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Research paper

Incorporating Augmented Reality into Natural Science Study for 3rd Grade Elementary School Students

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Abstract

Augmented Reality is a technology that construct an interface in which 3D virtual objects are apparently put into the real world. Now research about Augmented Reality are growing rapidly. Utilizing Augmented Reality to improve learning and increase knowledge is one way to increase students' interest in learning. In our research, an augmented reality application is built using Blender, Unity and Vuvoria through ADDIE analysis and design model. This application is intended to facilitate teachers and students in teaching and learning Natural Science for 3rd grade elementary school, more specifically in "Plant and Animal Introduction" chapter. By scanning the marker on the book, this application is capable of displaying animated 3D objects that can be viewed from all sides. This application also features real-life-like animal-sound and facilitate object zoom in - zoom out. Our test shows that this application is welcomed by students and teachers alike and as a supplement to enhance Natural Science Study learning experience.

Keywords: *Augmented Reality, Unity, 3D, Android.*

1. Introduction

Currently, the information and communication technology is growing very rapidly. One example of this technology development is Augmented Reality (AR). Augmented Reality is a technology that combines visual virtual objects into the real view in real time. Over time Augmented Reality can be useful and allow it to be used in various fields as one model of learning 3D animation [1].

In the book Science My Pals Are Here Science published by Marshall Cavendish Education 3A subject matter presented in a clear and colorful with a succinct explanation. The book also uses English as the language of instruction. Many students, especially primary school 3rd-grade elementary schools Ar-Rafi often experience difficulties when using this book. Besides, because the language used in English, the absence of real objects they study makes students sometimes only imagine the body parts of animals and plants that cause some problems in the learning process. With the language of instruction in English also make teachers should explain the material using two languages, Indonesian and English. And also need to adjust the way teachers deliver material to the student's learning style. 3rd-grade students Ar-Rafi has learning methods vary although most students have a visual learning style, but among them are also many who have auditory and kinesthetic learning methods.

From the above problems, to help facilitate the learning process for science subjects 3rd grade Ar-Rafi in particular for the introduction of animal and plant material needed for an application. Therefore, at the end of the project, the writer tries to make a breakthrough by creating learning apps of Animal and Plant Introduction To Lesson IPA SD Class 3 based Augmented Reality. This application serves as a supporting media in teaching and learning that is expected to assist teachers in teaching and learning. With this 3D animated visualization to see the object that is to be seen more clearly and visible. This application can also be used to use two languages, Indonesian and English and is also equipped with sound.

2. Literature Review

3D

Three-dimensional or 3D or commonly abbreviated called space, is the shape of the object that has length, width and height. The term is usually used in the fields of art, animation, computer and mathematics [3].

Augmented Reality

Augmented Reality is a merger between virtual objects with real objects. According to Ronald Azuma in 1997, Augmented Reality is to combine the real and virtual worlds, interactive in real time, and a 3D animation.

In the Augmented Reality technology, there are three characteristics that form the basis is a combination of real and virtual worlds, running in realtime interaction, and the object of which is a 3D model [1].

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Implementing Augmented Reality in Education

Previous research has been conducted regarding Augmented Reality implementation in the field of Education. Based on the instructional approach adopted by an AR System, [4] classify three categories of instructional approaches that emphasize the 'roles', 'tasks' and locations'. Another interesting research tries to assess the pros and cons of implementing AR in education; by analyzing 26 publications that have previously compared student learning in AR versus non-AR applications, [5] identifies a list of positive and negative impacts of AR experiences on student learning and highlights factors that are potentially underlying these effects. Meanwhile, there are also researches that focus on implementing AR for specific instructional strategies, for instance [6] whose objective is to understand the process of designing the AR to support collaborative learning activities.

Blender 3D

Blender is a 3D animation program that is open source, free to be developed by the user and can be redistributed and is Legal. Blender has a Compositor and integrated video game engine. Work produced no royalty properties to developers, and can be published either free or for commercial [7].

Unity 3D

Unity is a game engine that is widely used. With this software, making the game itself can be done more easily and quickly. Amazingly, unity supporting the game development in a variety of platforms, such as the Unity Web, Windows, Mac, Android, iOS, XBox, Playstation 3 and Wii [8].

Storyboard

Storyboard is a radiant area of a drawing that is used as a planning tool to visually show how the action of the story takes place. Storyboard is a series of sketches made rectangular depicting a sequence (storyline) elements that will be proposed for multimedia animation. Storyboard combines narrative and visual aids on paper so that texts and visuals be coordinated [9].

Android

Android is a Linux-based operating system is an open source which is used for smartphones or tablet developed by Google [10].

Vuforia Qualcomm

Vuforia Qualcomm is a supporter library of Augmented Reality on the Android. Vuforia analyzes images using Marker detection that can produce 3D animation [11].

Adobe Audition CS6

Adobe Audition is an application of Adobe Systems, inc. The specific function of this software is to perform a variety of audio processing in the manufacture of songs, movies, sound effects etc. Adobe Audition is able to produce high-quality audio files [12].

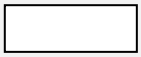
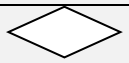
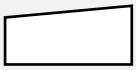
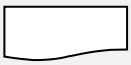
Application

The application is software that becomes the front end in a system used to process data into a useful information for people and the systems in question [13].

Flowchart

The flowchart is a diagram illustrating the flow of documents or data on a working procedure that shows a flow chart showing the flow of documents, data flow physical entities information systems. Usually, begins with observing and analyzing what would be the document information or media data. Then discover how a document is formed, any existing entities, changes and process what happened to the document, and so on [13].

Table 1: Symbols of Flowchart

Symbol	Description
	Terminator Shows start and end of the process flowchart
	Process Is used to represent the process
	Decision Used to indicate that there branching a groove
	Display Output is displayed on the terminal
	Manual Operation Shows the manual operation
	Manual input Put it manually on the keyboard
	Document Documents can be printed and can be held physically
	Arrows Used to represent the workflow

Animal

Animals are living creatures who are able to adapt to various environments. Animals can live on land, water, and air. No animals that eat other animals. There is a parasite, some eat plants and animals, and there is also that eat plants alone [14].

Plant

The plant is one of the classifications of living things that have chlorophyll or green substance that serves as a medium for the creation of food and to the process of photosynthesis that can be interpreted plants can produce their own food [14].

User Acceptance Test

Acceptance testing is a test performed by a user who uses black box testing techniques to test the system against specifications. The end user is responsible for ensuring all relevant functionality has been tested [15].

3. Method

In the project currently uses a model of instructional design ADDIE (Analysis-Design-Develop-Implement-Evaluate) developed by Reiser and Molenda (1990s) is a model of instructional design or training that is generic, combined with research steps recommended by Brog and Gall with the consideration that this model is suitable to develop products appropriate learning models targeted, effective and dynamic and help in the development of learning. [2]

Stages employed include: analyze, design, develop, implementation, evaluation. Where the system is built to be applied in SDIT Ar-Rafi Bandung.

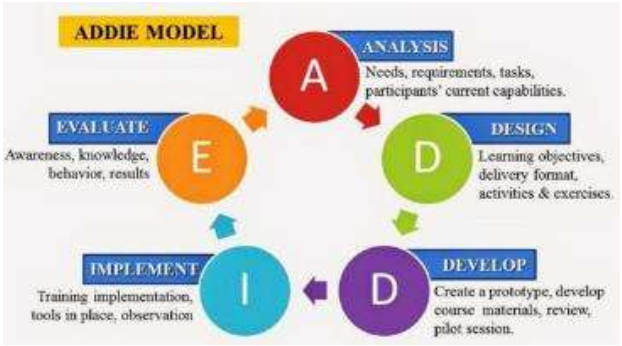


Fig 1: The execution method ADDIE (Branch, 2009: 9)

Such processes can be explained as follows:

1. **Analyze :**
   In the analyze phase is carried out several activities including interviews with teachers, questionnaire distributed to students 3rd grade Ar-Rafi to define the general objectives, the needs are known and description of parts that will be needed next;
2. **Design :**
   Storyboard design process and some 3D objects that will be used for manufacturing applications. This design was the basis for the creation of applications;
3. **Develop :**
   Making the applications done quickly. And design that is supposed to represent all aspects of the application are known, and this design became the basis for the creation of applications;
4. **Implementation:**
   Application has been completed and ready to be tested by teachers and students;
5. **Evaluation:**
   Clients will evaluate applications based on the initial objectives have been planned. If they do, the application can be used, but if it is not then it will be evaluated.

4. Results and Discussion

1. **System Overview**
   This application uses the book My Pals Are Here 3A published by Marshall Cavendish Science Education. This book is standardized with learning system in Singapore that has a language of instruction in English. The book also still conventional with the delivery of information in the form of text and 2D images, so the authors sought to complement this book incorporates Augmented Reality technology.

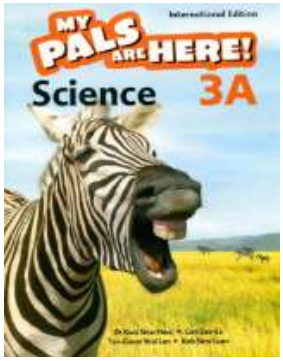


Fig 2: (a). Textbooks SD Ar-Rafi (My Pals Are Here Science 3A)

2. **Functionality**
   Here are some of the functionality that can be done by this application.
   1. Detect Marker that of the book My Pals Is Here then Android camera will display the visualization of three-dimensional (3D).
   2. Displays the visualization of three-dimensional (3D) from the image on the screen Marker Android device in accordance with Marker scanned by the camera.
   3. Remove the sound according to Marker scanned.

4. Displays 3D objects bigger or smaller.

3. Application Storyboard and Mock Up

Below is the application storyboard and mock up that visualize the sequence or storyline of Augmented Reality applications based on Android.

Table 2: Application Storyboard and Mockup

No	Frame	Content	Description
1		First Frame Contains: Start Button to enter the AR camera. Button How To Use? To see how to use the application. Exit button to exit the application.	The first frame displays the main menu of this application is the Start Button, How To Use, and Exit.
2		Second Frame Contains: Dialog display Select Language. English and Indonesian button is used to select the language of instruction to be used when running the application.	At the time of the Start Button selected it will display a dialog box that serves Select Language to select the language that will be used to run the application.
3		Third Frame Contains: a. Dialog Display How To Use.	At the time of the Start Button selected it will display a dialog box How To Use that explains how to use the application.
4		Fourth Frame Contains: Display when the scanning process on Marker. Button Sound to play audio. Button Home to return to the main menu. Exit button to exit the application. Button Zoom in to enlarge the object. Button Zoom out to zoom the object.	At the time of Marker in the scan will display a 3D animated object animal or plant and the button on the smartphone display. Button Sound function to play audio encyclopedia about objects. Home Button function to return to the main menu. Exit button to exit the application. While the button Zoom-in and Zoom-out is used to zoom in and out of 3D objects.

4. Navigation Flow

The navigation flow that is used in the making of this application are as follows:

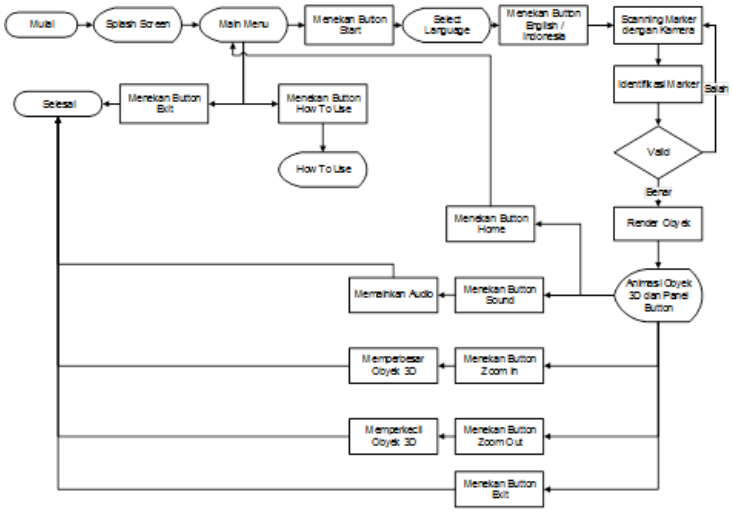


Fig 3: Navigation Flow

5. Animation Implementation

Here's what the application when running on the device.

The picture below are the view of Main menu (Fig. 4) and the view of Select Language dialog. (Fig.5)



Fig 4: Main Menu of My Pals Application



Fig 5: Dialog Select Language My Pals

The picture below are the view of the dialog How To Use (Fig. 6) and the process of scanning Marker page 1 chapter Animals (Fig. 7).



Fig 6: How To Use Menu of My Pals Application



Fig 7: Marker for Page 1 Chapter Animals

The picture below are the process of scanning Marker page 2 chapters Animalia (Fig. 8) and the process of scanning Marker page 3 chapter Animals (Fig. 9).



Fig 8: Marker for Page 2 Chapter Animals



Fig 9: Marker for Page 3 Chapter Animals

6. User Testing Results

To assess the application feasibility, a test is conducted. Test objectives are to measure three (3) aspects of software quality, namely learnability, understandability and operability. *Learnabili*ty measure time needed in order to be able to operate the application, *Understandability* measure user's perception on the software interface quality and *Operability* measure the relative efforts needed by user to operate the software easily. Test results are presented on the following table:

Table 3: Hasil Pengujian

No	Statements	Strongly Agree	Agree	Disagree	Strongly Disagree
Learnability					
1	This application is easy to use.	70%	30%	-	-
2	Interface is visually appealing	70%	30%	-	-
Understandability					
3	Animal and plant objects clarity is good	70%	20%	10%	-
4	Sound clarity is good	70%	30%	-	-
5	This application promotes fun learning activities	80%	10%	10%	-
6	This application improve subject comprehension	70%	30%	-	-
Operability					
7	Button layout is user friendly	60%	40%	-	-
8	Overall, application is user friendly	60%	30%	10%	-

Based on presented table, it can be concluded that this application has already met user's requirements and expectations. It has been successful both in promoting and facilitating learning activities. This application is also expected to be continually improved for future needs

5. Conclusion

Based on previous explanation, some conclusions can be drawn as follows:

1. Applications My Pals Animals and Plants can be used as a tool in the learning process that takes place in SD Ar-Rafi who can visualize a 3D animation of animals and plants of the textbook My Pals Are Here Science 3A using Android smartphones.

2. Applications My Pals Animals and Plants can play audio encyclopedia animals and plants.

3. Applications My Pals Animals and Plants features a select language, namely Indonesian and English.

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