photogrammetry software to generate point clouds, meshes, and textured models. The final result of this research is a 3D model of the STMIK TIME campus, which can be used for various purposes such as architectural planning, building preservation, and visual simulation. Based on the evaluation conducted, the resulting 3D model demonstrates a high level of accuracy in representing the actual building structure. Thus, the photogrammetry method has proven to be an effective technique for creating 3D building models at a more affordable cost compared to conventional 3D modeling techniques.

Keywords: *Photogrammetry, 3D Model, Architectural Modeling*

1. Introduction

The rapid advancement of digital technology has created new opportunities in various fields, including the virtual visualization of physical objects. In the educational context of STMIK TIME, innovation in documenting campus buildings is essential. Photogrammetry offers an efficient solution for generating realistic 3D models from photographs without relying on costly and complex physical scanning.

This study focuses on two main issues: the systematic process of constructing a 3D model of the STMIK TIME campus building using photogrammetry, and the accuracy of the resulting model in representing the building's actual form and details. The research aims to develop a 3D digital model of the campus and evaluate the effectiveness of photogrammetry in producing realistic visual documentation.

The outcomes are expected to provide a valuable digital asset for 3D animation production and serve as a reference for future applications of building documentation technologies in both academic and professional fields.

2. Literature review

2.1. Production

Production is a series of activities aimed at processing raw materials into final products through several specific stages. This process involves the utilization of various resources, such as basic materials, human labor, and technological support. The primary objective is to create products with quality that meets the needs of the end users. Manufacturing techniques or methods can be carried out manually, automatically, or with the assistance of advanced technology, depending on the level of complexity and production scale. In the current era, growing attention to sustainability demands that manufacturing processes be more efficient in resource utilization while minimizing negative impacts on the environment [1].

2.2. 3D

A three-dimensional (3D) object refers to a form or space that has three main directions, namely length, width, and depth. Unlike two-dimensional (2D) shapes, which only cover length and width, 3D objects possess volume and appear more realistic as they can be observed from multiple perspectives. In the field of visualization, 3D representation is able to create a sense of space and depth that resembles human perception of the real-world environment [2].

2.3. Model

A model is a form of representation of an object, system, or idea in a simplified form, making it easier to analyze, study, and understand. In the field of computer graphics, the term "model" usually refers to a three-dimensional (3D) model, which is a visual representation of the physical form of an object—whether real or imagined—within a 3D space. This representation is commonly used in various sectors such as animation, architecture, engineering, and the digitization of physical objects.

A 3D model itself is the result of geometric construction of a three-dimensional object, formed through a combination of points, lines, and surfaces in a digital environment. Its creation can be carried out using various methods, one of which is photogrammetry, a technique that generates three-dimensional models by processing two-dimensional (2D) images as the basic data for reconstructing the shape of an object [3].

2.4. Building

In general, a building is the result of human-made construction erected on the ground surface with specific purposes and functions, such as residential use, business activities, education, or public services. In the fields of architecture and civil engineering, a building is understood not only as a physical structure but also as a functional space designed to support human comfort, safety, and activities according to its intended purpose [4].

Referring to Government Regulation of the Republic of Indonesia Number 36 of 2005, which is the implementation of Law Number 28 of 2002 on Buildings, a building is defined as a physical form resulting from construction that is integrated with its site, either above or below the ground and/or water surface, and is used as a facility for human activities, whether for residential purposes or other needs.

From this definition, it can be understood that the term "building" encompasses not only houses or multi-story buildings but also various types of structures such as bridges, towers, and other public facilities.

2.5. Campus

A campus is an area that serves as the center for academic activities of a higher education institution. Within the campus environment, various facilities are provided, such as classrooms, laboratories, libraries, faculty offices, as well as common areas like cafeterias and gardens. Its function is not limited to being a place for gaining knowledge but also as a space for social interaction, research activities, and the development of students' character.

According to the Directorate General of Higher Education (Dikti), a campus is an environment that encompasses both physical and social aspects where the process of higher education takes place. This environment involves lecturers, students, and academic staff, and is equipped with various supporting facilities and infrastructure. A campus plays a strategic role in the national education system, particularly in shaping human resources who are excellent, creative, and globally competitive [5].

2.6. Method

A method is a systematic step designed to achieve a specific objective. In research activities, a method refers to a set of techniques or approaches used to obtain, analyze, and interpret data in a logical and organized manner. The selection of an appropriate method is crucial to ensure that the research results are reliable and can be scientifically justified [6].

In general, a method can be defined as a scientific approach to obtaining data relevant to a particular objective. This process includes stages ranging from planning and implementation to the evaluation of the collected data. The choice of method is strongly influenced by the type of problem being studied, the kind of data required, and the expected outcomes.

2.7. Photogrammetry

Photogrammetry is a method of measuring and mapping objects or areas by using photographs as the primary source of data. Typically, this technique involves capturing images with cameras—either manually or automatically—which are then geometrically and visually analyzed to produce three-dimensional (3D) models. The fundamental principle of photogrammetry is triangulation, which determines the position of a point in space based on observations from multiple perspectives [7].

In general, photogrammetry can be described as a combination of art, science, and technology aimed at obtaining measurable data from photographs, particularly information about the shape, dimensions, and location of an object in three-dimensional space. In practice, photogrammetry is divided into two main types: terrestrial photogrammetry, which uses cameras positioned on the ground, and aerial photogrammetry, which employs cameras mounted at higher altitudes, such as on drones [8].

3. Research Method

3.1. Analysis

Analysis is a systematic approach carried out with the aim of understanding and solving problems through the collection of relevant data, the breakdown of key elements, and the reorganization of these components in a logical and structured manner. This process requires a deep understanding of each constituent element of a system or problem, including the identification of relationships, patterns, and potential weaknesses within it.

3.1. Planning

In creating the 3D model of the STMIK TIME campus building, several stages were carried out by the author. The first step was capturing images of the campus building from various angles and room perspectives to ensure that all important parts were well-documented. Next, the author constructed the three-dimensional model of the building using SketchUp software, which allowed the modeling process to be more structured and accurate. After the modeling stage was completed, the 3D file was then exported into Blender for the next phase, namely the placement of characters and the arrangement of motion animations to be used in the visualization project.

4. Research results

In the results section, the author presents the output of the stages previously designed by utilizing SketchUp and Blender software. The final outcome is a three-dimensional model of the STMIK TIME campus building, constructed based on the principles of the photogrammetry method. This model was designed with a high level of accuracy to represent the original form of the building, both in terms of structure and visual appearance.

The developed 3D model will subsequently be used by the author's colleague as the main component in creating a three-dimensional animation. This animation aims to provide a more interactive and engaging visualization of the building for users. The following presents the final result of the 3D model that has been successfully created.

Fig. 1: Exterior View of the STMIK TIME Building

The author presents the 3D model results of the STMIK TIME building from the exterior view, as shown in Figure 1 above.

Fig. 2: Front Lobby View of the STMIK TIME Building

The author presents the 3D model results of the front lobby of the STMIK TIME building, as shown in Figure 2 above.

Fig. 3: Reception Desk View of STMIK TIME

The author presents the 3D model results of the STMIK TIME reception desk, as shown in Figure 3 above.

Fig. 4: Rear Lobby View of the STMIK TIME Building

The author presents the 3D model results of the rear lobby of the STMIK TIME building, as shown in Figure 4 above.

Fig. 5: Right Stairway Corridor of the STMIK TIME Building

The author presents the 3D model results of the right stairway corridor of the STMIK TIME building, as shown in Figure 5 above

Fig. 6: Left Stairway Corridor View of the STMIK TIME Building

The author presents the 3D model results of the left stairway corridor of the STMIK TIME building, as shown in Figure 6 above.

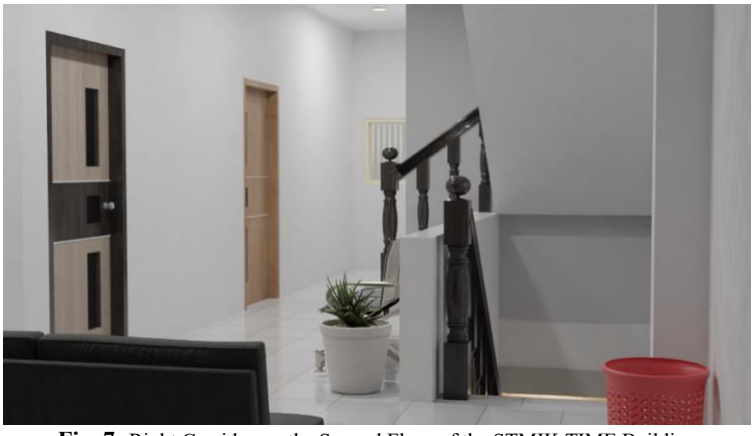

Fig. 7: Right Corridor on the Second Floor of the STMIK TIME Building

The author presents the 3D model results of the right corridor on the second floor of the STMIK TIME building, as shown in Figure 7 above.

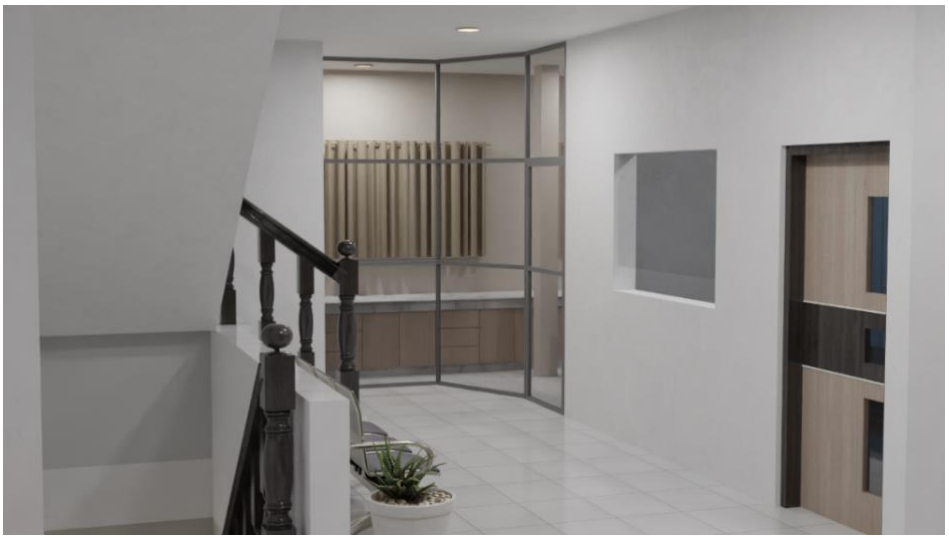

Fig. 8: Left Corridor on the Second Floor of the STMIK TIME Building

The author presents the 3D model results of the left corridor on the second floor of the STMIK TIME building, as shown in Figure 8 above.

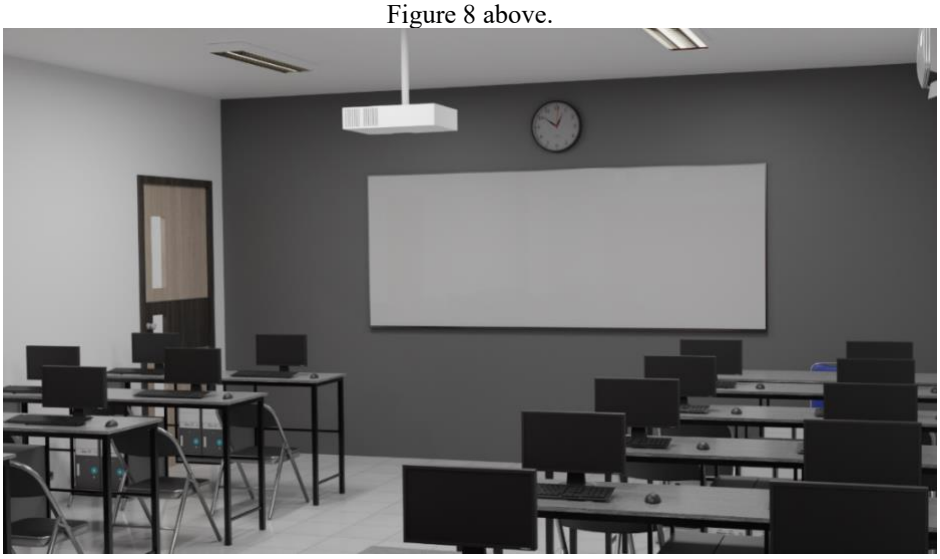

Fig. 9: Front View of the STMIK TIME Practice Classroom

The author presents the 3D model results of the front view of the STMIK TIME practice classroom, as shown in Figure 9 above.

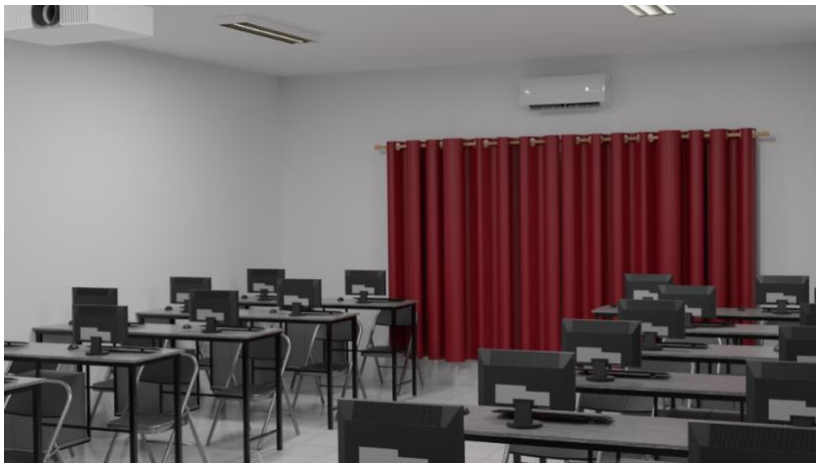

Fig. 10: Rear View of the STMIK TIME Practice Classroom

The author presents the 3D model results of the rear view of the STMIK TIME practice classroom, as shown in Figure 10 above.

5. Conclusion

Based on the research conducted, the following conclusions can be drawn:

1. The photogrammetry method has proven effective in producing 3D building models that are accurate and closely resemble the original form, both in terms of exterior and interior.
2. Structured image capturing, along with the use of SketchUp and Blender applications, facilitated the overall modeling process.
3. The resulting 3D model can be utilized as a visual asset for presentations, digital documentation, and the development of educational animations.

Acknowledgement

The author would like to thank all individuals who contributed to the completion of this research, particularly Didik Aryanto, M.Kom and Leony Hoki, S.Kom., M.M for their guidance and feedback throughout the project. Appreciation is also extended to the respondents who participated in the survey and provided valuable data for this study.

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