An Interactive Augmented Reality Implementation of Hijaiyah Alphabet for Children Education

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Abstract. Hijaiyah alphabet is letters used in the Qur’an. An attractive and exciting learning process of Hijaiyah alphabet is necessary for the children. One of the alternatives to create attractive and interesting learning process of Hijaiyah alphabet is to develop it into a mobile application using augmented reality technology. Augmented reality is a technology that combines two-dimensional or three-dimensional virtual objects into actual three-dimensional circles and projects them in real time. The purpose of application aims to foster the children interest in learning Hijaiyah alphabet. This application is using Smartphone and marker as the medium. It was built using Unity and augmented reality library, namely Vuforia, then using Blender as the 3D object modeling software. The output generated from this research is the learning application of Hijaiyah letters using augmented reality. How to use it is as follows: first, place marker that has been registered and printed; second, the smartphone camera will track the marker. If the marker is invalid, the user should repeat the tracking process. If the marker is valid and identified, the marker will have projected the objects of Hijaiyah alphabet in three-dimensional form. Lastly, the user can learn and understand the shape and pronunciation of Hijaiyah alphabet by touching the virtual button on the marker.

1. Introduction

Technology is evolving very rapidly; this development makes technology help humans in all fields. One of the technological development examples is augmented reality. Augmented reality is a technology that combines two-dimensional or three-dimensional virtual objects into actual three-dimensional circles and projects them in real time. Augmented reality can be applied to the sense of hearing and touch. Besides being utilized in areas such as healthcare, military, and manufacturing industries augmented reality can be implemented to learning media, one of which is learning the Qur’an.

Augmented reality (AR) technology is an impressive multimedia technology development since it is not only impressing the users but also making them feel entertained and enjoy the technology as well as gain some useful information. Augmented reality (AR) technology is a variation of virtual environments that thoroughly immerse users in a synthetic environment [1].

Childhood is the time to learn and play. Lessons delivered by educators or parents should include many playful and fascinating activities. If the fun element is not on the table, the children will simply get bored and reluctant to follow the lessons to be given by educators or parents. Furthermore, to learn Hijaiyah alphabet, it is vital to have the fun element so that the children can enjoy learning Hijaiyah.
alphabet at an early stage. By utilizing augmented reality technology, the unpleasant and boring lessons of Hijaiyah alphabet can be minimized, so that it would be more fun and exciting.

The augmented reality which usually runs on Android platform has the advantages that can provide experience and knowledge of the subject easy to be understood by the learners. It also can be implemented to give information to the user [6]. With these advantages, augmented reality can be used as an engaging and interactive method of learning. Based on these matters, we were motivated to develop augmented reality application to give children a different learning process on understanding Arabic letters in the Holy Quran. It also can stimulate the children to be more active in learning Hijaiyah letters through Android in the future. In learning Hijaiyah alphabet, a child tends to experience tiredness and boredom. Therefore, a solution is required to tackle this problem so children do not easily get bored and saturated during the learning period. Other studies related to augmented reality has been conducted earlier, among which is Pratama (2014). In his research, they implemented augmented reality in the development of Android-based bataknese musical instrument Taganing introduction [2]. In the study, He used a marker with five 3D objects, and each object produced a different sound.

Yudiantika et al. (2013) conducted research to implement augmented reality on museum by developing an educational application for museum visitors [3]. In 2014. Nugraha, in his research, utilized augmented reality in Piano basic learning. [4]. Nugraha developed a useful application for theory learning of Piano to assist the users on Piano chord lessons.

2. Methodology

System modeling aims to simplify the development and comprehension of the system. System modeling consists of general architecture, general design flowchart, 3D object creation flowchart, marker creation flowchart, application development flowchart and use case diagram.

2.1. General Architecture

The general architecture of the proposed method for the learning process of Hijaiyah alphabet is shown in Figure 1. The proposed steps of the application development using augmented reality are as follows: User is going to place the marker that has been registered; smartphone camera will be tracking the marker. If the marker tracking is invalid, user should repeat the tracking process. If the marker is valid or identified, the marker will have projected the objects of Hijaiyah alphabet in three-dimensional form. The object of Hijaiyah alphabet will be placed on the identified marker; the user can listen to Hijaiyah letters pronunciation by touching the marker on the virtual button; system generates the sound of the selected Hijaiyah letter through the smart phone.

![Input and Output Diagram](image)

**Figure 1. General architecture of the proposed method**
2.1.1. Input
In this stage, the camera will identify the selected images, after the image pattern is saved in the library.

2.1.2. Process
Before the application can project 3D objects and Hijaiyah letters sound, it must be subjected to some process.

1. Tracking marker
The process of target registration is using Vuforia. The user will upload images for the target to be tracked and registered, then download the target resource, which bundled with the application. In this process, the target resource is downloaded in the form of libraries that have been bundled with Unity 3D application.

   The working process of Vuforia AR SDK is as follows [5]: the camera captures images of the real world to track the marker then register the marker. The captured image serves as marker converted from YUV 12 to RG565 format for OpenGL ES and then set the lighting for marker tracking; the marker is turned into multiple frames, using a computer vision algorithm to detect and track real objects taken from the camera. The object is evaluated, and the result will be stored and accessed by the application; after getting the perfect position of the camera, the captured object will be rendered and visualized in the form of video in real-time.

2. Virtual button
The targeted image is used to place the virtual button, so when the marker is touched, the app will generate the sound of Hijaiyah alphabet in accordance with the selected visual button. The workflow is as follows: the virtual button on targeted images, each targeted image has five virtual buttons. Alter the name of each virtual button to simplify the configuration process; then add the audio file of Hijaiyah alphabet on each virtual button by dragging audio file on window asset into virtual button; on inspector audio source window, Bypass Effects and Play on Awake are unchecked and positioned the Pan Level at zero so the sound can be heard; reset the existing script of the virtual button, to declare the variables of Audio Source data so that the audio source variables appear on the target inspector image window and to set the virtual button for the audio to be heard when the hand touches the coordinates of the virtual button [4].

3. Output
   Outputs generated are the 3D objects and sounds of Hijaiyah alphabet.

3. Experimental Results And Analysis

3.1. Marker Design
There are 28 markers in this research, divided into one marker as the cover and the others as Hijaiyah letters.
3.2. Application Layout

3.2.1. Main menu layout
Main menu page consists of a start button, information button, help button and exit button. It is shown in Figure 3.

3.2.2. Start submenu layout
Start submenu shows the function of smartphones camera to track the augmented reality in order to project 3D objects of Hijaiyah augmented reality.
On the left side of the marker, there is a virtual button that consists of five circles and each circle has a certain code that serves as a button that will sound when touched or covered. For more detailed information, it can be seen in Figure 4.
3.2.3. **Information submenu layout**

Information submenu displays brief information about Hijaiyah letters and the application. The layout design of submenu information can be seen in Figure 5 below:

![Figure 5. Information submenu layout](image)

3.3. **Marker Testing**

There are several tests to detect the markers, i.e., marker trial, distance trial, Android camera resolution test, and lighting test.

3.3.1. **Marker trial**

In this research, authors limit the detection system to a single marker. So if there is more than one marker, the application is going to show one 3D object.
3.3.2. Distance test
In distance test, the closer the distance between the camera, the marker will result in the bigger marker being recognized by the camera so that the marker can be adequately captured.

Table 1. Marker distance test

| No | Distance | Tracking Marker Result |
|----|----------|------------------------|
| 1  | 15 cm    | Well detected          |
| 2  | 30 cm    | Well detected          |
| 3  | 50 cm    | Well detected          |
| 4  | 100 cm   | Well detected          |

Figure 6. Detected ‘Ba’ letter

Figure 7. Distance test (a) 15 cm, (b) 30 cm, (c) 50 cm dan (d) 100 cm
3.3.3. Lighting test
In lighting test, to detect the marker, lighting has great influence on 3D object quality. The trial was conducted in dark room without any lighting, the only source of lighting came from the brightness of the laptop screen. A marker is placed on keyboard, and laptop screen is lowered to allow light to illuminate the marker. Lighting test is shown in Figure 8.

![Figure 8. Lighting test](image)

4. Conclusion and Future Research
Based on the results of analysis and testing of android-based learning application of Hijaiyah letters using AR, it can be concluded as follows; AR applications are still a new thing for children, so it looks more appealing to try the application of learning hijaiyah letters using AR; the marker detection on the application has functioned well. 3D objects Hijaiyah can appear on the marker; each virtual button can make a sound based on the button selected by the hand; in the application usage, must be considered the distance and focus of the camera with the marker; the application cannot run in a place that has less light (dark), because the camera requires light to track AR marker.

For future research, to be able to create a more responsive virtual button, to make it easier to use; in building applications, it is wise for researchers to master 3D Blender application not as a modeling but also animation, in order to create changes effects of 3D objects when touched

5. References
[1] Azuma T R 1997 A Survey of Augmented Reality (Presence: Teleoperators and Virtual Environments)
[2] Pratama M A 2014 Augmented Reality Implementation In Android-based Batak Taganing Application Design (Universitas Sumatera Utara: Medan)
[3] Yudiantika A R, Pasinggi E S, Sari I P, Hartono B S 201 Augmented Reality Implementation At Museum: Study case Educational Application for Museum Visitors (Universitas Gajah Mada: Yogyakarta)
[4] Nugraha I 2014 Augmented Reality Utilization For Piano Instrument Learning (Universitas Diponegoro: Semarang)
[5] Siregar A S 2011 Application Development Of Interrelationship Determinant Between Student Data And Length Of Study Using Multiple Linear Regression Algorithm STT Harapan Medan Students Case Study (Universitas Sumatera Utara: Medan)
[6] Muchtar M A, Syahputra M F, Syahputra N, Ashrafia S and Rahmat R F 2017 Augmented Reality for Searching Potential Assets in Medan using GPS based Tracking Journal of Physics: Conference Series 801 p. 12010