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Utilization of Image Tracking for Recognizing Local Animals of Timor-Leste with AR Technology

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ABSTRACT

Timor-Leste as a country adapting to technology aims to better introduce its local animals to users. The purpose of this research is to utilize augmented reality (AR) technology as a tool to provide more engaging information to users. The method used is augmented reality as an interactive tool that helps deliver information to users in two-dimensional (2D) or three-dimensional (3D) formats. This allows users to receive the presented information for decision-making and evaluation of completed work while advancing the development of application systems designed for local animals based on technology in Timor-Leste. Based on the results achieved, to educate primary school children about Timor-Leste's local animals, books about these animals have been published. To make the presentation more engaging and interactive for students, an application for recognizing Timor-Leste's local animals based on augmented reality (AR) has been implemented on the Android platform. The data align with previous research on book media and augmented reality media. The purpose of this measurement is to evaluate how engaging and interactive both media are in introducing Timor-Leste's local animals to primary school children.

Keywords: local animals of Timor-Leste, augmented reality, android platform

I. INTRODUCTION

The Democratic Republic of Timor-Leste (also known as Timor Lorosa'e), previously known as East Timor before its independence, is a small nation located north of Australia and to the east of the border with Indonesia. In addition to the mainland, its territory includes Atauro Island, Jaco Island, and the Oecussi-Ambeno enclave in West Timor. Timor-Leste was internationally recognized as an independent country on May 20, 2002, with Dili as its capital.

To safeguard the nation's education, Timor-Leste established primary schools, or Ensino Básico, under the Ministeriu Edukasaun Juventude no Desportu (MEJD), which is the governmental body responsible for protecting the country's education. MEJD's current activities include gathering information on Timor-Leste's education system and creating educational books.

To further introduce Timor-Leste's local animals to users, this research utilizes augmented reality (AR) technology as a tool to provide more engaging and informative content. Augmented Reality serves as an interactive tool that delivers information in 2D or 3D formats, enabling users to receive and act on the provided information ([1] Liu & Seipel, 2017). AR has been widely applied across fields such as healthcare, military, entertainment, engineering, robotics, and customer design, and its benefits are increasingly evident on smartphones ([2] Silva, Oliveira, & Giraldi, n.d.).

Giles Westerfield et al. in their paper titled "Intelligent Augmented Reality Training for Motherboard Assembly" demonstrated the use of AR for providing step-by-step tutorials on assembling motherboards effectively ([3] Westerfield, Mitrovic, & Billinghurst, 2015).

Erkan Bostanci, in his study titled "Augmented Reality Applications for Cultural Heritage Using Kinect", explored the use of Kinect sensors for AR applications in cultural heritage ([4] Indriani, Sugiarto, & Purwanto, 2016).

Riana Indriani et al. developed an Android-based AR application using the AR Vuforia library to assist early childhood education in recognizing animals. Krevelen & Poelman (2010) demonstrated how AR is utilized in sports for facilitating training and managing competitions in a fair and engaging manner. In the medical field, AR supports imaging processes such as ultrasound imaging, enabling ultrasound technicians to view volumetric images of a fetus with optical overlays.

A. AR Image Tracking Technology

The AR system employs Vuforia SDK, which detects and tracks natural features in an image by comparing them to a predefined database. Unlike traditional markers such as matrix codes or QR codes, Vuforia image targets do not require specific black-and-white regions for recognition. Once the image target is detected, the Vuforia SDK continues to track the image as long as any part of the marker remains visible to the camera ([6] Indriani et al., 2016). This capability allows AR to display layered volumetric images effectively, making it a versatile tool for various applications.

II. THEORY OF LOCAL ANIMAL RECOGNITION IN TIMOR-LESTE USING AR TECHNOLOGY

Several sources and related literature used in this writing are based on previous research, serving only as references, comparisons, and guidance for this study. Some of the previous studies conducted include:

According to Marlena (2016) [7], woven fabric is the interweaving of two different threads with distinct patterns woven vertically and horizontally. In her study titled "Carrying Traditional Legacy to Modern Efficiency"

[8] (Marlena, 2016), this research discusses how to introduce diverse traditional weaving forms from various regions in Indonesia to the modern global fashion world. Another study, "Desde os Primórdios à Contemporaneidade," discusses the development of Timor-Leste's Tais weaving over time, which was nearly forgotten, and the efforts made by the government to preserve it [9] (Ximenes, 2012).

Another study, "Perancangan Game Kartu Interaktif Berbasis Android Menggunakan Augmented Reality," discusses how to design a card game on Android smartphones that is more interactive and engaging by utilizing Augmented Reality (AR) technology [10] (Chowanda, n.d.).

Similarly, the study titled "Perancangan Augmented Reality Untuk Peta Topografi" discusses designing a learning system about the Earth's surface that is easier, more interactive, and engaging through 3D features combined with Augmented Reality technology. This study uses analysis and design methods, with the output being an Augmented Reality-based topographic map application [11] (Yosanny, Ismail, & Said, n.d.).

III. METHODOLOGY

In this study, the author will conduct research at the Direksaun Ensino Basico Dili Timor Leste office to analyze the process of introducing education in Timor-Leste within the institution. This research follows four stages: the initial research phase, data collection and processing phase, system development phase, and the conclusion and recommendation phase.

Additionally, an evaluation will be conducted on the current media used for introducing Timor-Leste's local animals, comparing it with the introduction media using the Augmented Reality (AR) approach. The final stage involves drawing conclusions as an evaluation method and summarizing the work performed, while providing insights for further system development based on the research diagram for subsequent phases.

A. System User Identification

To identify what needs to be done, required, and desired by users and the system for introducing animals in Timor-Leste, a thorough system requirements analysis is essential. This ensures that the application meets user needs and supports its objectives effectively. The analysis includes hardware and software requirements as follows:

i. Hardware Requirements

To ensure the system operates smoothly and performs adequately, the following hardware components are necessary:

1. **PC (Personal Computer)**
2. **Processor**: Intel Core i7
3. **RAM**: 16 GB

4. **Storage**: HDD with 500 GB capacity

ii. Software Requirements

The following software is required to support the development and operation of the application:

1. **Operating System**: Windows 10
2. **Vuforia**: For augmented reality functionality and image tracking.
3. **Unity 3D**: As the platform for application development and 3D modeling.
4. **Android SDK**: For building and deploying the application on Android devices.

By fulfilling these requirements, the system will be equipped to meet the desired performance and user expectations in delivering an interactive and engaging animal recognition experience using AR technology.

B. Process and Designing Interaction for the Application

In this context, the design of the application to be developed will be illustrated, focusing on the **Home Layer** layout and its functions, which will later assist in the design phase of the **Timor-Leste Local Animal Recognition Application** using AR technology. The system requirements included in the application will follow the **Prototyping Model** design method. The **Prototyping Model** is a process used to build a system model based on user needs.

C. Experiment Results and Usability

Augmented reality is a technology that can be utilized as a medium for introducing animals. Generally, augmented reality applications still rely heavily on specific markers. With these markers, the application depends on their availability, as AR objects can only be displayed when the marker is present. In this project, the application is designed using a markerless user-defined target method. The design process of the augmented reality application uses the Unity software. The development begins with gathering data on animals, obtained from assets available in Unity, as part of the analysis for evaluating the implementation results.

For evaluation, the questionnaire method is employed in two forms: open-ended and closed-ended questionnaires, to assess the research objectives.

The next process involves utilizing a Likert scale, which represents a gradient from negative to positive levels, with each scale point assigned a specific value. Respondents can and will only select one level from the given scale options.

IV. FINDING AND DISCUSSION

To provide education about local animals of Timor-Leste to elementary school children, books featuring Timor-Leste's local animals have been printed. To make the material more engaging and interactive for students,

an augmented reality (AR)-based application for recognizing Timor-Leste's local animals has been implemented on the Android platform.

A. Designing an AR Application

This AR application is designed for Android-based devices using Android Studio version 2022.1.1.20 for Windows. The application is developed with the Mono Editor as the Integrated Development Environment (IDE), utilizing Unity 3D Pro X64 Version Unity 2017.1.0p5 (64-bit). Vuforia is the framework used as the library for the development of this AR system.

B. Workflow Marker Based Tracking

The results applied to Android as part of the workflow for marker-based tracking are illustrated in the following image (to be provided). This workflow showcases the process of identifying markers and displaying AR content, enabling a seamless interaction between the physical and virtual environments on Android devices.

Steps for Creating Animal Object Markers and Uploading Them to the Vuforia Database

a. Creating Markers

The marker creation process involves using the mobile phone camera to display 3D objects on the mobile screen. After creating the marker, it can be utilized in **Unity 3D Pro X64 Version Unity 2017.1.0p5 (64-bit)** to produce the final design.

b. Vuforia Testing Results

The application testing process using **Unity 3D Pro X64 Version Unity 2017.1.0p5 (64-bit)** and **Vuforia** involves downloading the application from the website **http://developer.vuforia.com**, then installing it on a smartphone. The steps are as follows:

1. **Testing in Unity 3D:**
    - Open Unity 3D and press the **Play** button to test the application.
    - Log in using your Vuforia account credentials. If you do not have an account, register for a new one.
2. **Uploading Markers to the Vuforia Database:**
    - Access the Vuforia Developer website at **http://developer.vuforia.com**.
    - Log in and go to the **Target Manager** section.
    - Create a new database or select an existing one.
    - Upload the marker object by clicking **Add Target**.
    - Specify the marker type (e.g., image target), size, and name.

- After uploading, Vuforia processes the marker and provides a tracking ID.

Design dan Coding

Next, the application design and coding are carried out using **Unity3D**.

Based on the research and testing results, this AR application is designed for Android-based devices using **Android Studio version 2022.1.1.20 for Windows**. After testing, the results were obtained based on questionnaire responses. The highest score for **"Strongly Agree"** is **5 x 20 = 100**, while the lowest score for **"Strongly Disagree"** is **1 x 20 = 20**.

If the total respondent score reaches 100, the interpretation of the respondents' evaluation of the application is calculated using the **Index Percentage Formula**:
Index % = (Total Score / Y) x 100

According to the percentage calculation, the average score from the respondents is **95%** out of a total of **20 respondents** who selected **"Strongly Agree"** and **"Agree."**

This percentage indicates that 20 respondents consider the application to be of high quality, as determined by the survey and calculated using the formula above.

V. CONCLUSION

Based on the research results on the Augmented Reality (AR)-based Timor-Leste animal recognition application, it received very positive responses. The AR application has several advantages, as it can display digital information in the form of 3D models, text, sound, and animations.

The strengths of this AR application lie in its ability to introduce Timor-Leste's animals in a more engaging and interactive way to its users. Evaluation results indicate that users are more interested in the development of AR applications.

From the evaluation and testing conducted, it can be concluded that the AR-based Timor-Leste animal recognition application is more engaging and interactive compared to traditional book-based media.

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