SAVAGE: Simulation of Virtual Reality-Based for Building Fire Victim Rescue Learning Media

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Abstract: Airports are very dynamic and complex environments, making them high-risk places for incidents and accidents, both due to the aircraft's movement and to the building facilities or structures at the airport. Emergency service personnel must have high skills in emergency response, quick decision-making abilities, and a deep understanding of the various dangerous situations that may be encountered in the field. Continuous education and training are essential to ensure their readiness and ability to deal with emergencies. This study aims to develop Virtual Reality-based Search and Rescue learning media to improve the skills and understanding of training participants in search and rescue operations. This learning media is designed to provide a realistic and interactive simulation experience, allowing participants to practice rescue procedures in various dangerous scenarios without real risk. The development methods used in this study include the stages of needs analysis, design, development, implementation, and evaluation (ADDIE). At the analysis stage, the identification of training needs and competencies that must be achieved is carried out. The design stage involves designing Virtual Reality scenarios that cover various field conditions and rescue techniques. Effectiveness is evaluated by measuring the increase in skills and understanding of participants before and after using Virtual Reality media. The study results indicate that this learning media effectively improves the operational and decision-making skills of training participants in emergency situations. The feasibility assessment by media experts obtained an average score of 88.72%. Then, the feasibility assessment by material experts obtained an average score of 88.90%. After conducting a product trial on students, the evaluation results were 81.30%. Based on the results of the validation and trial of this product, Virtual Reality-based learning media can be recommended as an innovative and efficient training tool for Search and Rescue learning media.

Keywords: Learning Media, Search and Rescue, Virtual Reality

A. Introduction

Airports are complex facilities and involve many parties, including passengers, airport staff, security officers, and flight operators, making them places with a high

risk of incidents and accidents, whether due to the movement of the aircraft itself or to the building facilities or structures at the airport (Amren et al., 2022). This risk is caused by various factors, including the high volume of aircraft, passenger, and cargo movements and the involvement of many parties with various tasks and responsibilities (Febiyanti et al., 2024). Every day, thousands of activities occur at the airport, from flight operations and refueling to baggage and cargo handling, requiring proper coordination to avoid potential incidents and accidents with high severity levels (Krisna et al., 2021).

A building fire at an airport is a severe incident because it can cause significant losses in terms of material and loss of life (Widya Mustika et al., 2018). Airports are very dynamic and complex environments. Therefore, preparedness and rapid response to fire are essential, especially in firefighting operations, searching and rescuing victims trapped in the emergency incident (Isma et al., 2022).

Search and rescue activities are vital in disaster management and emergency situations, especially in emergency incidents at airports (Putri et al., 2019). Emergency service personnel must have high skills, quick decision-making abilities, and a deep understanding of the various dangerous situations that may be encountered in the field. Continuous education and training are essential to ensure their readiness and ability to deal with emergencies (Nugraha, 2019).

However, conventional search and rescue training often faces various limitations, such as high operational costs, risk of participant injury, and limitations in replicating realistic field conditions. In addition, the variety of scenarios that can be applied in live training is minimal, reducing the effectiveness of learning in dealing with unexpected situations (Martadinata et al., 2021).

With the advancement of technology, especially in Virtual Reality, opportunities have emerged to address these challenges. Virtual Reality technology allows for immersive and interactive simulation environments, where trainees can experience various emergencies realistically without facing physical risks (Wicaksana et al., 2021). Virtual Reality also allows for the repetition of the same scenario over and over again, so participants can hone their skills until they reach the desired level.

The use of Virtual Reality-based learning media offers significant innovation in the world of education, enabling a more interactive and immersive learning experience (Somad & Haryanto, 2024). Virtual Reality allows students to experience a natural learning environment, providing opportunities for exploration and practice that cannot be achieved through conventional learning methods (Komalasari et al., 2023). For example, students can explore geographic locations, conduct laboratory simulations, or even practice in complex scenarios such as flight or surgical simulations, all in a safe and controlled environment (Darojat et al., 2022).

Therefore, this study aims to develop a Virtual Reality-based Search and Rescue learning media that has the potential to significantly enhance training. The development of this media is expected to improve the quality of Search and Rescue training by providing a more in-depth and realistic learning experience, as well as expanding the variety of scenarios that can be learned by participants.

Based on the background of the problem above, the problem in this study can be formulated: How can we develop a Virtual Reality-based "Search and Rescue" learning media that meets the needs of education and training in the Evacuation of Victims at Aviation Accident course?

B. Methods

The type of research used is research and development, a method used to produce specific products and test the effectiveness of these products (Sugiyono, 2010). This research procedure adapts the ADDIE development model, namely a development model consisting of five stages: Analysis, Design, Development, Implementation, and Evaluating.

The data analysis technique used in this study is a descriptive analysis that calculates the percentage of validation results. The level of feasibility of the product from the development research is identified with the score presentation (Septiani et al., 2024).
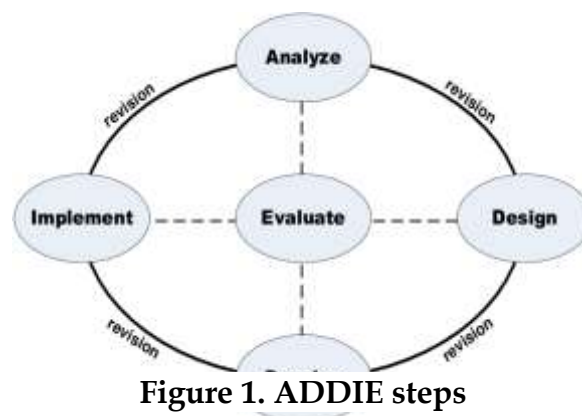

Figure 1. ADDIE steps

The greater the score presentation of the data analysis results, the better the level of feasibility of the product of the development research results. The criteria for making decisions in validating Android-based mobile learning media can be seen in table 1 (Lukiana, 2015).

Table 1. Eligibility Criteria

	Percentage	Remarks
1	80% - 100%	Good / Valid
2	60% - 79,99%	Fairly Good / Fairly Valid
3	50% - 59,99%	Not Good / Invalid
4	0 – 49,99%	Poor / Replaced

Data collection methods include questionnaires, observations, and interviews to produce qualitative and quantitative data. A questionnaire is a data collection tool containing several questions that must be answered by the research subjects (Soleh et al., 2024). The questionnaire is used to determine the feasibility level of the media being developed. The scale used is the Likert scale. Namely, the respondent's answers are stated in a range of answers on a scale of 1-5, ranging from very feasible to less feasible (Yuniar et al., 2024).

The data from the distributed research sheets are then calculated 'for the average score of each component to see the weight of each response. Here is the formula for calculating the average score:

$$\bar{x} = \frac{\Sigma x}{n}$$

Remarks: $\bar{x}$ = Total Score

                 Σx = Average Score

                 n = Number of Respondents

Figure 2. Average Score Formula

The average score obtained previously is converted to show the module's eligibility based on the measurement scale (rating scale). The scale is a conversion of measurement results from quantitative data to qualitative. The average score is then converted into qualitative data (interval) with four scales.

C. Results and Discussion

The design and development of this application go through several stages. The first stage is to analyze the needs of the application, which will be made a problem analysis consisting of needs analysis and student characteristics analysis (Soleh et al., 2019). Needs analysis is carried out to identify initial problems or issues faced in the learning process. Information system design is made to analyze the actual conditions that exist in an entity (Yulaini, 2018).

The author presents the observation results obtained at this stage in the form of a gap analysis table of the Root Cause Analysis (RCA) model, which is adapted from the research (Amalia et al., 2022). In addition, this diagram also explains the sequence and procedures included in the application. The product design flowchart is as follows.
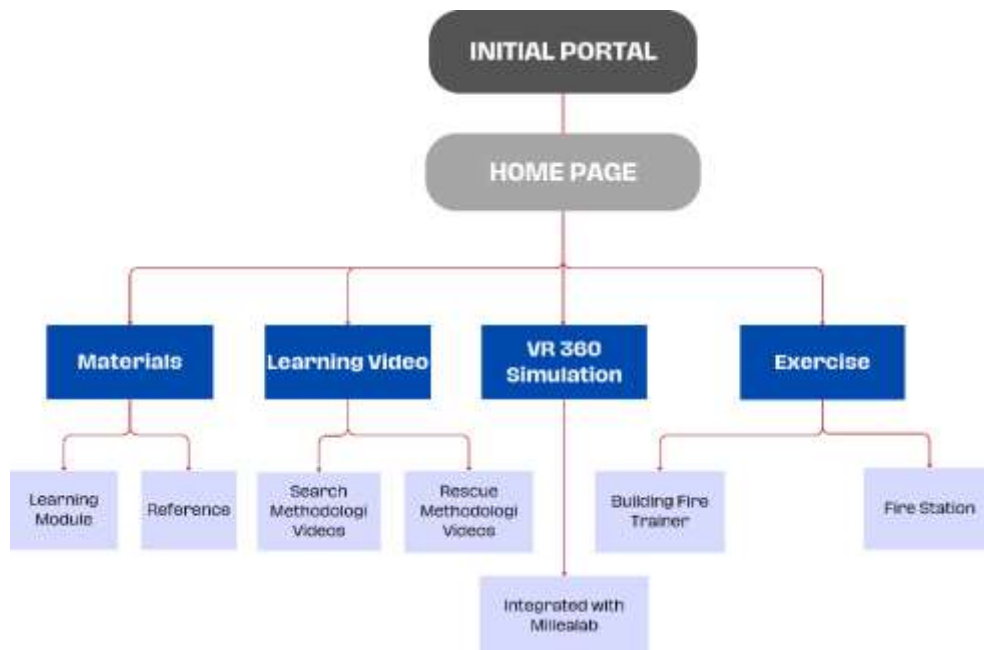
Figure 3. Product Design

Defining the Unified Modeling Language (UML) is the next stage. Websites for education can be designed and modeled using UML, a visual tool. Before writing code, developers can use UML to visualize the behavior and structure of complicated systems. This facilitates the planning, explaining, and recording of a project's essential components (Putra & Andriani, 2019).
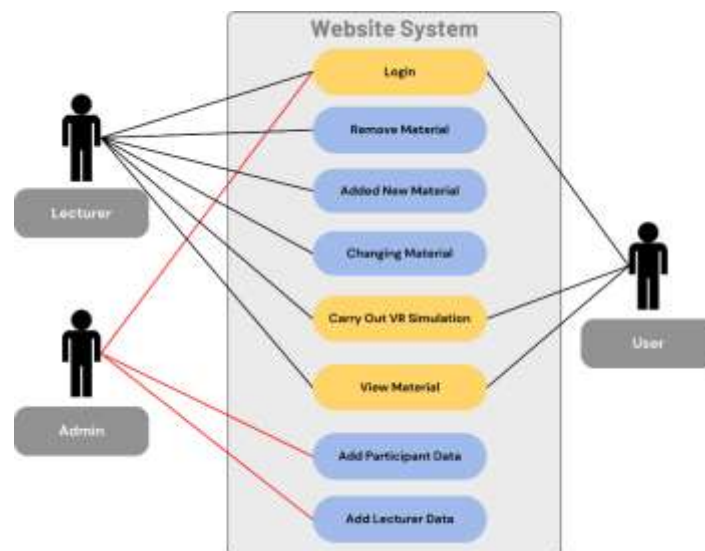
Figure 4. Use Case Diagram

The Use Case Diagram is the UML diagram employed to create this educational website. The primary functionalities of the learning website, including student registration, material access, training administration, and assignment collecting, are depicted in this figure (Kuswanto & Radiansah, 2018).
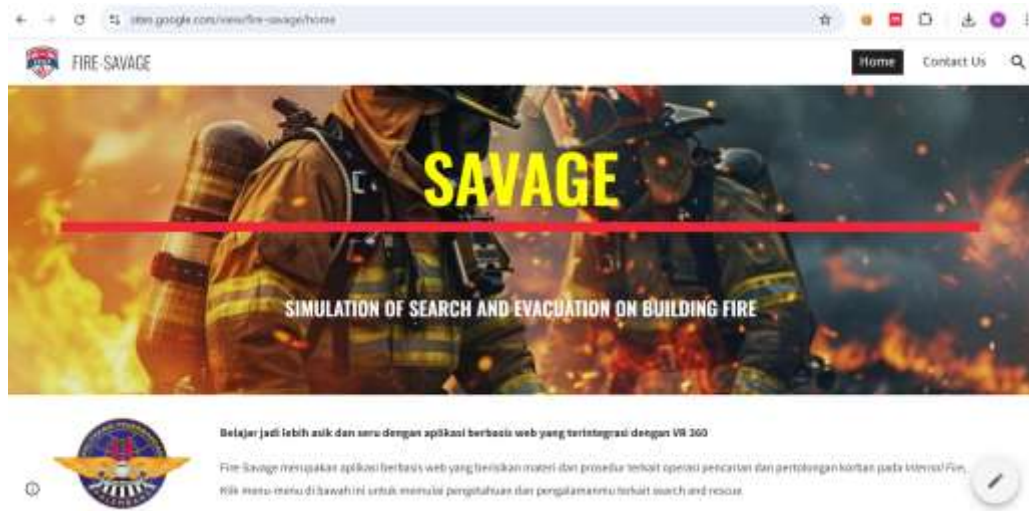
Figure 5. Initial Display

Programmers can create software more efficiently by using frameworks. Consequently, the Laravel framework is used in software development. Software for information technology includes a database. This program makes use of MySQL, a SQL-based database (Suryan et al., 2020).

Figure 6. Main Menu

On the menu display, there are several features that users can use to enrich the material and knowledge related to search and rescue itself. The main features that can be accessed include materials, video tutorials, simulations, and exercises (Aklimawati et al., 2023).

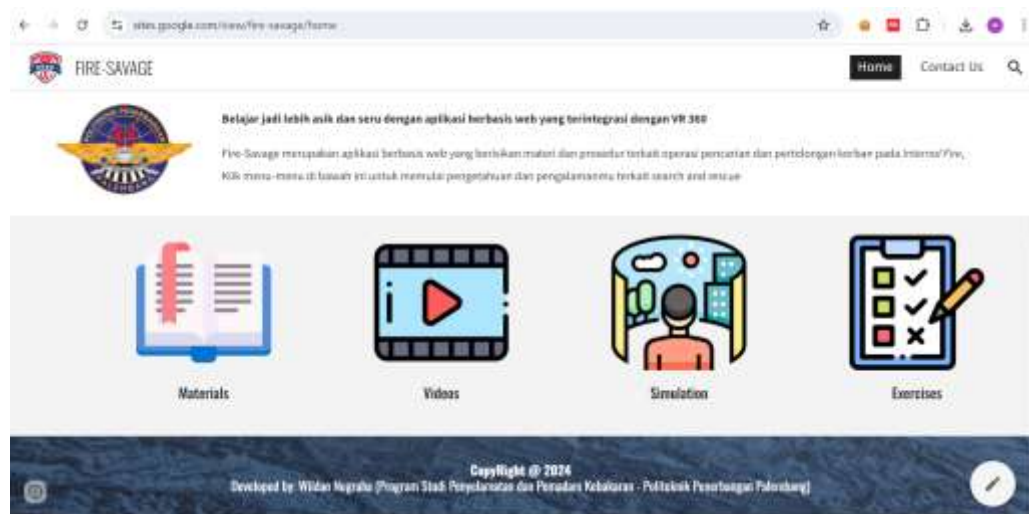**Figure 7. Virtual Reality Simulation**

The Millealab platform is used to illustrate this Virtual Reality simulation. The creation of Virtual Reality scenarios in the Virtual Reality Simulation menu covers various conditions and challenges that may be faced in the field, such as operations in remote areas, searching for victims in high-rise buildings, and evacuation in buildings with high complexity (Safwan Kasma et al., 2023). This Virtual Reality media is developed with interactivity, immersion, and realism to ensure an immersive learning experience.

Table 2. Media Validation Result

No	Criteria	Score	Percentage	Category
1	Display and Menu	13.50	90.0%	Valid
2	Ease of Use	13.75	91.6%	Valid
3	Linguistics	12.75	85.0%	Valid
4	Implementation	13.25	88.3%	Valid
	Average Value	13.31	88.72%	Valid

Based on the analysis of the validation of Media experts carried out by 3 (three) validators, an average percentage value of 88.72% was obtained, which is included in the "Good/Valid" category. Therefore, based on the validation of media experts, the

developed application can be declared feasible without revision as a website-based learning media.

Table 3. Material Validation Result

No	Criteria	Score	Percentage	Category
1	Learning objectives	12.7	84.7%	Valid
2	Learning materials	13.0	86.7%	Valid
3	Learning methods	13.7	91.3%	Valid
4	Learning Resources	13.0	86.7%	Valid
5	Learning Activities	14.3	95.3%	Valid
	Average Value	13.3	88,9%	Valid

Based on the analysis of the validation of material experts, an average percentage value of 88.90% was obtained, which is included in the category of "Good/Valid". Therefore, based on the validation of material experts, the developed learning media can be declared feasible without revision.

Table 4. User Test Result

User	Material Aspect					Media Aspect					Σ
	1	2	3	4	5	6	7	8	9	10	
Respondent 1	5	4	4	5	4	4	5	5	4	5	45
Respondent 2	4	4	5	4	4	5	5	4	4	5	42
Respondent 3	4	5	5	4	4	5	4	4	5	4	44
Respondent 4	4	4	4	5	4	4	4	4	4	4	41
Respondent 5	5	4	4	4	4	4	5	4	4	5	42
Respondent 6	5	4	5	4	4	5	4	5	5	4	45
Respondent 7	4	4	3	4	4	5	4	4	4	4	40
Respondent 8	5	5	4	5	4	4	4	5	5	5	46
Respondent 9	4	4	4	5	3	5	5	4	4	5	43
Respondent 10	5	4	4	4	4	5	4	5	4	5	44
Respondent 11	5	5	4	5	4	4	4	4	5	5	45
Respondent 12	4	5	5	5	5	5	4	4	4	4	45
Respondent 13	4	4	5	4	4	4	5	4	4	5	41
Respondent 14	4	4	4	4	5	5	4	4	5	5	42
Respondent 15	5	4	4	5	4	4	4	4	4	4	42
Respondent 16	4	4	4	4	3	5	4	4	4	4	40
Respondent 17	4	5	5	4	4	5	4	4	4	5	42

Respondent 18	5	4	4	5	5	4	4	4	5	4	44
Respondent 19	4	4	4	5	4	5	5	4	4	4	43
Respondent 20	4	5	5	4	4	4	4	3	5	4	42
Respondent 21	5	5	4	4	4	5	4	4	5	5	45
Respondent 22	5	4	4	4	3	4	4	4	4	4	40
Respondent 23	4	5	4	5	4	5	5	4	5	4	45
Respondent 24	5	4	5	5	5	5	4	4	5	4	46
Respondent 25	4	4	4	4	5	4	5	4	4	5	41
Respondent 26	5	5	4	4	4	4	4	5	4	5	44
Respondent 27	4	4	5	4	4	5	5	4	5	5	43
Respondent 28	5	4	4	5	5	4	5	4	5	4	45
Amount	125	121	120	124	115	127	122	116	124	126	
Aspect Value			605					615			
Ideal Value			750					750			81.3%
Percentage			80.67%					82.00%			

The author conducted a direct experiment related to the use of the savage learning media application system. The trial was carried out by providing an assessment questionnaire related to satisfaction with the system to 28 (twenty-eight) respondents. The respondents' trial obtained an average of 81.3% overall with a decent category. The assessment instrument uses a Likert scale, where the assessment object is the material aspect with a weighting of 80.67% and the media aspect with a weighting of 82%.

D. Conclusions

The development of this learning media includes the creation of realistic rescue scenarios, which reflect the actual conditions of the field and the situation. The feasibility assessment by media experts obtained an average score of 88.72%. Then, the feasibility assessment by material experts obtained an average score of 88.90%. After the product trial was conducted on students, the evaluation results were 81.30%. In general, training participants showed a high level of satisfaction with the use of Virtual Reality-based learning media. This media also provides flexibility in training, allowing participants to practice anytime and anywhere with the available Virtual Reality devices.

E. Acknowledgement

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