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3-Dimensional Animation Simulation of Underground Parking with Lift System

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Abstract

Congestion and limited parking spaces in the city require innovative solutions, one of which is an underground parking system with elevator technology for vertical parking. This research aims to design and make a 3D animation simulation of how the system works as an educational medium. The method used is Research and Development (R&D) through pre-production, production, and post-production stages with Blender. The results of the study were in the form of a 3D animation video of approximately 2 minutes that showed the flow of the vehicle and the leverage mechanism. This simulation is expected to provide a clear visual picture of the concept of modern underground parking..

***Keywords**:* 3D Animation Simulation, Underground Parking, Lift Parking.

1. Introduction

Underground parking has become a practical solution to overcome parking space limitations in urban areas. By utilizing the basement, the facility is able to accommodate a large number of vehicles without taking up significant surface land. The existence of underground parking not only helps reduce traffic congestion, but also improves land use efficiency [1]. However, the management of underground parking requires an efficient system to ensure vehicles can enter and exit easily, especially in scenarios with a high volume of vehicles [2].

The lift system is one of the innovative technologies designed to maximize vertical parking capacity [3]. This system allows vehicles to be parked on multiple levels or steps with the help of automated mechanisms, such as lift or movable platforms. With the implementation of the grader system, parking space can be used more optimally without the need for *horizontal* expansion. In addition, this system can also reduce parking search time, improve comfort, and reduce the potential for accidents in congested parking areas [4].

3D (3D) technology offers powerful tools for simulating and visualizing the concept of underground parking equipped with a grader system. By utilizing 3D animation simulations, developers can realistically depict how these systems work in real-life situations. This technology allows for an in-depth analysis of the design, efficiency, and potential challenges that may arise muncul selama implementasi. More so, 3D simulations can be an effective educational tool to introduce this concept to the public and stakeholders, as well as help in the planning and decision-making process.

2. Theoretical foundations

2.1. Planning

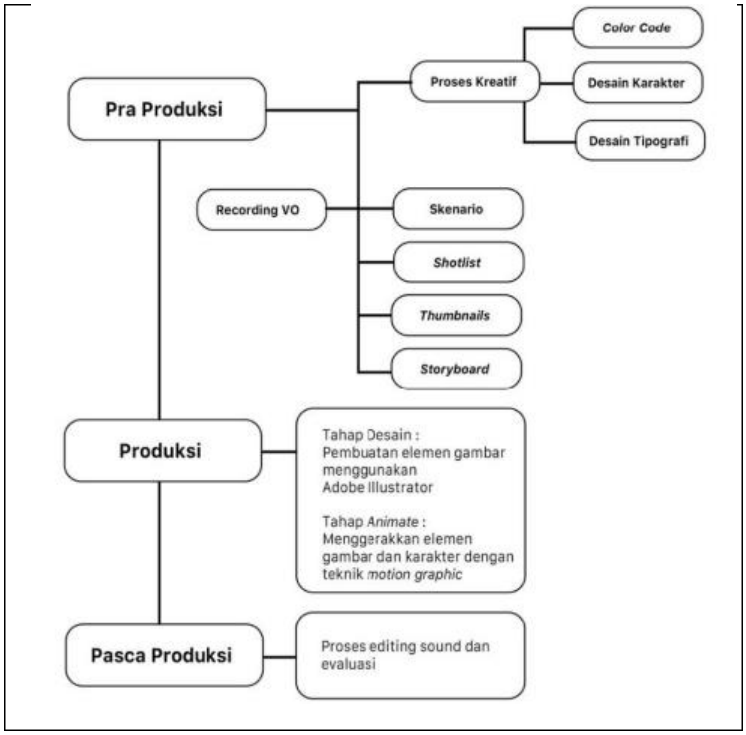

Fig .1: Chart of design methods in three stages

In every process of designing a video, a series of stages are needed with various processes that adjust the output of the design. In this study, the output that will be produced is motion *graphic* animation which has three stages called a *pipeline,* namely the pre-production, production and post-production processes.

Design is a process that aims to analyze, assess, improve, and compile a system, both physical and non-physical systems that are optimal for the future by utilizing existing information. Design is an activity or design engineering that starts from design innovation ideas, or the ability to produce works and inventions that can really describe market demand due to research and technology development. [5]

2.2. Content

According to the great Indonesian dictionary, content is information that is available through the media or electronic products. So that it can be used to display in such a way through the delivery of content through various social media such as the internet, television, audio CDs, and even now it can be done through mobile phones (*mobile phones*).

2.3. Lift

An elevator (also called *an elevator* in English) is a vertical means of transportation used to transport people or goods from one floor to another in high-rise buildings, such as office buildings, shopping centers, apartments, hospitals, and factories. The elevator works on the basis of a mechanical or electromechanical system driven by an electric motor, with the help of a cable and pulley system (in conventional lift), or a hydraulic system (in hydraulic lift).

2.4. *Multimedia development life cycle* MDLC

Multimedia Development Life Cycle (MDLC) is a system development model that is specifically used to design and develop multimedia applications or products, such as *games*, animations, interactive simulations, educational applications, and visual presentations. MDLC is a systematic approach that helps developers manage multimedia projects to be more structured, efficient, and on target.

In contrast to *Software Development Life Cycle* (SDLC) which focuses on software development in general, MDLC is designed to handle typical elements of multimedia, such as text, images, audio, video, animation, and interactivity.

The MDLC model consists of six main stages, namely:

1. **Concept**

   This initial stage serves to determine the basic idea, objectives, and scope of the multimedia project. Some of the things that are formulated in this stage:

2. **Target audience**
   1. Multimedia app objectives
   2. The type of multimedia to be used (audio, video, animation, etc.)
   3. Delivery platforms or media (presentations, *desktop, mobile, web*, etc.)

   Example: In an underground parking simulation, the concept is to provide an interactive visualization of the elevator mechanism to the user.
3. **Design**

At this stage, the design of multimedia elements and interaction structures is carried out. The goal is for developers to have clear guidelines on what to create.

4. Material Collecting

This stage is the process of gathering all the materials and resources that will be used in the application,

5. Assembly

This stage is the process of developing multimedia applications. All the components that have been designed and assembled are integrated into a development program or tool.

These stages include *scripting*, interactivity, and media integration. This is where the product begins to take shape in real terms.

6. Testing

The finished product will be tested to ensure functionality and quality go as planned. The results of these tests are used to perform repairs before they are released to end users.

7. *Distribution* (Distribusi)

Setelah produk dinyatakan siap, aplikasi multimedia didistribusikan ke target pengguna. Distribusi dapat dilakukan melalui:

a. Penyimpanan fisik (*CD, flashdisk*)
b. Distribusi *online* (*website, platform digital, Play Store*, dll)
c. Presentasi langsung (untuk keperluan edukasi atau promosi)

2.5. Animation

Animation is a method in which an image or object is manipulated to create a moving shape [6]. Animation comes from the Latin language, anima which means soul, life, life and spirit. Animation is a collection of fast-moving images that are continuous and have a relationship with each other.

Animation is an object or several objects that appear to move across a stage or change shape, change size, change color, change rotation, change other properties. Animation adalah suatu proses dalam menciptakan efek gerakan atau perubahan dalam jangka waktu tertentu. Animasi merupakan bentuk karya Motion graphics that are widely used for the purposes of movies, advertisements, profile videos and so on. Animation is the process of creating an object that appears to move across the *stage* for a certain period of time by changing shape, size, color, rotation or other *properties*.

2.6. 2D Animation

2D animation is a technique of making 2D animations such as paper, photos, *flip books*, and so on. This technique is also called conventional method animation or traditional animation. Because the average process of making it is still traditional using paper. [6]

2.7. 3D Animation

The general definition of 3-dimensional works of art is art that is composed of 3 sides, namely long, wide, and also high sides. In simple terms, the definition of 3-dimensional art can also be defined as a work of art that has volume and is found in a space.

2.8 . Storyboard

Storyboard is simply the basis of a story. In full, it is defined as a region that lines from a sketch image to display an image of the action in a story. Another meaning is a series of sketches made in the form of a rectangle by depicting a sequence of stories combined with visual elements and presented in media applications (film, games, and animation) [8].

2.7 . Multimedia

Etymologically, the word multimedia comes from two words, namely *multi* which means a lot, and *media* which means a tool or means to convey information. Thus, multimedia can be interpreted as the use of various media simultaneously to convey or present information. Multimedia is a form of information presentation that combines various media elements, such as text, images, audio, animation, and video, which are delivered in an integrated and interactive manner, usually through digital devices. The main purpose of using multimedia is to increase the effectiveness of information delivery as well as attract the attention and interest of the audience.

3. Research methods

3.1. Ongoing system analysis

System analysis can be defined as the breakdown of a complete information system into its component parts to identify and evaluate problems, opportunities, obstacles, and expected needs so that improvements can be proposed. In designing a 3-dimensional animation simulation of underground parking with this monitoring system, the author will analyze the existing system to find out the flow and features of the animation to be designed.

3.2. Storyline result

This animation aims to provide an in-depth understanding of the idea of modern underground parking that uses an elevator or escalator mechanism.

Here are the details of each scene from this animated storyline:

1. **Opening**
   Show the campus logo animation with the words "Underground Parking 3D Animation Simulation with Lift System" and a name to open.
2. **Scene 1**
   The animation begins by showing several vehicles moving back and forth.
3. **Scene 2**
   The vehicle arrived at the parking lot and then put the car into the elevator.
4. **Scene 3**
   The original appearance of the elevator in detail.
5. **Scene 4**
   Comparison of adjacent parking.
6. **Scene 5**
   The operator operated the car out of the elevator, several cars and some people passed by.
7. **Scene 6**
   The operator operates in close proximity.
8. **Scene 7**
   Underground application and display.
9. **Penutup**
   The animation closing features the STMIK Time campus logo and a message of gratitude to the supervisors and teachers of the 3D multimedia course.

3.3. Storyboard results

Storyboards are designed to set the timing and depict each event in each scene, making it easier for writers to design an animated storyline. Storyboard design is a series of images that are arranged sequentially following the story script that has been made. With storyboarding, the idea or message that the animation creator wants to convey can be more easily translated to the production team or other parties involved.

A well-structured story structure will help the audience to understand the intent and purpose of the simulation presented. Thus, the message that wants to be conveyed through this animation simulation can be clearly received and provides an understanding of the underground parking system with advanced technology. Here are some examples of *storyboards* made for a thesis titled "3D Animation Simulation of Underground Parking with Lift System."

Table 1 : Storyboard Table

No	Timing	Judul	Deskripsi *Scene*
1	0.00-0.10	**Pembuka**	Menunjukkan animasi logo kampus dengan tulisan "Simulasi Animasi 3D Parkiran Bawah Tanah dengan Sistem Pengundak" dan nama untuk membuka.
2	0.10-0.25	***Scene* 1**	Animasi dimulai dengan menunjukkan beberapa kendaraan berlalu lalang.
3	0.25-0.40	***Scene* 2**	Mobil sampai dan memakirkan di lift, operator membuka parkiran.
4	0.40-0.55	***Scene* 3**	Penampakan asli lift secara detail.
5	0.55-1.10	***Scene* 4**	Perbandingan bersebelahan parkiran bawah tanah dengan parkiran biasa.
6	1.10-1.30	***Scene* 5**	Operator mengoperasikan secara dekat
7	1.30-1.50	***Scene 6***	Operator mengoperasikan, memasukkan mobil dan beberapa orang berlalu lalang.
8	1.30-1.50	***Scene* 7**	Penerapan dan tampilan bawah tanah
9	1.50-2.21	**Penutup**	Ending.

4. Results

4.1 Opening

The appearance of this title page is the beginning of a series of animations that serve as an introduction to the project and also reinforce the visual identity of the scientific work created.

Fig. 2: Opening appearance

4.2 Comparison view of conventional parking and underground parking

This comparison aims to clarify the space efficiency and parking management generated by the technology of the driver, conventional parking can only accommodate 18 cars while multi-storey parking can accommodate 54 cars.

Fig. 3: Comparison view

4.3 Underground parking simulation view using lift

Featuring an elevator-based underground parking system with a side-by-side perspective. The system is designed to maximize parking capacity in limited land, by arranging vehicles vertically at several levels.

Fig. 4: Underground parking simulation view

4.4 Perspective view of underground parking elevator system

Shows a perspective view of the underground parking elevator system that has been integrated into the urban environment. Several vehicles were seen to have been parked on platforms that could move vertically underground

.

Fig. 5: Underground parking lift system perspective view

4.4 Vehicle Lifting Process Display by Parking Elevator System

Showing the active process of the underground parking elevator system, where one unit of black vehicle is in the vertical lifting stage using a hydraulic platform.

Fig. 6: Parking Lift Vehicle Lifting Process View

4.5 Final View of Vehicle in Vertical Parking System

Shows the final view of the automated vertical parking system after the white vehicle was successfully moved to the underground position by the lift system.

Fig. 7: Final View of Vehicle in Vertical Parking System

4.6 3 Level Vertical Parking System Frame Design Display

Shows a detailed view of the parking lot.

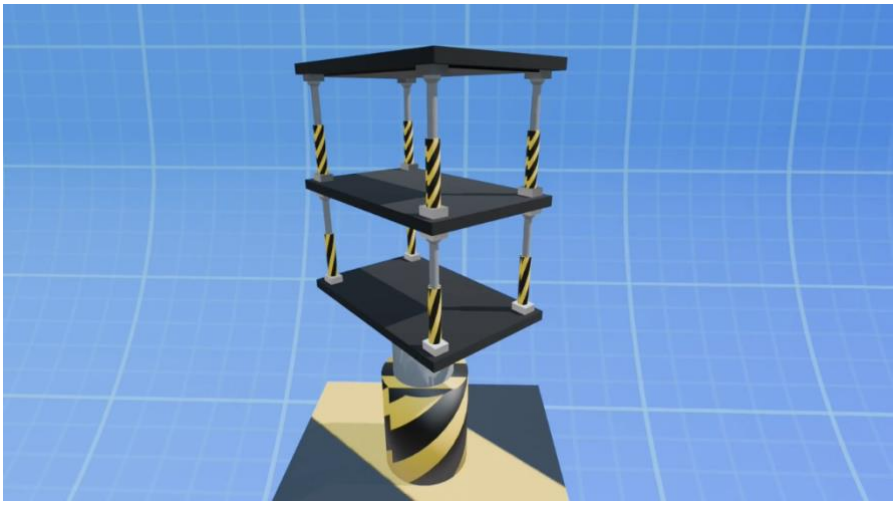

Fig. 8: Level vertical parking system frame design view

4.7 Closing

The image is the closing slide of a video that shows the identity of the STMIK Time (College of Informatics & Computer Management) educational institution located in Medan.

Fig. 9: Closing appearance

5. Conclusion

After the research is completed, it is necessary to explain the conclusions of the research results presented, namely: The *Multimedia Development Life Cycle* (MDLC) method has been systematically applied in the creation of this animation, starting from the concept stage, design, material collection, manufacturing, testing to distribution. This allows for the creation of structured, effective, animated content for the audience. The use of 3D animation media is able to provide a more realistic and interesting visual experience in delivering modern parking solutions on limited land, so that this simulation can be an educational and promotional medium for future vertical parking concepts.

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