

Design of Virtual Reality (VR) Machine of Palm Oil Sterilizer as Learning Media for Processing Palm Technology

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ARTICLE INFO

ABSTRACT

Published

Keywords:

Design
Virtual Reality
Android
Sterilizer
Palm

This research aimed to help students and workers better understand how to operate a Sterilizer machine using a virtual reality (VR) system. The Multimedia Development Life Cycle (MDLC) method was used, consisting of six stages: concept, design, material collecting, assembly, testing, and distribution. In the concept stage, the goal was to create a VR learning tool simulating the machine's operations. The design phase focused on creating 3D models and user interfaces for immersive interaction. Materials were gathered in the material collecting phase, followed by the assembly of assets in Blender and Unity, with C# programming used to build interactions. The system was rigorously tested for functionality and user experience before distribution on Android devices. The research showed that using VR technology allowed users to practice operating the machine in a safe, cost-effective environment without needing the actual equipment. This approach enhanced learning efficiency and accessibility, making training more flexible and adaptable for students and workers in the palm oil industry.

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I. Introduction

Virtual Reality or virtual reality is one of the advanced technologies that is being developed in various sectors around the world to improve the quality of performance and products. This technology allows users to interact with an environment simulated by a computer. The simulated environment is similar to the real world. The virtual reality experience includes a simulation of a combination of sensory results (visual, audio, touch) designed in 3 dimensions (3D) so that users feel as if they are physically involved. [1]

Many students or workers in the palm oil processing industry may have a limited understanding of the concept, function, and operation of the Sterilizer machine. Moreover, conventional learning methods such as textbooks or slide presentations may be less motivating or less interactive for some students and make it difficult for students/workers to understand the concepts of palm oil processing technology better.

Because the palm oil processing industry is an important sector in the economy, and to improve production efficiency and quality, the use of the latest technology is essential. The Sterilizer machine is one of the key devices in the palm oil processing process that requires in-depth understanding. Therefore, the development of innovative learning media, such as Virtual Reality, can help students and workers in this industry to understand the concept and operation of the machine. [2] Based on the background of the existing problems, the development and implementation of Virtual Reality Sterilizer Machine as a learning medium for palm oil processing was carried out.



It is hoped that with the "Design and Construction of Virtual Reality (VR) Sterilizer Machine as a Learning Medium for Palm Oil Processing" it will make simulation work and operational training in palm oil processing factories effective and efficient. From a learning psychology perspective, the use of VR is effective because it supports experiential learning, where learners actively engage in hands-on practice, improving retention and understanding through immersive experiences. The ability to simulate real-life processes in a safe, controlled virtual environment allows for better cognitive absorption, enhancing both procedural knowledge and practical skills. To further elaborate on the technologies involved, the following sections detail the role of key technological aspects in this project, which include digital technology, Virtual Reality, Android, and 3D modeling.

A. Digital Technology

Technology is advancing rapidly. In the field of audio and visual recording, developments have evolved from vinyl records and cassettes to CDs and DVDs. Cassettes, which were popular in the 1960s, used analog technology for sound and image recording. This required manually rewinding the playback device to the desired data point to select a specific song or image. The progress of digital technology has significantly simplified our lives. Devices such as cameras, radio-tapes, televisions, and telephones have undergone a transformation in signal processing from analog to digital. Digital technology has led to rapid advancements, particularly in the domains of information technology and telecommunications [6].

B. Virtual Reality

Virtual Reality is a technology that creates a virtual environment or simulation that provides a complete sense of interaction for the user. In a VR environment, users can feel as if they are actually in a digitally created place, even though they are physically in a different location, but users can feel and interact with an environment that is completely based on the real world. VR technology provides an artificial reality that brings humans into a computer-generated 3D area. This Virtual Reality system uses stereoscopic glasses that provide 3D visuals and other sensor-based devices that are attached to the body to give the impression that the player can hold objects on the 3D virtual world glass. Visual Reality presents a visual experience, which is displayed on a screen through a stereoscopic display, but some simulations include additional *sensory information, such as sound through speakers or headphones.*[6]

C. Android

Android plays a vital role in Virtual Reality (VR) by providing a development platform, hardware compatibility, access to VR applications, intuitive user controls, and integration with Google services. This allows users to enjoy more affordable, accessible, and varied VR experiences.[6] The Android operating system is one of the most widely used operating systems, especially among students and workers, therefore Virtual Reality is designed based on Android using a gyroscope sensor.

D. 3D Modelling

3D modeling is the activity of forming and designing an object so that it looks like the original object. Which is designed using Blender 3D software. For the design of 3D Virtual Reality object animation on the Sterilizer machine, Blender software is needed to design and render 3D modeling, Blender is an open source 3D computer graphics software. This software is used to create animated films, visual effects, 3D printed models, interactive 3D applications, and video games. [7]

II. Method

The main objective is to develop a Virtual Reality (VR) based media application that can be accessed via an Android Smartphone device. To achieve this goal, the method used is the multimedia development method, namely the Multimedia Development Life Cycle (MDLC). The MDLC method was chosen because of its systematic and organized structure, which is very suitable for developing complex applications such as VR [11].

MDLC consists of six interrelated stages that must be passed sequentially to ensure that application development runs smoothly. The first stage is the concept, where the basic idea of the VR application is developed, including determining the goals, target users, and the main functionality desired. The second stage is design, where the user interface, navigation structure, and visual elements are designed to ensure that the application is easy to use and attractive as described in Figure 1.

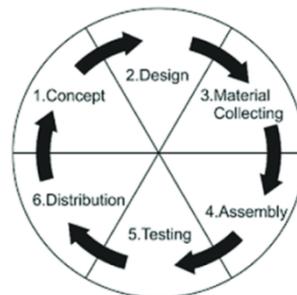


Fig.1. MDLC Method

A. Concept

The concept used in making this Interactive Media is 3D Animation on the Sterilizer machine, which explains how the process of boiling palm oil from being raw after being put into the Sterilizer when it comes out of the machine, the palm oil has become soft. In making Interactive Media that combines the concept of 3D Animation, the main focus is on the visualization of the process in the Sterilizer machine, which is an important part of palm oil processing. This animation is designed to provide a clear Fig. of how crude palm oil is processed in the Sterilizer, which is a critical stage in the palm oil processing industry.

The animation process begins by showing the initial stage where crude palm oil is put into the Sterilizer machine. This machine then works by using hot steam to boil and soften the oil. The use of 3D Animation allows users to see how the pressure and temperature in the Sterilizer gradually increase, which ultimately affects the consistency of the oil as explained in Figure 2 below.

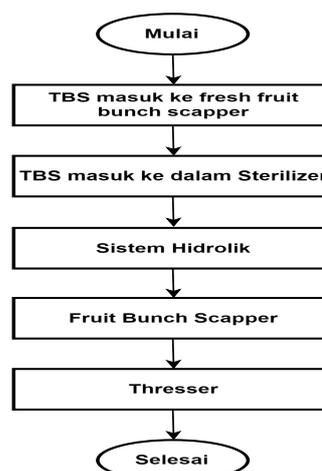


Fig. 2. Sterilizer Machine Working Process

B. Design

In Figure 3, the design is done before creating a Virtual Reality (VR) Application, as an applied art that involves the arrangement of lines, shapes, colors, sizes, and values of a display that has certain principles, the software used. In this context, design not only includes technical aspects, but is also an applied art that combines various visual and functional elements to create an immersive and intuitive experience for users.

The use of the right software is very important in this design stage. Some commonly used software in designing VR applications include Unity3D and Unreal Engine. Unity3D, for example, is a powerful platform for creating interactive and immersive 3D environments. With features such as real-time rendering and support for various VR devices, Unity3D allows designers to design and test various aspects of the application directly.

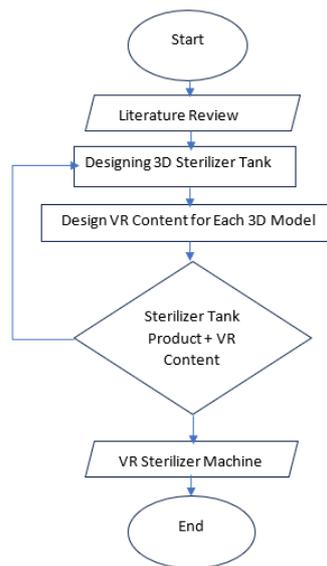


Fig. 3. VR Creation Flowchart

Table 1. Flowchart Explanation

NO	FLOWCHART DESCRIPTION
1.	Determine the 3D object data to be created and data to design Virtual Reality.
2.	Create a design that has been implemented when designing the application.
3.	Designing a 3D model of a Sterilizer Tank using Blender and Unity software.
4.	Designing VR content for each 3D modeling process using Blender and Unity software.
5.	Create a Sterilizer machine product + VR content developed into an application file.
6.	Conducting a trial/quality control process to identify errors in the Virtual Reality design process.
7.	If the design fails, repeat the work steps from the 3D Sterilizer Tank model design process.
8.	If the design is successful, the VIRTUAL REALITY STERILIZER MACHINE can be used by the user.

C. Material Collecting

The material collection stage is an important step in building a Virtual Reality (VR) Application that is focused on being a learning medium for palm oil processing technology. At this stage, the

collected materials act as the main foundation for application development, ensuring that all the elements needed to create a realistic and effective learning experience are available. The main material collected in this stage is a 3D model of the Sterilizer machine, which is an important component in the palm oil processing process. This 3D model must be designed with high accuracy to ensure that application users can understand exactly how the machine works. For this reason, technical data and reference images of the actual Sterilizer machine are essential.

The collection of materials can also include sound elements, such as the sound effects of the Sterilizer machine in operation, which can increase user immersion in the VR application. All of these materials will then be integrated into the application during the assembly stage, creating a complete and informative virtual learning environment.

D. Assembly

In the development of virtual reality for palm oil machine learning media, the Sterilizer machine was chosen. The stage where all objects or multimedia materials are made is the production stage. The creation of this application is based on the design stage. Application creation is based on the creation flow. In loading this application, several software such as blender, Unity 3D, and android are used. To create an object we must understand the coordinate points X, Y, and Z. X is the coordinate that is the reference for the length of an object, Y is the coordinate that is the reference for the width of an object, and Z is the coordinate that is the reference for the height of an object [5]. There are several stages in creating an interactive fruit cages machine object, namely: making a floor, building walls, building a lorry machine, building oil palm fruit, building a loading ramp machine, building a sterilizer [6].



Fig.4. Real and 3D Sterilizer Machine



Fig.5. Real and 3D Lorry on Sterilizer

In the first stage of creating a Virtual Reality (VR) application for a Sterilizer machine, the main focus is on creating a 3D model of the machine. This process begins with the use of 3D modeling software such as Blender. Blender is a very effective tool for creating visualizations of object designs in three dimensions, allowing designers to create accurate and detailed representations of the Sterilizer machine. In Blender, designers can start by creating an initial sketch of the Sterilizer machine, then modify the basic shape to reflect specific features of the machine, such as the drum, valves, and control panel. Blender provides a variety of tools and features to assist in this process,

including mesh modeling, texturing, and lighting. Designers can use sculpting tools to add finer details and rigging tools to prepare animations if needed. in figure 6



Fig. 6. 3D Design of Sterilizer Machine

E. Testing

After the development process is complete, the Virtual Reality (VR) application for introducing palm oil Sterilizer machine processing is now ready to be introduced and tested for feasibility. This stage is very important to ensure that the application functions properly and meets the learning objectives that have been set. The implementation of this application is carried out by testing the application to target users, namely students studying palm oil processing technology and workers in the palm oil industry. During the trial session, students and workers will use the application to learn how the Sterilizer machine works. They can interact with the 3D model of the machine, observe the sterilization process, and understand the working mechanism in more depth. Users will also be asked to provide feedback regarding their experience, whether this application helps in understanding the material, and whether there are aspects that need to be improved.

F. Distribution

After the testing stage is complete and the Virtual Reality (VR) application for the Sterilizer machine has been improved based on user feedback, the next stage is the distribution of the application. This distribution is a crucial step to ensure that the tested system functions properly in a production environment and is ready to be used by the target audience, namely students and workers in the palm oil industry. The distribution stage involves implementing the tested VR system into a wider production environment. This can include installing the application on VR devices used in laboratories or palm oil processing plants, as well as ensuring that all related hardware and software are functioning properly. This distribution aims to ensure that the application can operate consistently and meet user needs in a real context.

The final product will be explained in detail, covering the main features of the application that has been developed. This includes a 3D model of the Sterilizer machine that is produced with high accuracy, interactive animations that illustrate the operational process of the machine, and controls and interaction features that allow users to understand the working mechanism of the machine in depth. The implementation of the product in the context of operational training will be described, explaining how this VR application is used to train new employees and students in understanding palm oil processing technology. This explanation includes how the VR application is implemented in the training environment, how users interact with the simulation, and the benefits obtained from using this technology in the context of industrial education and training.

G. Products produced

In Figure 7, the home page is the first view that users see when opening the Virtual Reality (VR) application for the Sterilizer machine. The design of this home page is very important because it serves as a starting point for users to access various content and features in the application. The appearance of the home page must be designed with ease of access and navigation in mind. The home page includes several main elements, such as the main menu that provides access to various parts of the application, such as the introduction of the Sterilizer machine, operation simulation, and user guide. Additional features such as help buttons, settings, or options to select display modes can also be included to enhance the user experience. A clean appearance and easy-to-access navigation will ensure that users can quickly find relevant content and start training or exploration smoothly.

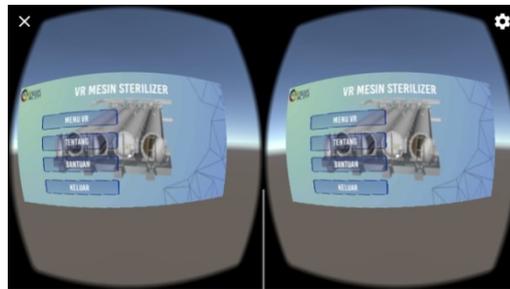


Fig.7. Main Menu

Figure 8, is an image of the VR content of the sterilizer machine. Showing VR content with the on-off button on the panel that controls the sterilizer machine shows one of the important features of this VR system. The button is designed to simulate the basic operation of the sterilizer machine in a virtual environment, providing an interactive experience to the user.

The on-off button serves as the main control that allows the user to start and stop the machine operation in the simulation. By pressing this button, the user can see how the sterilizer machine works from start to finish, including the movement process and mechanisms that occur during operation. This provides an opportunity for the user to better understand how the machine is operated in real conditions. This feature is also designed to mimic the real experience, where the user must ensure that the machine is turned on or off according to the correct procedure. Through this simulation, the user can learn about the importance of the correct sequence of steps in operating the machine, as well as understand the consequences of operating it incorrectly. This image shows how the VR system can be used as an effective training tool, allowing users to practice and improve their operational skills without the risks associated with using physical machines in the real world.

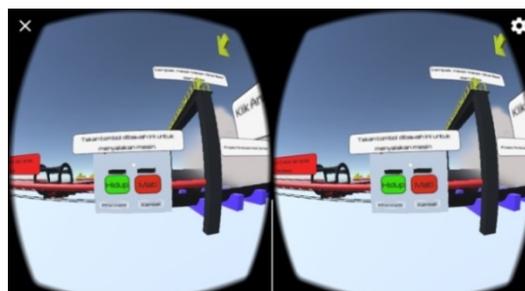


Fig. 8. VR Content

Figure 9, clearly shows how Virtual Reality (VR) can serve as a highly effective training tool in raising awareness of workplace safety. In this simulation, VR provides a safe and controlled environment to practice various operational procedures without the risk of physical harm. Users can interact with the Sterilizer machine model in the VR simulation, practice operational skills, and

virtually face emergency situations, allowing them to understand and address potential problems that may occur in a real-world work environment.

Using VR, users can explore and practice various safety scenarios, such as recognizing signs of machine failure or dealing with system failures without the risk of an accident. This process helps them understand the safety measures to take and enhances their ability to act quickly and appropriately in an emergency situation.



Fig.9. Dangerous Area Display

Figure 10, shows Virtual Reality (VR) content equipped with process information designed to help users understand each step in operating a Sterilizer machine. This content provides clear and structured guidance, so that users can follow operational procedures easily and accurately. Process information is presented in the form of visual and textual instructions that appear contextually when the user performs certain actions.

With the process information integrated into the VR simulation, users can learn how to operate the Sterilizer machine in a more structured and informative way. This feature not only improves operational understanding and skills but also minimizes the risk of errors and ensures that users can follow safety procedures more effectively. Figure 13 shows how the integration of process information in VR can be a very useful training tool, providing an interactive and immersive learning experience.

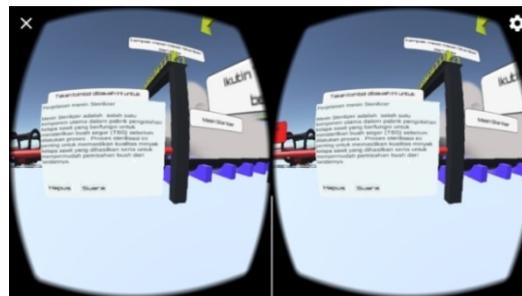


Fig.10. Process Information Display

H. Testing and test results

The purpose of this test is to evaluate the effectiveness of the Virtual Reality (VR) system as a training tool for staff and students in the palm oil industry. The test was conducted through a questionnaire designed to collect direct feedback from users regarding their experience in using this VR system. By completing the questionnaire, it is expected to obtain in-depth insights into the extent to which this system helps users understand and operate the Sterilizer machine effectively.

The results of this test will help ensure that the VR system is not only effective in conveying technical knowledge about the Sterilizer machine, but can also improve productivity and operational safety in the field. By involving students and palm oil industry staff in the test, the VR application

can be evaluated from various perspectives, ensuring that this system is relevant and useful for various user groups.

Table 2, shows a list of questions contained in the questionnaire, which was addressed to students studying the palm oil industry and palm oil industry staff. These questions were designed to measure various aspects of the user experience, including understanding of the material, ease of interaction with the system, and the extent to which the VR system meets training needs. By analyzing the answers to this questionnaire, the development team can obtain valuable information for further refinement and development of the VR system.

Table 2. questions on the questionnaire

No	Question	Evaluation	
		A	D
1	Does the use of VR make you more interested in learning about Sterilizer machines in palm oil processing technology compared to textbook learning methods or slide presentations?	33	1
2	Does using VR motivate you to learn more about the Sterilizer machine?	31	3
3	Does VR help you understand how the Sterilizer machine works?	33	1
4	Does VR provide a clear Fig. of how the machine operates?	30	4
5	Does the application not crash when used?	30	4
6	Did VR help you understand the safety aspects of working with this machine?	32	2
7	After using VR, do you feel more prepared to face real situations in operating a Sterilizer machine?	33	1
8	Are the 3D objects displayed interesting?	33	1
9	Does VR help make the learning process more interactive and enjoyable?	33	1
10	The VR application display is attractive	34	0
AMOUNT		322	18

Note :

A = Agree

D = Don't Agree

Figure 11, shows a graph depicting the distribution of responses from the questionnaire regarding the Virtual Reality (VR) system for Sterilizer machine training. The graph shows the comparison between respondents who agreed and disagreed with each question in the questionnaire. Of the total 35 respondents, the results show that the majority were satisfied with the VR system. With a total score of 321 for the agree option and only 18 for the disagree option, it can be concluded that this system is generally well received by users. From the data obtained, if calculated in percentage, 95% of respondents chose to agree with the statements in the questionnaire, while 5% of respondents chose to disagree. This high percentage indicates that the VR system is very effective in meeting training objectives and providing adequate experience to users. Positive feedback from most

respondents indicates that the VR system has succeeded in meeting training needs well. However, to further improve the quality and effectiveness of the application, feedback from the 5% of respondents who disagree also needs to be considered. This evaluation is important to make necessary adjustments and improvements, so that the VR system can better meet training standards and user expectations in the future.

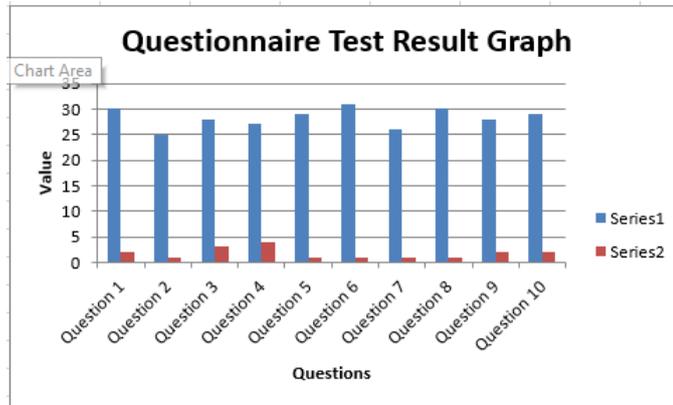


Fig. 11 Questionnaire Test Results Graph

From Figure 12, it can be concluded that the Virtual Reality (VR) application for the Sterilizer machine is very feasible to use in the context of palm oil processing technology training. The graph shows that the application obtained a total percentage of 95% with a "very good" representation result from respondents. This high percentage reflects the satisfaction and effectiveness of the application in meeting training objectives. The results of this evaluation indicate that the VR application not only meets user expectations but also makes a significant contribution to improving the understanding of students and staff in the palm oil industry. With interactive features and realistic simulations, this application facilitates deeper learning about the Sterilizer machine, allowing users to practice and acquire operational skills in a safe virtual environment.

With the results showing that the VR application obtained a "very good" rating, it can be concluded that this technology is a very valuable training tool and is feasible to use for education and training in the palm oil processing industry. The implementation of this application is expected to improve skills, safety, and productivity in the field, as well as provide significant benefits for all users.

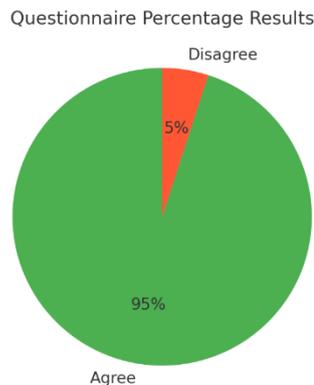


Fig 12. Questionnaire Percentage Results

Figure 16, The gender distribution results showing 56.8% female and 43.2% male provide important insights into the demographics of the respondents in this study. The higher percentage of females reflects that this Virtual Reality (VR) application may attract greater interest among female

users or that female groups are more involved in training or education related to the palm oil industry. This distribution also shows a relatively good gender balance in this study, which is important to ensure that the results of the VR application evaluation reflect the views and experiences of a diverse group. This data can help VR application developers to better understand their target audience and tailor the application content or features to be more inclusive and relevant to all users, regardless of gender. Ensuring that the application is acceptable and useful to all users, regardless of gender, will increase the success and positive impact of this training system in the field.

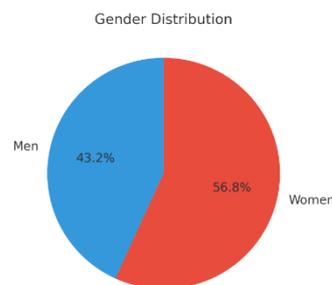


Fig. 13 Gender distribution results

III. Conclusion

The following are five conclusions from the results of this study related to the objectives and benefits of the VR palm oil sterilizer system and also based on the results of the questionnaire conducted:

1. The Virtual Reality (VR) application developed for Sterilizer machine training in the palm oil industry has proven to be effective as a training tool. Testing and feedback show that the system helps users understand and operate the machine better, with 95% of respondents giving a “very good” rating.
2. VR simulations provide a safe learning environment, allowing users to practice operational skills and safety procedures without physical risk. This helps them recognize and avoid hazardous areas, and understand the importance of proper safety procedures.
3. Interactive features in VR applications, such as on-off buttons and contextually displayed process information, enhance the user experience by providing clear visual and textual guidance. This facilitates a deeper understanding of how the machine works and the correct operating procedures.
4. With the test results showing high satisfaction from the majority of respondents, this VR application is considered feasible and effective for improving skills and safety in the field.
5. The Android-based Sterilizer VR application has proven to be a useful and efficient training tool. It not only enhances the user's understanding and operational skills but also ensures compliance with high safety standards, contributing to a safer and more productive work environment.

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