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Android Based English Learning Media and Quiz Using Augmented Reality

Dias Agata*, Heny Yuniarti, Ahmelia Ayu Pratiwi Adison
Department of Informatics and Computer Engineering
Politeknik Elektronika Negeri Surabaya
Surabaya, Indonesia
*diasagata@pens.ac.id

Abstract—**The pandemic hits the world today has made educators and parents moved to develop attractive English learning media for young learners to keep them excited while learning from home. Android smartphone devices are currently popularly used for interaction media between young learners and teachers during learning from home. From this background, researchers developed English learning media using Augmented Reality that can be easily accessed from Android smartphone for young learners. This research focuses on creating learning media and English quizzes based on Android using Augmented Reality (AR) technology. The English materials used in this research are taken from Thematic English Learning 1 book from chapter 1 to chapter 5 and focused on enriching student's vocabulary. The AR application was made using Unity with the addition tool named Vuforia SDK. It is used to detect an image target so that the AR objects can be displayed throughout the screen. Vuforia SDK detects image target by comparing captured images with those stored in the database. This research resulted 24 three-dimensional AR objects, 6 two-dimensional AR objects which are ready to be used as English learning media and 54 quizzes which are feasibly to evaluate students' skills after learning English through AR objects.**

Keywords—English learning, augmented reality, learning media, Unity, Android

I. INTRODUCTION

Education about foreign languages, especially English for young learners today is considered necessary [1]. A study involving elementary and junior high school students showed that elementary students learn foreign languages better than middle school students [1]. Five out of five parents agree that their children need to get English education since grade 1 of elementary school because they assume that English education is needed in the globalization era [1].

There was a significant increase in the use of technology systems for education in the year of 2008-2018 [2]. Digital devices become equipment that has an important role in almost all aspects of education in connection with the concept of technology systems for education that aims to make conventional education more interactive and more effective.

One of the most popular technologies used for interactive learning media today is Augmented Reality (AR). AR is a technology that combines two-dimensional or three-dimensional cyberspace objects with the real world in real time [3]. AR is different from VR (virtual reality). VR completely replaces a reality and AR only adds an object to a real state [3].

The advantage of AR in education is that it can increase student's interest in independent learning and make it easier for students to learn foreign languages [4]. AR is able to provide more choices for students to enjoy interactive learning instead of passive learning. AR is also easier to use because it can be accessed on computers and mobile devices, so it can be used anytime and anywhere. AR has been widely applied to improve language skills, such as learning English in the form of three-dimensional pop-up books [4], vocabulary learning [5], and as a storytelling media through the Pokemon GO application [5].

This study focuses on creating a learning media that can help the English language skills improvement, especially in learning vocabularies, of grade 1 elementary school students.

Vocabulary has been acknowledged important for language learning in which lacking in vocabulary mastery of the learner led to troubles in second language learning [6]. A study reported that learners used a reading method to understand the word meaning [6]. Reading storybook is effective to develop children's vocabulary knowledge [7], but these days children are able to independently learn from richer contextual information from modernized media [7].

The main reference in creating the learning media in this study is the book Thematic English Exploration 1. It contains English material for grade 1 elementary school compiled by Djoko Semedi, S.Pd and is referring to the 2013 Curriculum (K-13).

The learning media created in this study is an Android application made by utilizing AR technology. Learning media consists of 5 levels (1 semester) according to the number of chapters in the Thematic English Exploration 1. There are vocabulary that can be formerly learned by students before working on the questions provided.

II. DESIGN AND IMPLEMENTATION SYSTEM

A. General Description of The System

The general system in this research is depicted in Figure 1. There are six important parts of the system, first is the system input in the form of an image and hereinafter referred to as a target image. The second part is the target image stored in the Vuforia database and then downloaded on Unity. After that in the third part, the output is generated in the form of Augmented Reality objects in the form of 2-dimensional and 3-dimensional images along with the writing of the object's names in English which is listed at the top of the AR image. This application is built on Android and uses a cellphone camera to compare the captured image with the image stored in the database. The fourth part of the system is a question that is structured to evaluate students' understanding after learning English vocabulary using the application. After the application system has been properly developed, in the fifth part, the system is tested on first grade students of elementary school and then in the sixth part, the results of the system test are analyzed by the researchers.
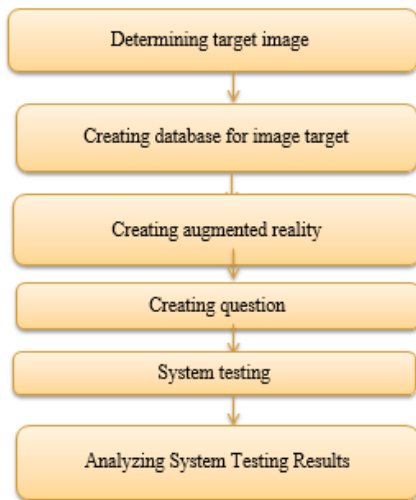

Fig. 1. Diagram block of general system.

Android platform was chosen because it is an open source platform [8]. Unity software is used to create the augmented reality. A study reported that Unity, which often used to make a VR object, can be used as a tool to also create an AR [9].

Several components needed to support the performance of the digital image processing process in implementing AR technology [10] are:

1) Scene generator: Scene generator is a component that has the role of rendering the image captured by the camera from an Android device. The virtual object will be detected and then processed so that the object can be displayed.

2) Tracking system: This system detects virtual objects which are then synchronized with real objects in order to keep the projection results of virtual objects in the real environment valid.

3) Display: It is necessary to pay attention to the aspects of optics and video technology to be able to display the projection results of virtual objects in the real environment. They are interrelated and depend on the resolution, flexibility, field of vision, and area of detection. Meanwhile, the limitations of displaying objects in AR are lighting, screen resolution, and the difference in lighting between virtual objects and real objects.

4) AR devices: Devices can be used as a medium for displaying objects created using AR technology are virtual retina system, a video viewer, an AR-based monitor, an AR-based projector, or a mobile phone screen.

B. Creating Database for Image Target

Augmented reality has been implemented in a study [11] which focuses on developing learning media about Indonesian animals. In introducing animals to children in the age range 6-7 years, it is generally done by visiting the zoo. This is less efficient because it requires additional costs and a relatively long travel time. Augmented reality integrated with Android devices is a facility for learning about Indonesian animals without inviting students to go to the zoo.

An image target is chosen based on the image's details, sharpness of contrast, and non-repetitive patterns. Vuforia will detect the target more easily if a target image meets the three conditions. Then the chosen images are uploaded to the Vuforia site (developer.vuforia.com). Required target image is a file with the extension .jpg, .jpeg, or .png with a maximum size of 2 megabytes. The process of making database for image target is shown in figure 2.
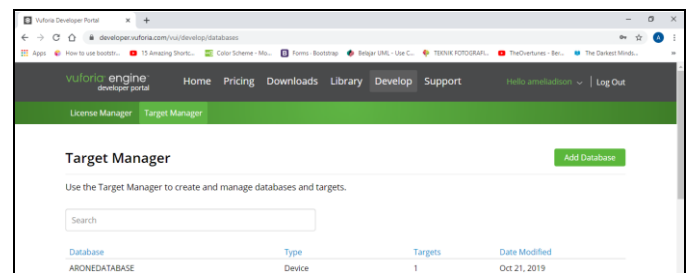

Fig. 2. Database making in vuforia site.

C. Creating Augmented Reality

The augmented reality is made using Unity 2018.2 version on Windows 10 64 bit. The image target used is the one that was previously uploaded to the database on the Vuforia website. Inserting the image target into the scene is done in figure 3 by clicking the GameObject tab, then selecting Vuforia Engine, and selecting Image.
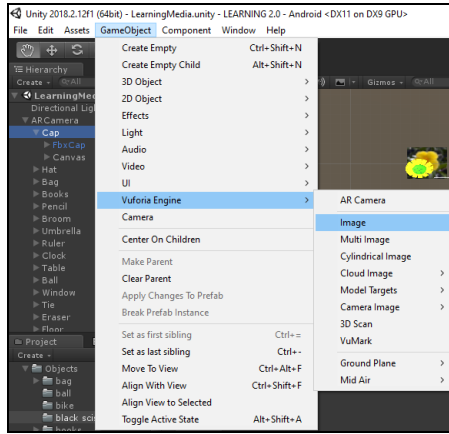
Fig. 3.   Inserting image target.

Then the 3-dimensional object is dragged and dropped into the target image. The visualization of 3-dimensional object on top of an image target is shown in figure 4.

Fig. 4.   3-dimensional object on image target.

D. *Creating Questions*

To find out the level of students' understanding of learning about English vocabulary using the application, 54 items quiz were made using Unity in the form of multiple choice questions. The sentences or phrases written in bold are the correct answers.

TABLE I.   LEVEL 1

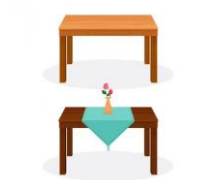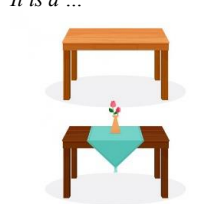| No.	Questions	Answers
1	*What is that?*	a. *it is a bag. It is a big bag.* b. *it is a table. It is square.* c. *they are pens. They are small.* **d. *it is a ball. It is round.*** e. *they are pencils. They are long.*
2	*What are these?*	a. *it is a bag. It is a big bag.* b. *it is a table. It is square.* **c. *they are pens. They are small.*** d. *it is a ball. It is round.* e. *they are pencils. They are long.*

Table 1. Cont.

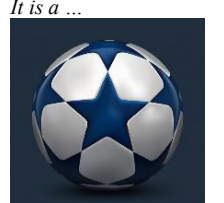| 3	*What are those?*	a. *it is a bag. It is a big bag.* b. *it is a table. It is square.* c. *they are pens. They are small.* d. *it is a ball. It is round.* **e. *they are pencils. They are long.***
4	*What is this?*	a. *it is a bag. It is a big bag.* **b. *it is a table. It is square.*** c. *they are pens. They are small.* d. *it is a ball. It is round.* e. *they are pencils. They are long.*
5	*What is it?*	**a. *it is a bag. It is a big bag.*** b. *it is a table. It is square.* c. *they are pens. They are small.* d. *it is a ball. It is round.* e. *they are pencils. They are long.*
6	*It is a …*	a. *pencil sharpener* **b. *bag*** c. *classroom*
7	*It is a …*	a. *pencil sharpener* **b. *table*** c. *classroom*
8	*These are …*	a. *pens* b. *pencils* **c. *rules***
9	*It is …*	**a. *broom*** b. *window* c. table
10	*It is a …*	a. *broom* **b. *ball*** c. *table*

Table 1. Cont.
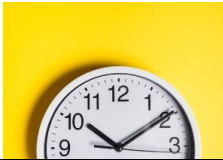
11	*They are ...*	**a. *pens*** b. *pencils* c. *rulers*
12	*It is a ...*	a. *ball* **b. *window*** c. *table*
13	*It is a ...*	a. *map* **b. *clock*** c. *window*

TABLE II. LEVEL 2

No.	*Questions*	Answers
14	*_ mbrella*	a. A **b. U** c. O
15	*Hou __*	a. sy b. es **c. se**
16	*_ p*	**a. ca** b. ce c. ke
17	*H __*	a. ay b. et **c. at**
18	*B _____*	**a. *ooks*** b. *uks* c. *oogs*

Table 2. Cont.
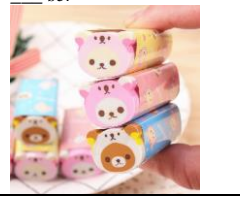
19	*___ ser*	a. *ere* **b. *era*** c. *ire*
20	*___*	**a. *tie*** b. *tye* c. *tei*

TABLE III. LEVEL 3

No.	*Questions*	Answers
21	*They are ...*	a. *yellow* b. *red* **c. *green***
22	*What colour is the ... ?* *It is ...*	**a. *bag, pink*** b. *bag, red* c. *bag, yellow*
23	*What ... is this balloon?* *It is ...*	a. *colour, red* b. *colour, yellow* **c. *colour, green***
24	*... colour is this chicken?* *It is ...*	**a. *what, white*** b. *what, blue* c. *what, orange*

Table 3. Cont.

25	*... is this pair of shorts? It is ...*	**a. *what colour, brown*** b. *what colour, blue* c. *what colour, pink*
26	*Brown ...*	a. A. *butterfly* b. E. *pencil sharpener* **c. D. *fence***
27	*White ...*	a. B. *rocks* **b. C. *clock*** d. G. *mango*
28	*Write in Indonesian: Blue.*	a. kuning b. hijau **c. biru**
29	*Write in Indonesian: Green.*	a. kuning **b. hijau** c. biru
30	*Write in Indonesian: Yellow.*	**a. kuning** b. hijau c. biru
31	*Write in Indonesian: Orange.*	a. kuning **b. oranye** c. biru
32	*Write in Indonesian: Purple.*	**a. ungu** b. biru c. merah
33	*Write in Indonesian: Pink.*	**a. merah muda** b. biru c. meah
34	*Write in Indonesian: Grey.*	a. hitam b. biru **c. abu-abu**
35	*Write in Indonesian: Black.*	a. cokelat **b. hitam** c. biru
36	*Write in Indonesian: Brown.*	**a. cokelat** b. hitam c. biru
37	*Write in Indonesian: Red.*	a. cokelat b. hitam **c. merah**

TABLE IV. LEVEL 4

No.	*Questions*	Answers
38	*What number is it? It is ...* *(17)*	a. *thirteen* **b. *seventeen*** c. *fifteen*
39	*After seventeen is ...* *(18)*	**a. *eighteen*** b. *nineteen* c. *fifteen*
40	*Do you know what number it is? It is ...* *(11)*	a. *thirteen* b. *twelve* **c. *eleven***
41	*What is after eleven? It is ...* *(12)*	a. *thirteen* **b. *twelve*** c. *eleven*
42	*What number is that? It is ...* *(14)*	a. *thirteen* **b. *fourteen*** c. *eleven*
43	*Before fourteen is ...* *(13)*	**a. *thirteen*** b. *fourteen* c. *eleven*
44	*What number are they?* *(13 and 16)*	a. *thirteen and fifteen* b. *thirteen and fourteen* **c. *thirteen and sixteen***
45	*... five books.*	a. *there is.* **b. *there are.***
46	*... two sharpeners.*	**a. *there are.*** b. *there is.*
47	*... two kites.*	a. *there is.* b. *there are.*

TABLE V.   LEVEL 5

No.	Questions	Answers
48	*Arrange the words into good sentences.* *Name – is – My - Safna*	**a. My name is Safna.** b. *Safna is My Name.*
49	*Arrange the words into good sentences.* *You – are - ? – how*	a. *are you how?* **b. *how are you?***
50	*Arrange the words into good sentences.* *You – nice – meet – to*	a. *nice meet to you.* **b. *nice to meet you.***
51	*Arrange the words into good sentences.* *Name – your – is – what - ?*	**a. *what is your name?*** b. *your name is what?*
52	*Arrange the words into good sentences.* *You – old - ? – how - are*	a. *how old you are?* **b. *how old are you?***
53	*Arrange the words into good sentences.* *You – see - later*	**a. *see you later*** b. *see later you*
54	*Arrange the words into good sentences.* *am – I – fine*	**a. *I am fine*** b. *fine I am*

Animation is given in each answer button so that when student chooses it, a response appears, whether the answer is correct or incorrect. Figure 5 depicts the animation that shows the answer is correct.
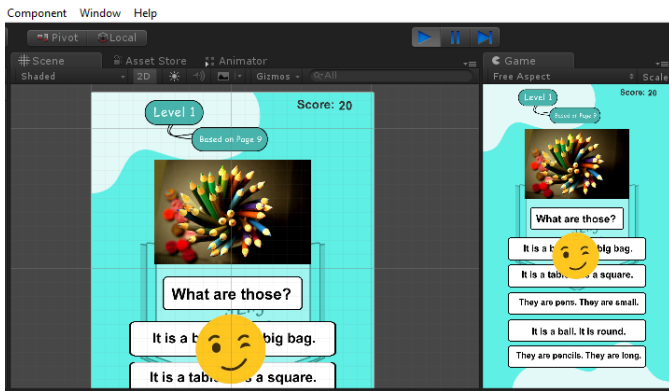

Fig. 5.   Animation shows a correct answer.

III. RESULTS AND DISCUSSION

A. Results

The Learning media testing was done on a mobile phone using Android operating system. The target images were tested based on the distance to the pixels. The process of identifying target images was done by comparing images that have been printed and captured by the camera with those which have been registered in the Vuforia database. A study about identifying image target based on distance measurement have been done to find the pattern of it [12]. There were 30 target images tested. The distance of the camera to the target image was varies from 5, 10, 20, 30, 40, and 50 cm with an image resolution size of 600x300 pixels. The results of this experiment are summarized in Table 6.

TABLE VI.   IMAGE TARGET TESTING RESULTS

Image Target	Camera Range to Image Target					
	5 cm	10 cm	20 cm	30 cm	40 cm	50 cm
1	-	√	√	√	-	-
2	-	√	√	√	√	-
3	-	√	√	√	√	√
4	-	√	√	-	-	-
5	-	√	√	√	-	-
6	-	√	√	√	-	-
7	-	√	√	√	√	-
8	-	√	√	√	√	-
9	-	√	√	-	-	-
10	-	√	√	√	√	-
11	-	√	√	√	√	-
12	-	√	√	√	√	√
13	-	√	√	√	√	-
14	-	√	√	√	√	-
15	-	√	√	√	√	√
16	-	√	√	√	√	√
17	-	√	√	√	√	√
18	-	√	√	√	√	-
19	-	√	√	√	√	-
20	-	√	√	√	√	√
21	-	√	√	√	√	√
22	-	√	√	√	√	-
23	-	√	√	√	√	√
24	-	√	√	√	√	-
25	-	√	√	√	√	-
26	-	√	√	√	√	-
27	-	√	√	√	-	-
28	-	√	√	√	√	√
29	-	√	√	√	√	√
30	-	√	√	√	√	√

B. Discussion

From table 6 it can be seen that the image target cannot be detected from a distance of 5 cm. All image targets with the size of 600x300 pixels can be optimally detected by the camera from a distance of 10 cm and 20 cm. 28 out of 30 image targets with the size of 600x300 pixels can be detected by the camera from a distance of 30 cm. 24 out of 30 image targets with the size of 600x300 pixels can be detected by the camera from a distance of 40 cm. 13 out of 30 image targets with the size of 600x300 pixels can be detected by the camera from a distance of 50 cm.

Based on the results, the optimal distance for the camera to detect image targets to see augmented reality as a visualization of an object starts from 10 to 20 cm.

IV. CONCLUSION

Augmented reality as an English learning media for young learners was made by utilizing Unity software, consists of

learning material in the form of AR and quizzes. Learning materials in the form of AR applications for mobile phones made with the Android operating system. the optimal distance for the camera to detect image targets to see augmented reality as a visualization of an object starts from 10 to 20 cm. Quiz to evaluate students presented in the form of questions with multiple choices. There are 54 questions consist of 13 questions to evaluate students' understanding in Chapter 1, 7 questions to evaluate students' understanding in Chapter 2, 17 questions to evaluate students' understanding in Chapter 3, 10 questions to evaluate students' understanding in Chapter 4, and 7 questions to evaluate students' understanding in Chapter 3, evaluate student understanding in Chapter 5.

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