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Animal Knowledge Application with Augmented Reality Technology

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ABSTRACT

The Animal Knowledge Application with Augmented Reality Technology is a learning support application on the theme of animals for early childhood. This application utilizes augmented reality technology, which displays a real environment combined with three-dimensional or two-dimensional virtual objects that are displayed in real-time. This research aims to build an Animal Knowledge Application with Augmented Reality Technology. This Animal Knowledge Application with Augmented Reality Technology uses the MDLC (Multimedia Development Life Cycle) method. The results of this study include animal recognition applications utilizing 3D objects, which employ mobile-based Augmented Reality technology on the Android operating system. These applications can display 3D animal objects, accompanied by audio explanations. Based on the results of application functionality testing, each function in the application runs according to the expected results. Application testing is also carried out on several devices, and the result of the test is that the application on the smartphone being tested can run smoothly according to features, and the appearance of the application adjusts to the resolution of every smartphone.

Keywords: Augmented Reality, Application, Animal, MDLC, 3D

INTRODUCTION

Augmented Reality is a technology that displays a view of the real world environment combined with three-dimensional or two-dimensional virtual objects that are displayed in real time. With the development of technology in the field of education as a medium or support for learning, this can be used to build an animal recognition application using mobile-based Augmented Reality in an effort to

create interesting learning, make it easier to introduce animals that are difficult to find in the surrounding environment, and improve the quality of learning.

The rapid development of digital technology has significantly transformed the way knowledge is acquired and disseminated. In particular, Augmented Reality (AR) has emerged as an innovative tool that integrates virtual content with real-world environments, providing users with interactive and immersive learning experiences (Azuma, 2017). AR applications have been widely implemented in various educational contexts, ranging from science and engineering to cultural heritage and medical training (Bacca et al., 2014; Garzón & Acevedo, 2019). Within this spectrum, the potential of AR to enhance understanding of animal knowledge is promising, as it can bridge the gap between abstract information and real-life visualization.

Despite these advances, a key challenge remains in how animal knowledge, covering taxonomy, behavior, and habitat, can be effectively delivered to learners. Traditional methods such as textbooks, videos, and static illustrations often fail to stimulate learners' engagement and critical interaction with the subject matter (Yilmaz, 2020). This limitation reduces students' motivation and results in superficial rather than meaningful learning. The absence of an interactive and engaging medium hinders the ability to contextualize animals within their natural environment, which is crucial for developing both scientific knowledge and environmental awareness.

Although AR has been widely explored in education, most studies have concentrated on general science, mathematics, language learning, or engineering applications (Bacca et al., 2014; Ibáñez & Delgado-Kloos, 2018). In biology-related learning, AR implementations remain limited, often focusing only on basic visualization such as anatomical structures or general biological concepts (Santos et al., 2014). Meanwhile, animal knowledge education is still predominantly delivered through traditional methods such as textbooks, static illustrations, and videos, which often fail to capture learners' engagement and provide interactive experiences (Yilmaz, 2020). This situation creates a gap in the availability of domain-specific AR applications that not only visualize animals but also integrate their behaviors, habitats, and sounds in an immersive learning environment. Furthermore, empirical studies assessing the impact of AR on learning animal-related knowledge are still scarce.

Addressing this gap, the present study proposes the Animal Knowledge Application with Augmented Reality Technology, which introduces an innovative approach to learning about animals by combining multimedia interactivity with AR features. The novelty of this research lies in the design and implementation of an application that not only visualizes three-dimensional animal models but also contextualizes their behavior, sound, and habitat through AR. This integrative approach provides a more holistic learning experience compared to conventional methods or existing AR applications.

This study proposes the Animal Knowledge Application with Augmented Reality Technology, which introduces an innovative approach to learning about animals by combining multimedia interactivity with AR features. The novelty of this research lies in the design and implementation of an application that not only visualizes three-dimensional animal models but also contextualizes their behavior, sound, and habitat through AR. This integrative approach provides a more holistic learning experience compared to conventional methods or existing AR applications.

The main objective of this research is to develop and evaluate an AR-based application that enhances users' understanding of animal knowledge interactively and engagingly. Specifically, the study aims to (1) design an AR application that presents comprehensive animal-related information;

(2) assess its effectiveness in improving learner engagement and knowledge acquisition; and (3) contribute to the body of research on the use of AR in domain-specific education.

METHOD

Data Collecting Techniques

- Observation:
  Studying and observing directly at the research location, namely at GMIM Solafide Uner Kindergarten.
- Interviews:
  Conducting question and answer sessions with teachers at GMIM Solafide Uner Kindergarten regarding the application to be made.
- Literature Study:
  Collecting theories from previous research sources, such as books, journals, or articles, and other information from the internet that can help with the research to be carried out.

System Development Method

The system development method used is the Multimedia Development Life Cycle (MDLC) Method. MDLC is a method that can be used for the design and development of multimedia applications where the application is a combination of sound, video, animation, image, text, and so on. The stages of MDLC can be seen in Figure 1.

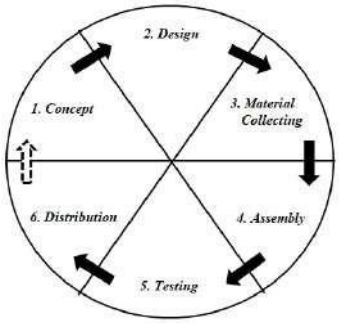


Figure 1. Metode Multimedia Development Life Cycle

- Concept:
  Determining the purpose, who will use it, and the needs of the system to be created.
- Design:
  Describing the appearance of the application to be created in detail.
- Material Collecting:
  This stage involves collecting or creating the materials needed for the application.
- Assembly:

This is the coding or application creation stage.

- Testing:
  The system testing stage is to see whether the application functions as expected.
- Distribution:
  Distributing/disseminating the application.

RESULTS AND DISCUSSION

Concept

This stage determines the purpose of the application to be created, and who will use it, as well as the needs of the system to be created. This stage can be seen in Table 1.

Table 1. Concept

Category	Description
Title	Animal Knowledge Application With Augmented Reality Technology
Purpose	supporting the learning process of early childhood and to help teachers create interesting learning, making it easier to introduce animals
Application name	Get to know animals
Multimedia type	Interactive and informative learning media for animal recognition using Augmented Reality technology
Platform	Mobile with Android operating system
Target users	Early childhood
Graphics	2D and 3D
Audio	Backsound, audio effect, animal sounds, information sounds. with (.wav and .mp3) format

Design

This stage is the stage of designing the scene display using wireframes, mockups, and storyboards, as well as determining the links for each scene using a hierarchy menu and creating an application flowchart.

1) Wireframe

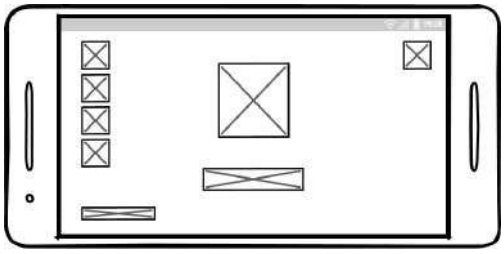


Figure 2. Wireframe Main Page

The display in Figure 2 is the Wireframe design display of the application's main page.

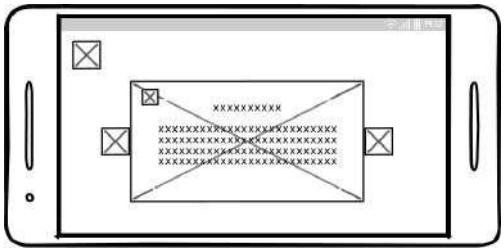


Figure 3. *Wireframe* Material Page

The display in Figure 3 is the Wireframe design display of the material page.

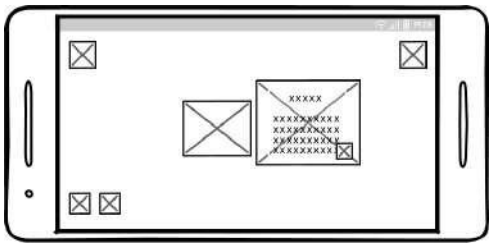


Figure 4. *Wireframe* AR Feature

The Wireframe design display of the AR Camera Feature can be seen in Figure 4.

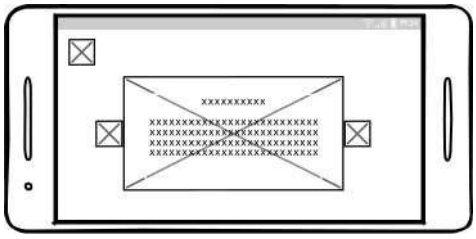


Figure 5. *Wireframe* Info and Help Page

The Wireframe design display of the help and information page can be seen in Figure 5.

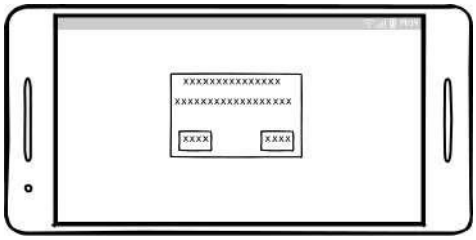


Figure 6. *Wireframe* Exit Page

The Wireframe design display of the application exit page can be seen in Figure 6

2) Mockup

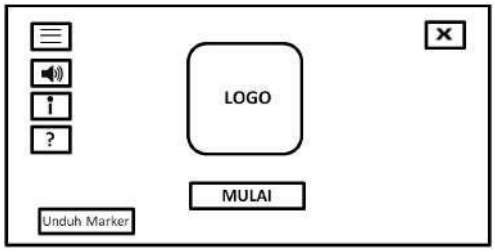


Figure 7. *Mockup* Main Page

The display in Figure 7 is the mockup display of the main page. There is an application logo image, a landscape image as a background, a menu button, sound, "i", "?", download marker, "X", start, and application background music.

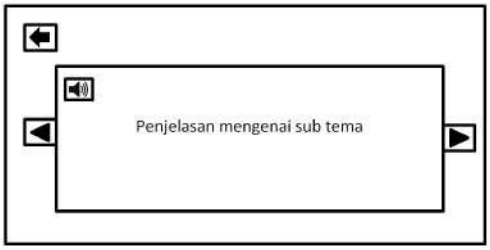


Figure 8. *Mockup* Material Page

The display in Figure 8 is the mockup display of the material page. There is an explanation text about the sub-theme, an image of the marker from the selected sub-theme, there are sound buttons, "<", ">", and back.

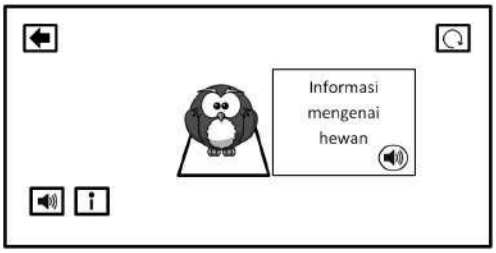


Figure 9. *Mockup* AR Feature Page

The display in Figure 9 is the mockup display of the AR Camera feature, where the marker is detected, a 3D animal object will appear, an info board containing information about the animal, and sound buttons, “i”.

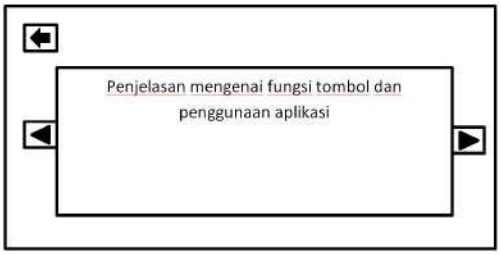


Figure 10. *Mockup* Info and Help Page

The display in Figure 10 is the mockup display of the help and information page, which contains an explanation of the use of the application and application information. There are “<”, “>” buttons, and back.

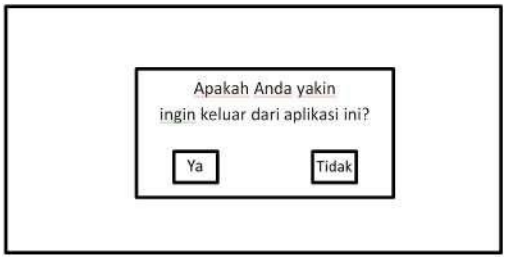
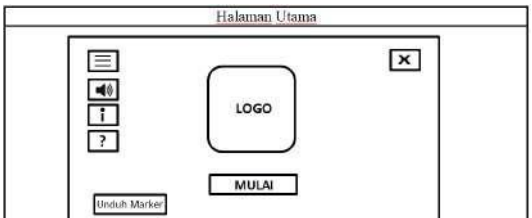


Figure 11. *Mockup* Exit Page

The display in Figure 11 is the mockup display of the application exit page; there is a text ”Are you sure you want to exit this application?”, and there are "Yes" and "No" buttons. *3) Storyboard*



Gambar	Pemandangan alam, Logo aplikasi, Gambar setiap tombol,
Suara	Musik latar belakang
Text	-
Animasi	logo aplikasi
Warna	-
Tombol	Tombol menu, Tombol suara, Tombol “i”, Tombol “?”, Tombol “x”, Tombol unduh marker, Tombol mulai

Figure 12. *Storyboard* Main Page

Figure 12 is the storyboard display of the main page.

Notes for the main page :

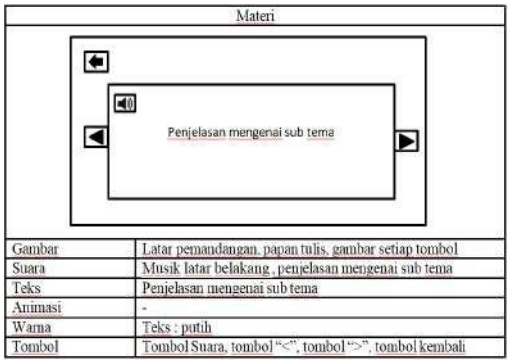
The "Start" button is used to display the sub-theme selection menu.

The "sound" button is used to turn off or turn on the application's background music.

The 'i' button is used to display the information page, which contains information about the developer and the application.

The '?' button is used to display the help page.

The "Download marker" button is used to open a link to download the marker. The 'x' button is used to display the application exit page.



Gambar	Latar pemandangan, papan tulis, gambar setiap tombol
Suara	Musik latar belakang , penjelasan mengenai sub tema
Teks	Penjelasan mengenai sub tema
Animasi	-
Warna	Teks : putih
Tombol	Tombol Suara, tombol "<", tombol ">", tombol kembali

Figure 13. *Storyboard* Material Page

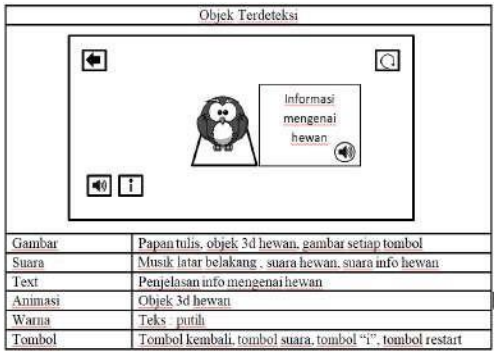
Figure 13 is the storyboard display of the material page.

Notes for the material page :

The "sound" button is used to play the sound explanation of the sub-theme.

The ">" button is used to move to the next material display.

The "<" button is used to move to the previous material display. The "Back" button is used to display the sub-theme menu page.



Gambar	Papan tulis, objek 3d hewan, gambar setiap tombol
Suara	Musik latar belakang , suara hewan, suara info hewan
Text	Penjelasan info mengenai hewan
Animasi	Objek 3d hewan
Warna	Teks : putih
Tombol	Tombol kembali, tombol suara, tombol "i", tombol restart

Figure 14. *Storyboard* AR Feature Page

Figure 14 is the storyboard display of the AR Camera Feature.

Notes for AR feature :

The "restart" button is used to reload the AR camera page.

The "back" button is used to return to the sub-theme menu page.

The "sound" button is used to play the sound of the animal that appears.

The "i" button is used to show and hide the info board.

The sound button on the info board is used to play the info sound of the animal.

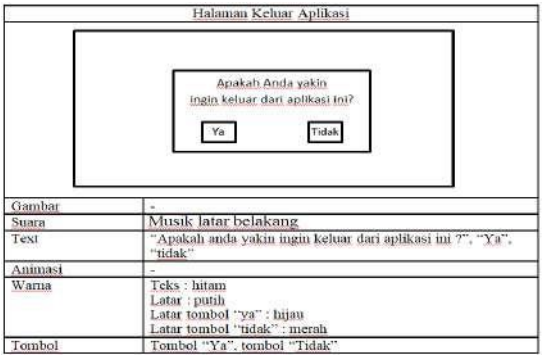
Gambar	Latar pemandangan ,papan tulis, gambar setiap tombol
Suara	Musik latar belakang
Text	Penjelasan mengenai penggunaan aplikasi
Animasi	-
Warna	Teks : putih
Tombol	Tombol kembali, tombol "<", tombol ">"

Figure 15. *Storyboard* Help Page

Figure 15 is the storyboard display of the help page.

Notes for help page :

The "back" button is used to return to the main page.
The “>” button is used to display the next help page.
The “<” button is used to display the previous help page.



Gambar	-
Suara	Musik latar belakang
Text	"Apakah anda yakin ingin keluar dari aplikasi ini ?", "Ya", "tidak"
Animasi	-
Warna	Teks : hitam Latar : putih Latar tombol "ya" : hijau Latar tombol "tidak" : merah
Tombol	Tombol "Ya", tombol "Tidak"

Figure 16. *Storyboard* Exit Page

Figure 16 is the storyboard for the application exit page, where there is the text “Are you sure you want to exit this application?”. There is also a ‘Yes’ button to close or exit the application and a ‘No’ button to cancel or not exit the application. *4) Hierarchy Menu Design*

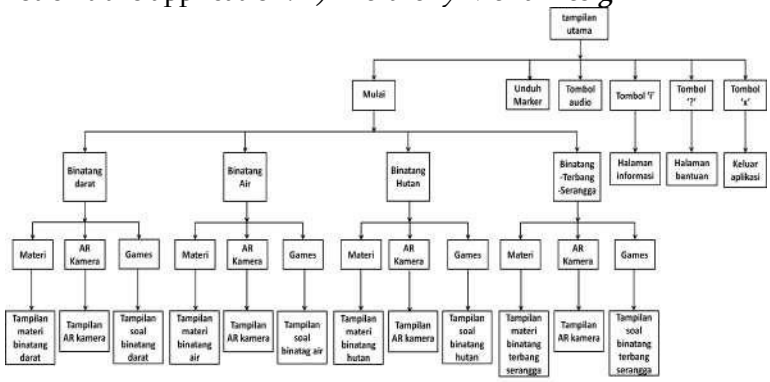


Figure 17. Hierarchy Menu

The design of the menu hierarchy used in the application can be seen in Fig. 17.

Material Collecting

In collecting the materials needed to build this application, some materials were taken from the internet. The interface and marker materials were created using Adobe Photoshop. The Blender application was used to convert 3D objects that had been downloaded from the internet to .fbx or .obj format. For the creation or arrangement of this AR application, the Unity software was used.

Assembly

This stage is the stage of creating the application based on the materials collected at the material collection stage, and making it an application based on the design process. In the creation of this application, Unity software with the C# programming language was used. Here is the process of making the Animal Knowledge application, and here are the final results of the Animal Knowledge application display.

Figure 18. Main Page

The display in Figure 18 is the main page of the application, consisting of 7 buttons, namely the Menu button, audio button, 'i' button, '?' button, start button, 'x' button, and download marker button.

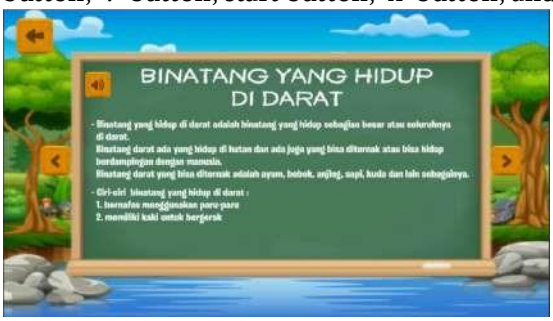


Figure 19. Material Page

The display in Figure 19 is the Material page; there is an explanation and a marker of the selected sub-theme, and there is an audio explanation of the material. There are 4 buttons, namely the back button, sound button, '<' button, and '>' button.

Figure 20. AR Feature Page

The display in Figure 20 is the AR Camera display when a 3D object is detected, as well as a sound for the animal's name. There is also an 'i' button, an information board about the animal, and a sound button.

Figure 21. Info and Help Page

The display in Figure 21 is the Help Page, which contains information about the function of the application buttons and how to use the application's features.

Figure 22. Exit Page

The display in Figure 22 is the application exit page. There is text asking "Are you sure you want to exit this game?", and there are 'yes' and 'no' buttons.

Testing

At this testing stage, the application that has been built or created will be tested to see whether the application functions as expected. The testing method used to test this application is the black box testing method. For testing the functionality of this application, it was tested by the developer, 1 media expert, 2 teachers, and 10 kindergarten students aged 5 years. From the test results, each function in the application runs in accordance with the expected results. Testing of the animal recognition application was also carried out on several devices. The following is Table II for device testing.

Testing of the animal recognition application was also carried out on several devices or smartphones. The following is Table 2 of device testing.

Table 2. Device Testing

Device	Result
Samsung A20 OS : Android 11 Size : 6.4 inches Resolution: 720x1560 Pixels, 19.5:9 ratio Camera : 13 MP	On this device every function or feature in the application can run smoothly according to the design, and the application's appearance adjusts to the resolution of this device
Xiaomi Redmi Note 5 OS: Android 9 Size : 6 inches Resolution : 1080x2160 Pixels, 18:9 ratio Camera : 13 MP	On this device every function or feature in the application can run smoothly according to the design, and the application's appearance adjusts to the resolution of this device
Xiaomi redmi 9C OS: Android 10 Size : 6,53 inches Resolution : 720x1600, 20:9 ratio Camera : 13 MP	On this device every function or feature in the application can run smoothly according to the design, and the application's appearance adjusts to the resolution of this device
Asus Zonefone 3 laser OS: Android 7 Size : 5.5 inches Resolution : 1080x1920 pixel, 16:9 ratio Camera : 13 MP	On this device every function or feature in the application can run smoothly according to the design, and the application's appearance adjusts to the resolution of this device

The conclusion from the device testing in Table II is that the application on the smartphones that were tested can run smoothly according to the features, and the application's appearance adjusts to the resolution of each smartphone.

Distribution

The application that has been tested is then built with a .apk format so that it can be run on a smartphone device. The application is distributed using Google Drive by sharing the application file link. Here are the details of the animal recognition application.

Name : Animal Knowledge Application
Format : .apk
Size : 140.03 Mb

CONCLUSION

From the research that has been done, the researcher has successfully built an animal recognition application with 3D objects, using mobile-based Augmented Reality (AR) technology, where this application can run on the Android operating system. The system development method used in this application is the Multimedia Development Life Cycle (MDLC) method with the following stages: concept, design, material collection, assembly, testing, and distribution. The application is able to detect markers and can display 3D animal objects, and there is an audio explanation for each object. The 3D object can be zoomed in, zoomed out, rotated, and dragged. There is a material feature in the form of text and audio, as well as a games feature. Based on the results of the application functionality testing, each function in the application runs in accordance with the expected results. Application testing was also carried out on several devices and smartphones, and the result of the testing is that the application on the smartphones tested can run smoothly according to the features, and the appearance of the application adjusts to the resolution of each smartphone. With this learning medium, it can help teachers in the learning process on the animal theme for early childhood, can make it easier to introduce animals that are difficult to find in the surrounding environment, and can help in creating interesting learning.

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