

Development of Tactical Air Maneuvers Game Application in Olah Yudha System in Supporting Joint Operation Posko Training at Pusoyu Seskoau

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ABSTRACT

The main goal of TAMG development is to increase the effectiveness of military training by integrating the latest advances in simulation technology. This application is designed to strengthen the strategic and tactical skills of military personnel, particularly in scenarios that require quick decision-making and precise coordination. TAMG development involves a systematic and comprehensive approach. It begins with an in-depth analysis of training requirements specific to air maneuvers and joint operations. Realistic scenarios and adaptive learning features allow users to engage in high-pressure situations that closely resemble actual combat conditions. Insights gained from implementing TAMG indicate that similar simulation technology can be applied across multiple branches of the armed forces, further enhancing overall military readiness and operational effectiveness.

INTRODUCTION

The development of the Tactical Air Maneuvers Game (TAMG) application in the olah yudha system has become a major focus in efforts to improve the effectiveness of military training, especially in the context of joint operation post training. This application promises sophisticated and realistic simulations to support the development of tactical skills, cross-force coordination, and rapid decision-making in modern battlefields (Ilcev, 2019).

In the dynamics of modern warfare, readiness and ability to operate integrated across forces (TNI AD, TNI AL, TNI AU) is crucial to ensure effectiveness in responding to increasingly complex threats (Simon, 2011; Klein, 2013). This integrated operation includes the ability to share information, synchronize strategies, and implement integrated tactics in real time (Otto and Jernberg, 2021). Joint operations command post exercises are designed to test and improve these capabilities through scenarios that require cross-force cooperation (Maqsood, 2020). However, such exercises often require large resources, are time consuming, and involve high logistical complexity (Kurt et al., 2021). The development of the Tactical Air Maneuvers Game (TAMG) application is presented as an innovative solution to simulate war scenarios realistically and interactively, reducing the need for direct physical equipment and personnel, and increasing the efficiency and effectiveness of training (Becmeur et al., 2018; Prakoso and Suhirwan, 2021). With advanced simulation technology, this application can help make decisions faster and more accurately on the battlefield, while minimizing the risk of human error that can impact troop safety (Ilcev, 2019; Simon, 2011; Klein, 2013).

TAMG does not just provide game simulations, but also offers a platform that can simulate diverse and realistic tactical scenarios. Using this technology, soldiers and commanders can train in a safe and controlled virtual environment, without risk to personnel or physical assets. This allows for more frequent and intensive training, with a focus on strategy development, inter-unit coordination, and timely decision-making. (Otto & Jernberg, 2021). The development of the TAMG application represents a significant advancement in the integration of technology into military training. With features such as tactical air movement simulation, air attack control, and coordination between air, sea and land, TAMG allows commanders to test their strategies in realistic scenarios that are close to actual battlefield situations. This not only saves time and money, but also allows for more effective and in-depth learning for military personnel.

This study aims to develop the TAMG application of the Yudha Operation System in improving the effectiveness of joint operation post exercises. By analyzing the implementation and user experience, it is expected to gain a deep understanding of the contribution of TAMG to the formation of optimal tactical decisions and increasing operational readiness between forces. The results of this study are expected to provide a significant contribution to the development of military training strategies in the future.

LITERATURE REVIEW

Simulation Theory in Military Training

Simulation plays an increasingly vital role in the modernization of military training. In addition to providing an environment that approximates real-world conditions, (Kurt et al., 2021) emphasize that simulation allows for repeated training without logistical constraints, which are often a constraint in conventional field training. Simulation allows for significant savings in time and resources, while maintaining high training intensity. In addition, simulation also provides flexibility in setting up training scenarios that can be modified according to the specific needs of each military unit, resulting in more effective and targeted training. Modern simulations equipped with artificial intelligence (AI) can test the tactical and decision-making abilities of commanders in more depth through dynamic and unpredictable training scenarios. These simulations also provide direct feedback to users, allowing for rapid and real-time strategy adjustments. The use of simulation in military training also helps in reducing the risk of injury and loss, especially in high-risk combat training.

Tactical Decision Making Theory

Ilcev (2019) highlighted that in the modern battlefield, rapid tactical decision-making is the key to the success of military operations. TAMG, with its ability to simulate various dynamic scenarios, allows soldiers and commanders to practice decision-making in stressful situations. In addition, this realistic yet safe simulation creates a space to practice different tactics and strategies without the risk of failure that can occur on a real battlefield. Simulations such as TAMG not only provide an opportunity for repetitive practice but also allow for in-depth analysis of various tactical options. In these scenarios, soldiers can test their quick responses to changing situations, evaluate the best options under pressure, and get instant feedback on the effectiveness of their decisions. This not only develops technical skills but also increases their mental resilience and adaptability, which are essential in dealing with unpredictable situations on the battlefield.

Technology Integration Theory in Military Training

The integration of artificial intelligence (AI) in military training further strengthens the adaptability of simulations (Maqsood, 2020). AI can analyze user behavior and decisions during training, then adjust the scenarios to create new, more complex challenges. This ensures that training is not static but evolves as military personnel improve their capabilities. AI also has the ability to integrate big data from multiple sources, allowing simulations based on real-life past scenarios and projections of future conflict trends. Using AI, simulations can provide more immersive and realistic training, where the system learns from user actions and adjusts the complexity of the scenarios. This technology also allows military personnel to face combat scenarios they have never experienced before, preparing them for more diverse and unpredictable situations.

Joint Operation Command Post Training Theory

Cross-service coordination is a major challenge in joint operations exercises. The success of such exercises depends largely on the ability of the various military branches to share information in real time and align their strategies (Simon, 2011). Technologies such as TAMG facilitate more effective communication and coordination between air, ground, and naval forces, allowing them to train in situations that are mimic real joint operations. Successful joint operations require the harmonization of strategies and tactics across military units, often operating with different platforms and objectives. TAMG enables cross-service simulations that demonstrate realistic joint operations scenarios, with features that enable integrated command and control and communications. The technology can also simulate scenarios, such as joint assaults or rescue missions, that require tight coordination between units. With these capabilities, TAMG supports the development of stronger coordination skills between units, thereby strengthening military readiness to face complex and diverse joint operations that reflect modern operational challenges on the battlefield.

METHODOLOGY

This study uses a qualitative descriptive approach to identify and analyze the development needs of Tactical Air Maneuver Game (TAMG) at Seskoau, focusing on the development of 3D displays, real-time object control, and integration of artificial intelligence (AI). The research methods used include interviews, direct observation, and document analysis, which are designed to provide a comprehensive understanding of user needs and weaknesses of existing systems. The following are details of the research methods used:

Interview

Interviews were conducted with the development team, instructors, and learners to gain diverse perspectives on the current TAMG system. Interview questions were designed to explore the need for 3D displays, real-time object control, and the use of AI in simulation. According to (Saldana, 2021), in-depth interviews provide an opportunity to explore complex issues and generate rich data, which is relevant to deeply understanding user experiences and needs related to military simulation systems (Saldana, 2021). The interviews used a semi-structured approach, allowing flexibility in adjusting questions based on participant responses. This technique has been found to be effective in providing space for respondents to share their experiences freely, while also providing an opportunity for researchers to explore unexpected issues.

Direct Observation

The researcher conducted direct observations of the current TAMG system in the training environment. These observations were intended to identify weaknesses in the existing system and understand the user experience firsthand. Observations also helped document the interactions between learners and the software used, as well as the challenges faced in the simulation. As explained by (Merriam and Tisdell, 2016), observation as a data collection technique provides deeper insight into the social and environmental context in which interactions take place. In this study, observation allowed researchers to witness firsthand how participants interacted with the simulation and how the system responded to their commands in a tactical training scenario (Merriam & Tisdell, 2016).

Document Analysis

Document analysis was conducted by analyzing documents related to the TAMG system, such as test reports, user manuals, and training materials. This analysis aims to identify the strengths and weaknesses of the current system. This document analysis also provides additional context that supports data from interviews and observations. According to (Bowen, 2009), document analysis is a method that can enrich researchers' understanding of certain issues, especially in identifying patterns or deficiencies in the system being studied. In the context of this study, document analysis helps assess the effectiveness of the simulation system used and provides additional insight into needed improvements (Bowen, 2009).

Data Comparison

To ensure the validity of the findings, this study uses data triangulation by comparing the results of interviews, direct observation, and document analysis. This comparison aims to identify consistency between data obtained from various sources, so as to increase the credibility of the research results. Data comparison allows researchers to examine the correspondence between user experiences, field observations, and technical documents, providing a more comprehensive picture of the shortcomings and development needs of the Tactical Air Maneuver Game. In this way, the resulting analysis will be more accurate and based on empirical evidence from various perspectives.

Data Analysis

After data collection is done through interviews, observations, and document analysis, the next step is thematic data analysis. Braun and (Clarke, 2006) stated that thematic analysis is an effective method for identifying themes or patterns that emerge from qualitative data, which allows researchers to understand key issues relevant to system development (Braun & Clarke, 2006). In this study, the collected data will be categorized into key themes, such as 3D display needs, real-time object control, and AI. Each theme will be analyzed in depth to identify areas that need improvement and development in the TAMG system.

RESEARCH RESULT AND DISCUSSION

This study aims to develop a Tactical Air Maneuver Game olah yudha system at Seskoau, which involves the development of 3D simulation aspects, real-time object control, and integration of artificial intelligence (AI). Based on the research findings, the following are the results and analysis of the development carried out.

Improvement Simulation 3D

One of the key findings of this research is the urgent need to improve the visual quality of 3D simulations in Tactical Air Combat systems. Maneuver Games. Moment This, appearance graphic Which used in simulation still less realistic and does not provide a sufficiently immersive experience for users. The use of more sophisticated 3D visuals can increase user engagement and create a training environment that is closer to real conditions on the field. Based on interviews with system users, many of them expressed that visualization Which There is moment This No Enough help in understanding tactics in depth. One respondent stated, "We need a more realistic environment, where every unit movement can be seen clearly and in accordance with the actual field conditions." This statement is in line with the literature that emphasizes the importance of 3D visualization in military simulations. For example, a study conducted by (Wang et al., 2019) showed that improving the visual quality in military simulations helps in decision-making. decision Which more effective. Improvement this 3D view also supported by research that emphasizes the importance of realistic visualization in context exercise military for increase understanding user to complex situations (Wang et al., 2019). Therefore, improving 3D graphics is a priority in the development of the Tactical Air Maneuver Game.

Control Objects in general Real- Time

Another significant finding is the lack of real-time object control in the existing system. The current system has limitations in matter interactivity, in where user No can control unit or simulation elements directly in real time. This hampers flexibility and adaptability in tactical training scenarios, which require quick and precise responses from users. Real-time object control is essential in improving the effectiveness of tactical training. Several respondents mentioned that "lack of ability for interact in a way direct with object in simulation making the exercise feel stiff and less relevant to the situation in the field. This is also supported by research (Zhang et al., 2021), which found that real-time control in military simulations improves user response to rapidly changing scenarios (Zhang et al., 2021). Therefore, the development of this feature will allow the Tactical Air Maneuver Game to be more dynamic and interactive.

Real-time control also allows for the integration of tactical movements in real time, where users can change their decisions according to the evolving situation. In simulations without real-time control, users often have to wait until the simulation phase is complete before they can see impact from decision, they, which reduce relevance and the usefulness of the simulation. Therefore, this feature will increase the relevance of training for officers involved in tactical exercises.

Integration Intelligence Artificial (AI)

Wrong One lack significant in system moment this is not yet the presence of artificial intelligence (AI) in simulation scenarios. Users must rely on the scenarios which has set up previously and no can interact with AI-controlled enemies. This limits the complexity of the scenarios and reduces the realism of the simulation.

AI integration will allow enemies in the simulation to react dynamically to decisions made by the user. This will create challenge Which more real for users, which must continuously adapt their strategies based on the actions of the enemy. Several respondents stated that with AI, we can get more challenging and unpredictable training, like in a real battlefield. Research (Chen et al., 2018) also highlights the importance of AI integration in simulations. military, especially in increase adaptability system. In the simulation that use AI, scenario exercise can become more complex, in where enemies can respond with diverse and unpredictable tactics (Chen et al., 2018). AI integration also allows the use of learning algorithms machine For Keep going increase ability simulation along time, which will result in more realistic and challenging training scenarios for users.

Challenge And Limitations

Although the results of this study show great potential in the development of Tactical Air Maneuver Game, there are several challenges and limitations. Which must overcome. Wrong One challenge the main thing is the limitations of technological resources available at Seskoau. The development of 3D graphics, real-time control, and AI integration require sophisticated technological infrastructure, including sophisticated computer hardware. strong and complex software. In addition, there are also limitations in terms of available technical expertise. Developing sophisticated simulations requires collaboration with experts in field graphic computer, programming AI, And design games, Which Possible not always available in the military environment. This requires collaboration with external parties, including the technology industry and academia, to develop a system that fits the tactical training needs at Seskoau. A number of respondents also state that "development technology this requires investment big, Good from aspect time and cost." For To overcome these challenges, long-term planning and adequate budget allocation are required, as well as training for personnel who will manage and use the system.

Analysis Impact

If the development of the Tactical Air Maneuver Game is successful, the impact will be very significant for the effectiveness of training at Seskoau. More realistic and dynamic simulations will improve the quality of training and preparation of officers in facing real field situations. Technology integration new features, such as real-time control and AI, will also enrich the training experience and help users think more strategically and adaptively. Impact other Which can be anticipated is improvement efficiency in training. With simulation Which more advanced, time Which required for arrange practice scenarios will be reduced, and users can focus more on taking decision tactical. Besides That,

system Which more interactive will allow repetition scenario Which more flexible, in where users can direct change tactics, they and see the impact in a way directly without having to restart the simulation from the beginning.

In the long term, this development can also open up opportunities for cooperation with external parties, including the gaming and technology industries, which can contribute to the development of military simulation systems in Indonesia. By adopting the latest technology in simulation, Seskoau can become a pioneer in the use of advanced technology for military training at the regional level.

CONCLUSIONS AND RECOMMENDATIONS

This study highlights the importance of developing the Tactical Air Maneuver Game as a simulation tool for olha training at Seskoau. Using qualitative descriptive methods, this study identified three main aspects that need to be developed: 3D visualization, real-time object control, and integration of artificial intelligence (AI). Each of these elements aims to increase the realism, interactivity, and complexity of training scenarios that are currently still limited in existing simulation systems. Enhanced 3D visualization is seen as essential to creating a more realistic environment, which can enhance officers' understanding of the battlefield and the tactics applied. Real-time object control provides greater flexibility and adaptability, allowing users to respond immediately to changing situations in training, thus approaching real-world conditions on the battlefield. In addition, AI integration is expected to add challenges through simulation. More dynamic and unpredictable enemies, forcing users to constantly hone their strategic skills.

Although this research shows great potential in the development of Tactical Air Maneuver Game, the challenges faced include limited technology and human resources. Therefore, significant investment is needed, both in terms of hardware, software, and technical training for the personnel involved. Collaboration with external parties, such as the technology industry and academia, is also key to realizing a more sophisticated and effective simulation system. Overall, the development of a more interactive, realistic Tactical Air Maneuver Game supported by the latest technology will be very beneficial for improving the quality of tactical training at Seskoau. This will not only improve the readiness of officers in facing the real battlefield, but also strengthen the tactical capabilities of the Indonesian Air Force in facing complex and dynamic situations.

Based on the research results regarding the development of the Tactical Air Maneuver Game at Seskoau, several recommendations can be given to ensure the success of the development of this simulation system:

1. **Improvement of Technology Infrastructure.**

To support the development of 3D display, real-time control, and AI integration, Seskoau needs to improve the existing technological infrastructure. Investment in computer hardware with high graphics capabilities and large-capacity servers is essential. Adequate technological

infrastructure is essential to support AI-based military simulations and complex 3D visualizations (Yuan et al., 2018).

2. Collaboration with Technology Industry and Academics.

Developing advanced simulations such as the Tactical Air Maneuver Game requires collaboration with the technology industry and academia that are experts in military simulation development. Collaboration with universities and technology companies, especially those focused on AI and 3D simulation, will accelerate the development of these systems. Such collaborations have been shown to increase the success of innovative projects in the military sector (Chen et al., 2018).

3. Technical Training and Human Resource Development.

Seskoau must provide adequate training for personnel who will use and manage this system. Special training to learn real-time control and AI programming will help improve personnel's skills in making the most of simulation. Continuous training is also important to maintain sustainable development in the future (Zhang et al., 2021).

ADVANCED RESEARCH

Further research on the development of the Tactical Air Maneuvers Game (TAMG) application on the olah yudha system needs to be focused on digital transformation in supporting the Joint Operations Command Post exercise at the Seskoau Yudha Olah Center (Pusoyu). In-depth studies can be directed at the design of tactical simulations based on realistic, interactive, and adaptive joint air operations scenarios to contemporary threat dynamics. The use of game engine technology, artificial intelligence, and real-time decision modeling allows for simulation of air combat maneuver scenarios that are close to real operational field conditions. The study also needs to explore the integration of TAMG with the C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance) system to hone the command and decision-making skills of training participants. Evaluation of pedagogical aspects, such as increasing understanding of tactics, inter-service cooperation, and the effectiveness of command communication in training are also important focuses. Collaboration with military technology research institutions, academics, and defense simulation software providers will strengthen the development of this system. It is hoped that TAMG can be a training innovation that improves officers' capabilities in facing the complexity of joint air operations, while supporting combat readiness through a modern, efficient and adaptive training approach to developments in defense technology.

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