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LEARNING ABOUT BIRD EDUCATION IN MALAYSIA THROUGH 3D SIMULATION

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Abstract

Bird species are classified as endangered when they are at risk of extinction and unlikely to survive due to various factors that negatively impact their populations. Birds play crucial roles in ecosystems, and their extinction can disrupt the food chain, leading to significant ecological imbalances. This study aims to assess public awareness regarding endangered bird species and their threatened habitats. The findings will provide insights into the impact of this awareness on the conservation of these birds and their environments among the public. A questionnaire was conducted to assess participants' knowledge and awareness on this matter. The questionnaire consists of two parts: a pre-questionnaire administered before the participants play the game, and a post-questionnaire administered after they have played the game. This project employs the Waterfall technique, a development process that is systematic and linear. The model that has been employed on this project is the Game-Based Learning concept. The result showed that the effectiveness of this game was successful after calculated result of evaluation which is 93.34% of improvement and 67.2% of table overview using SGES module. The limitations of this project include a lack of cross-platform compatibility, absence of multiplayer functionality, and support for English speakers only. To address these limitations, future development will be conducted

Keywords: Endangered bird species, Game-Based Learning, Effectiveness

INTRODUCTION

Bird species at risk of extinction play crucial roles in ecosystems, participating in essential ecological functions such as seed dispersal, pest control, and pollination (Şekercioğlu,

2012). The stability and resilience of entire ecosystems are jeopardized when the decline of these birds disrupts these processes. As noted by Spoorthy Raman (Raman, 2023), these birds, which occupy specific niches within environments, face significant threats from habitat loss, fragmentation, and climate change. Their risks are further exacerbated by human activities such as pollution, urbanization, and deforestation. Additionally, unsustainable hunting practices and invasive species pose immediate threats to their survival.

Addressing these challenges requires comprehensive conservation policies that prioritize habitat protection, restoration, and management, along with measures to reduce pollution, control invasive species, and mitigate climate change. Effective conservation of endangered bird species and their habitats demands collaborative efforts among governments, conservation organizations, researchers, and local communities.

In Malaysia, several bird species are endangered due to habitat loss, fragmentation, and other anthropogenic pressures. Notable examples include the Malaysian Plover (Charadrius peronii), the Wrinkled Hornbill (Rhabdotorrhinus corrugatus), and the White-rumped Shama (Copsychus malabaricus). This project aims to develop a 3D simulation to raise awareness about endangered birds in Malaysia and promote their conservation.

Problem Statement

Lack of awareness on endangered bird species

Insufficient knowledge about endangered bird species is a significant challenge due to educational gaps, limited media coverage, cultural differences, and a lack of accessible information. Educational programs often do not cover topics related to endangered species, leading to a general lack of awareness about the importance of these birds for ecological balance. According to Ibrahim et al. (2022), low public awareness is a major factor contributing to species loss. Therefore, closing this knowledge gap is crucial for promoting the conservation of endangered bird species and biodiversity. In Malaysia, many bird species inhabit the country's forests and habitats, but several are now threatened by habitat loss, fragmentation, and other human activities. Conservation measures are necessary to preserve this unique bird diversity. For instance, the Milky Stork is listed as endangered, and the Rhinoceros Hornbill is classified as vulnerable, according to the International Union for Conservation of Nature (IUCN) (Safawi et al., 2023). Many bird species of conservation concern are affected by these problems. Birds are integral to the natural system, playing crucial roles in pollination and seed

dispersal of many plants, especially native ones. They also help control populations of insects, rodents, and other small animals, maintaining ecological balance.

Lack of awareness of habitat fragmentation and its impact on avian biodiversity

As birdwatchers and conservationists recognize the importance of protecting bird habitats, there is a growing need to understand and replicate the natural processes that sustain these ecosystems. Advanced technologies often lead to habitat fragmentation, destroying bird habitats and causing birds to flee. Changes in land use and habitat degradation are major challenges for bird populations. Human activities, especially in agriculture, urbanization, and infrastructure development, threaten the natural environments essential for bird survival and reproduction. Birds often need specific habitats for foraging, nesting, and breeding, so alterations to their native environments can be harmful. Human land-use changes and biological invasions are the primary drivers of global biodiversity changes (Jaureguiberry et al., 2022). According to Tan (W.C. Tan, 2023), a lack of information due to biases can hinder the study of habitat fragmentation and the application of effective conservation strategies. Raising awareness is crucial to addressing these issues. Educational efforts must inform the public, policymakers, and communities about habitat fragmentation and its impacts on bird diversity. Clear communication through media, educational programs, and online platforms is essential to emphasize the importance of protecting entire habitats. This project aims to improve public awareness on this topic.

Project Scope

The project aims to develop an accessible and effectiveness educational initiative targeting the general public, specifically individuals aged 16 to 33 years old, leveraging a multi-platform approach centred around endangered bird species and their habitats. The game will be developed in the Malay language to relate to the various and unique cultures in Malaysia. The game will be designed in a game engine that focuses on Personal Computer (PC) users to provide broader access to the game. The content for the interactive game will draw from information provided by PERHILITAN Malaysia, the Department of Wildlife and National Parks. It will be presented in a visually and easily digestible format, incorporating gamified elements, quizzes, and interactive features to make learning and raise awareness about endangered bird species enjoyable for a broad audience. The game's structure will be based on

3D, and the bird models will be in 3D, allowing users to look around the bird in a display view when they interact with the bird. Within these environments, they will encounter some of endangered bird species, including those documented by PERHILITAN Malaysia, such as the Wrinkled Hornbill, Malaysian Plover, and White-rumped Shama. Users will have control to move around, view the surroundings, and search for the bird. Questions will be 6 asked at the end of the walkthrough to test the user's understanding of the birds that have been encountered. Throughout the experience, reference materials from PERHILITAN Malaysia will be cited to ensure accuracy and credibility of the information presented. By leveraging interactive technology and authoritative sources, the game aims to raise awareness and promote conservation efforts for endangered bird species in Malaysia in an educational manner.

Project Significant

This project is significant for its potential to use bird viewing games as educational tools, teaching about bird species, their behavior, and the importance of bird conservation. These games can enhance player knowledge, boost environmental awareness, and foster a greater appreciation for nature. The gamified elements and interactive features are designed to educate and inspire a sense of wonder about bird diversity. Bird viewing games can raise public awareness of conservation issues such as habitat loss and climate change. By highlighting these concerns, players may become advocates for bird conservation and support efforts to protect avian species. As the project gains momentum, it aims to inspire real-world action, promoting sustainable practices and conservation initiatives. Ultimately, this initiative hopes to protect threatened bird species and their habitats by educating and empowering the public.

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LITERATURE REVIEW

Bird

The status of threatened bird species in Malaysia raises significant concerns about the conservation of avian biodiversity in the country. Malaysia is home to 63 bird species classified as Threatened, 109 species categorized as Near Threatened, and several others considered Least Concern, along with one species marked as Data Deficient (BirdLife International, 2020). To lessen these risks and preserve the rare bird species that are found in Malaysia, conservation initiatives are essential. It is crucial to implement programs that emphasize protecting natural areas, strictly prohibiting the trafficking in illicit wildlife, and involving the public in conservation efforts. One of the initiatives is by this project to raise the awareness of general public about the conservation of endangered bird species that might affect the ecosystem life cycle. According to Tan Yin Lin (2023), state that Dr Yong Ding Li, flyways coordinator at Birdlife International Asia flyways coordinator at Birdlife International Asia says "People cannot talk about the conservation of migratory birds if they do not even know what migratory birds do, or what migratory birds are suffering from. The game offers people a very innovative way of learning."

3D Design

3D design is the process of using software to create digital models with three dimensions. It is used in various fields such as idea communication, product creation, education, and video game production. In 3D design, objects are created and manipulated using points, edges, vertices, lines, and polygons. Popular software for 3D design includes Blender, Autodesk, and SketchUp, which offer tools for creating, sculpting, texturing, animating, rendering, and adding visual effects to objects. This skill can be learned through online courses and tutorials (Coursera, 2023).

With advancing technology, 3D design software is continually improving, especially in rendering techniques like ray tracing, which enhances realism with better lighting and reflections. Artificial intelligence has also entered the 3D design field, making model creation easier and faster for professionals and reducing the learning curve for beginners. This has made the creative process and turning ideas into reality more accessible (Mohammad Usman Khan, 2023).

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Game Based Learning

Game-based learning refer to educational approach that integrates games and game-like elements into the learning process. Game-based learning aims to enhance education by capitalizing on the engaging and interactive nature of games. In this approach, educational content seamlessly integrates into games, simulations, or interactive activities, capturing learners' attention and encouraging active participation. Games also introduce challenges and structured progression, keeping player motivated. According to Annie (Annie Pho, 2015), research also strongly indicates that learning through games can enhance the learning process. Besides that, game-based learning can be applied to real-life environment to engage player into cycle of probing that need to think strategies. Higher-order thinking skills such as critical thinking and problem solving can be evaluated by observing the progress (Kaya, 2010).

Benefit Game Based Learning

Game-based learning offers significant advantages for both play and learning experiences. One of the key strengths lies in its innate ability to captivate and sustain learners' interest, creating an engaging and interactive learning atmosphere. Games should be designed to ensure that the students can repeat the cycles within the game context without becoming bored while inspire intrinsic motivation, prompting learners to actively participate and persist in their educational endeavours. Bundick et al. (2014) argue that despite the common perception of video games as mere pastimes in contemporary society, research has shown that game-based learning offers numerous positive attributes. Sandbox games stand out as a prime example of gaming environments that nurture decision-making skills. These games involve players guiding avatars through virtual worlds, providing them the freedom to explore and make choices (Adipat et al., 2021). This type of games could teach the player to make independent decisions based on the player quick thinking. The player might choose the bad decisions but the player could learn from it and could avoid it in the future.

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METHODOLOGY

Waterfall Methodology

This project adopts the Waterfall design method, a linear and sequential software development approach characterized by its structured and phased development process. In the Waterfall model, the development cycle follows a rigid sequence of stages, with each phase building upon the outputs of the preceding one. The development process initiates with detailed documentation and extensive planning at the inception of the project. Following this, each phase, including requirements collection, system design, implementation, testing and maintenance. The Waterfall model is known for its systematic and well-defined stages, making it suitable for projects with clear and stable requirements. According to Senarath (2021), "each stage in the growth process must be completed before the next one begins. In the waterfall model, the phases are sequential and do not occur simultaneously". The waterfall model prioritizes well-defined documentation and sets outcomes at every phase. It offers a systematic structure for development, concentrating on a straight progression from beginning to end. Figure 1 show the waterfall methodology process.

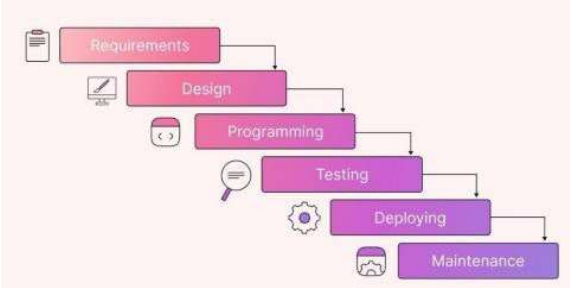

Figure 1: Waterfall Methodology

Requirement Phase

The requirement phase is fundamental in the Waterfall methodology as it lays the foundation for the project. According to Laoyan (2021), the Waterfall methodology requires thorough initial pre planning due to the interdependence of tasks on previous steps. This focus on the planning phase is crucial to the Waterfall model, leading to a large part of the project timeline being dedicated to planning. During this phase, the project team collects, analyses, and documents the specific requirements for the expected software system. Initial steps involve obtaining stakeholder information through methods such as workshops and interviews to

understand their requirements and expectations. The collected requirements are to resolve any ambiguities or discrepancies, ensuring alignment with the overall project goals. By precisely outlining these requirements, there will be a clear comprehension of the features that need to be incorporated to satisfy the player's needs. The requirement phase for this project is an activities literature review encompassing bird overview, habitat, 3D technology and simulation, game-based learning, and the three models that have been reviewed. The deliverable includes all the information that has been reviewed and serves as background research to guide the subsequent phases of the project.

Design Phase

The design phase is the second stage that follows the requirements phases. This phase involves creating a visual representation of how the game interface will look. According to Andersen (2023), this phase includes detailed information about how the system will be constructed, encompassing elements like data structures, software architecture, interface designs, and additional components. During the design phase of this project, the emphasis will be on formulating a comprehensive plan and framework for executing the educational initiative. This includes creating a low-fidelity storyboard that provides an initial, simplified depiction of the visual and interactive components of the project. The low-fidelity storyboard acts as a basic visual reference, delineating the order of scenes, interactions, and educational material. Moreover, a flowchart will be constructed to illustrate the logical flow and connectivity between different components within this project. Figure 2 show the flowchart of project

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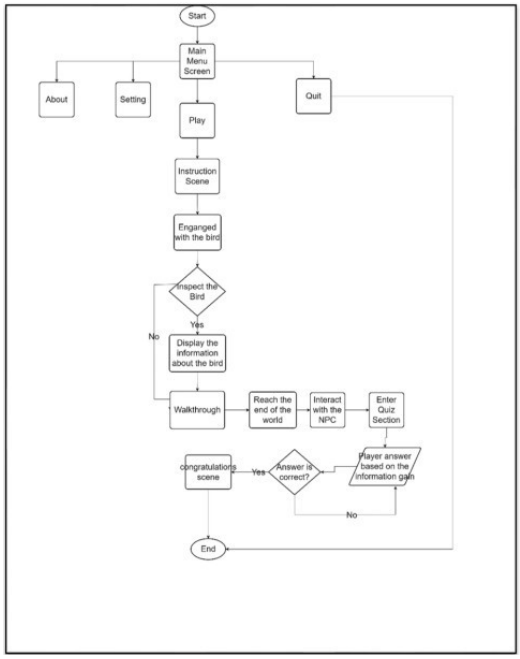

Figure 2: Flowchart of project

Implementation Phase

In the Waterfall methodology, the implementation phase is the third stage that follows the requirements and design phases. This phase encompasses the practical aspects of coding, construction, and the development of a 3D simulation for bird education, based on the finalized design for this project. Standards coding is crucial in ensuring the functionality, maintainability, and scalability of the software. Ongoing refinement actions are deemed necessary to enhance the overall polish of the game during this developmental phase. Thorough testing is essential during the implementation phase, which includes unit testing to examine each component, integration testing to assess their collective functionality, and system testing to confirm the overall performance of the system. There is a few software that will be used to develop this project that will discuss the hardware requirements.

Testing Phase

During this phase, a comprehensive evaluation will be conducted to ensure the game meets its objectives. This is crucial to verify the learning outcomes are effectively delivered to users. The testing process includes several stages, starting with unit testing to ensure individual components function correctly. The project's effectiveness will be assessed using the Serious Game Effectiveness Scale (SGES), focusing on learning effectiveness, realism, goal clarity,

and adequacy of learning material. To measure the game's impact on raising awareness and educating users about endangered bird species, pre- and post-evaluation tests will be conducted with participants aged 16 to 33. The pre-evaluation will assess their initial knowledge and awareness of endangered birds and conservation efforts. After playing the game, the post-evaluation will measure any changes in their understanding and attitudes towards bird conservation. This approach will determine the game's educational value and effectiveness. By comparing pre- and post-evaluation results, improvements in knowledge and awareness will be highlighted, helping to refine the game's content and approach. Feedback from the SGES questionnaire will identify areas for enhancement, ensuring the game remains engaging, educational, and effective in promoting bird conservation.

Deploying Phase

During this phase, the game is ready to be published and released once the entire functional system is obtained and tested once all of the modules have been successfully merged and tested. Deployment requires careful planning to ensure it's working as expected from development to practical application, including considerations for user training, support systems, and monitoring for any unforeseen issues that may arise in the live environment.

Maintenance

The maintenance phase is the final stage for this project after the game has been deployed. This phase is where continuous monitoring and updates are provided to ensure the continued smooth functioning of the game. This involves addressing any issues that may arise, making improvements, and adapting to changes or advancements in technology. The objective of this phase for this project is to maintain the game's usefulness and relevance throughout time.

RESULT AND DISCUSSION

Effectiveness Evaluation

The third objective of this project was to evaluate the effectiveness of the 3D simulation game in raising awareness about endangered bird species. The effectiveness of the educational game created for this project will be evaluated using the Serious Game Evaluation Scale (SGES). This scale is intended to examine many features of serious games in order to provide a thorough evaluation of the effects these games have on users. Perceived goal clarity,

perceived realism, perceived effectiveness of learning, and perceived appropriateness of the learning materials are among the characteristics taken from Emmanuel et al.'s (2019) SGES. These elements will function as markers for assessing how well the game achieves its stated objectives. These variables will be computed to assess the project's overall effectiveness at the conclusion of the evaluation. is an example equation created with Word's Equation Editor. To move this equation, highlight the entire line, then use cut and paste to the new location. To use this as a template, select the entire line, then use copy and paste to place the equation in the new location.

Pre-Evaluation

For the pre-test evaluation, a Pre-Test Questionnaire was distributed to 30 participants, but only 22 responses were received. These questionnaires were designed to assess the participants' level of awareness regarding endangered birds before playing the game. Participants were required to answer questions related to endangered birds, including their names, habitats, and threat levels. The questionnaire utilized a score scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) to gauge the participants' knowledge about endangered bird.

Post-Evaluation

For the post-evaluation, the same participants from the pre-evaluation responded. The participants completed the post-evaluation after playing the game. This was done to assess whether their knowledge had increased and to determine if the project's objectives had been met the post-evaluation the same responded from pre-evaluation were responded. The user answers the post-evaluation after user playing the game. This is to test if the knowledge user is increase and to know if the objective has been delivered.

Overall Finding

Based on Table 1 show the result overview of post evaluation SGES which is 67.2%. The calculation of Table 1 was calculated from data collected question that calculate the overall of each perceived section. This data proves that the game successfully raised awareness about endangered bird species, meeting the project's goal.

Factor	Mean
Perceived Learning Effectiveness	4.05
Perceived Realism	3.42

Perceived Goal's Clarity	3.86
Perceived Adequacy of the Learning Material	2.11
Total Average	3.36
% of Total Average	**67.2**

CONCLUSION (HEADING 1)

The project has successfully met the objectives outlined in the initial chapter. Its primary goal was the creation of a specialized 3D simulation game aimed at educating users about endangered bird species in Malaysia. Subsequently, the project assessed the game's effectiveness in enhancing awareness of these species. The SGES questionnaire was employed to evaluate this aspect. The evaluation process proceeded smoothly, confirming the project's achievement in providing a virtual platform that integrates gaming mechanics to enhance learning and raise awareness about endangered bird species.

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