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Augmented reality application on the tourism orientation sign digital system at the museum bawah langit

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Abstract

One of the most popular tourism places in Makassar is Losari Beach. It offers many entertainment options such as the beauty of the sunset, typical cuisine of pisang epe' (baked banana), floating mosques and rows of statues of heroes and icons of Makassar City which are spread over four platforms, namely the Makassar, Bugis, Mandar and Toraja pavilion, commonly called the Museum Bawah Langit. To attract the public, an accurate explanation of the statues is needed. In the current new normal era where interaction between humans is limited, digital and virtual explanations will be one solution to provide attractive and up-to-date information. This study aims to create a Digital Tourism Orientation Sign System, which is an information system that provides accurate explanations and descriptions of the statues of heroes in the Museum Bawah Langit. This application will make Losari beach one of the futuristic tourist attractions with local wisdom. This application has been tested using Alpha testing which includes distance testing at a minimum distance of 10 cm and a maximum of 1 m marker will be detected. light testing with object test results will appear from a room brightness level greater than 10 Lux.

Keywords: Augmented Reality; Digital Tourism Orientation Sign; Museum Bawah Langit

Introduction

In 2015, through Nawacita, the tourism sector was determined as one of the leading sector dimensions within the framework of the national development agenda by encouraging the acceleration of tourism development in almost all areas of Indonesia by involving a number of tourism stakeholders. Development of several tourism destinations such as natural, cultural/historical and artificial tourism is to increase the number of tourist visits. Unfortunately, at the beginning of 2020, world tourism was being tested by the unanticipated Covid-19 outbreak that hit the whole world terribly. The presence of a pandemic is very detrimental since it has been causing significant decline in tourism travels due to fear of risk of being infected with that deadly virus. The hope of all mankind in the world is to quickly find a vaccine and a cure for it.

The city of Makassar as one of the leading tourist destinations has been greatly affected by COVID-19 with the decline in the number of tourists visits as well as the temporarily close of the number of tourism destinations. The hope to revive the tourism sector begins with the New Normal which allows some activities in tourism areas with strict health protocols. The government also supports this policy by issuing Guidelines for the Implementation of Cleanliness, Health, Safety and Environmental Sustainability (CHSE) which is an operational guideline from the Decree of the Minister of Health Number HK.01.07/Menkes/382/2020 concerning Health Protocols for Communities in Public Places and Facilities in the Framework Prevention and Control of Corona Virus Disease 2019 (Covid-19).

In welcoming this New Normal, several tourism objects in Makassar City have been reopened to stimulate the tourism sector. One of them is the Losari Beach which is famous for the Museum Bawah Langit offering many statues spread over 4 pavilions, Makassar, Bugis, Toraja and Mandar Pavilions, as a reflection of the culture, art and local wisdom of Makassar City. However, these statues have not been equipped with detailed and accurate information so that visitors need to be accompanied by a tour guide to get the explanation. To obtain accurate information without intense interaction with other people in this new normal era, this study aims at designing a Digital Tourism Orientation Sign which applies Augmented Reality Technology that is expected to enable visitors to obtain detailed and interesting information about the statues in the Museum Bawah Langit via mobile phones using barcode scans that have been installed at several strategic points on the Losari beach.

Augmented Reality (AR) was selected in this digital tourism sign applications because this technology has undergone very significant developments nowadays. This development is in line with the many supporting

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applications easily found in e-commerce and marketplace [1][2]. The application of AR has been widely carried out in previous studies such as in the creating the promotional media for the University of Nurtanio which resulted a very satisfactory results [3]. The application of Augmented Reality is also widely found in learning media in schools to make the teaching and learning process becomes more interesting [4]-[8].

Method

A. Research stages

This research consists of three stages that make it easier for researchers to carry out research from beginning to end. The stages of the research can be seen in **Figure 1**.

Figure 1. Research Stages

Each stage in this research is designed systematically to obtain maximum research results. The stages of the research are described as follows:

a. Stage I: At this stage, the system design is carried out. The initial step is designing the software that will be used on the system, such as system and application software. At this stage, the database system will be designed using the Prototyping model. The system design tool used is based on the Unified Modeling Language (UML). Next, the researcher will take destination data (attractions, amenities and accessibility of the Losari Beach) at the Government Tourism Office. In addition, researchers will also collect other supporting data using interview techniques. The interview results obtained will then be included in the design of the database system that has been designed.
b. Stage II: At this stage, the system creation process is carried out. Researchers will create a Digital Tourism Orientation Sign system based on the results of data and information received from sources. This study applies Augmented Reality technology, a technology that expands the physical world by adding a layer of digital information to it. Researchers will build this system by starting from the programming stage, system analysis and finally creating the tourism-based digital information system applications.
c. Stage III: In the last stage, implementation and system testing is carried out in two stages. The first stage is Blackbox testing which is to test the validation on the interface, the suitability of input, process and output which is tested with Alpha testing from the system developer side, and Beta Testing from the system user side. The second stage is Whitebox testing which is to test the program structure in the logic processing section to find out program logic errors and the expected output suitability. In the second stage, the performance and durability of the system will also be tested.

B. Augmented Reality

This study applies Augmented Reality or AR technology which is a technology that combines and displays the real world and real-time digital content created by computers. Augmented Reality allows users to see and display 2D or 3D (3D) virtual objects that are projected or reflected on the real world [9],[10]. Marker-based AR uses a camera and several types of visual markers, such as 2D Quick Response Code (QR Code) [11]. This technology will produce output only when the marker is recognized by the user application. The camera on the device is used to distinguish markers from other real-world objects [12]. Simple patterns such as QR Codes are used as markers because they can be easily recognized and do not require much effort to read [13],[14]. Position and orientation are also calculated, where several types of content or information are then embedded in markers which are then displayed according to the desired object to display information related to the projected object.

C. Vuforia Algorithm

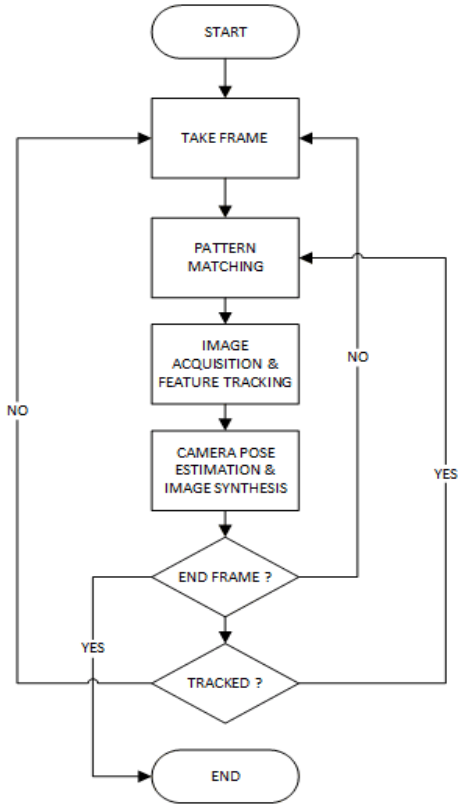


Figure 2. Algorithm Vuforia Flowchart

Figure 2 shows the algorithm for the process of scanning markers in the application. The first step is Bootstrap Pattern Matching which is to match the pattern from the image captured by the camera with the marker used in the application. The second step is Image Acquisition and Feature Tracking which functions to separate the background and the target marker used in the application [15]. The separated markers will then reappear the pattern from their features to determine where the object will appear. The third step is Camera Pose Estimation & Image synthesis which functions to estimate the movement, direction, and view or angle of the camera to the marker. In this step, the object will appear above the marker.

Results and Discussion

A. Design stages

1. Three-Dimensional Modeling for Augmented Reality

   Three-dimensional modeling is carried out before designing the Augmented Reality application. This research uses Blender with FBX format in the process of making three-dimensional models. **Figure 3** shows a three-dimensional model of Arung Palakka and Sultan Hasanuddin.

Figure 3. Three-Dimensional Modeling for Augmented Reality

2. Augmented Reality Applications Design

The design of the Augmented Reality application uses the Unity3D application as a game engine. Unity3D is the most popular Cross-Platform Game Engine that can be used to build applications for various platforms. Unity3D is developed by Unity Technologies.

3. Marker Database Design

The database used in the application was developed using a collection of markers that have been created by previous researchers. To enter the marker database into the Augmented Reality application, account registration is needed in the Vuforia website to enable login and register the marker that have been created. **Figure 4** shows the marker database that has been created.

Figure 4. Marker database

The next step is to enter the marker into the Vuforia database. Each image has its own rating. The higher the rating obtained by an image, the easier it is detected by the camera. In the License manager section, markers that have been registered in the database in the Target Manager section will be given a license key to be inserted into the 3D object in the AR Application.

4. Vuforia Import in Unity3D

Before designing an Augmented Reality application, it is necessary to import the database that we have created on Vuforia by downloading it from the Vuforia website. On the "download" menu select "Download Unity Extension (legacy)" then import the downloaded data into Unity3D.

5. Import the AR Camera and Enter License

After importing the Vuforia database and three-dimensional model, the next step is to import the AR Camera by right-clicking on the Hierarcy-Vuforia-AR Camera. After that, enter the license from the Vuforia website into the Vuforia Configuration in the Assets-Resources folder shown in **Figure 5**.

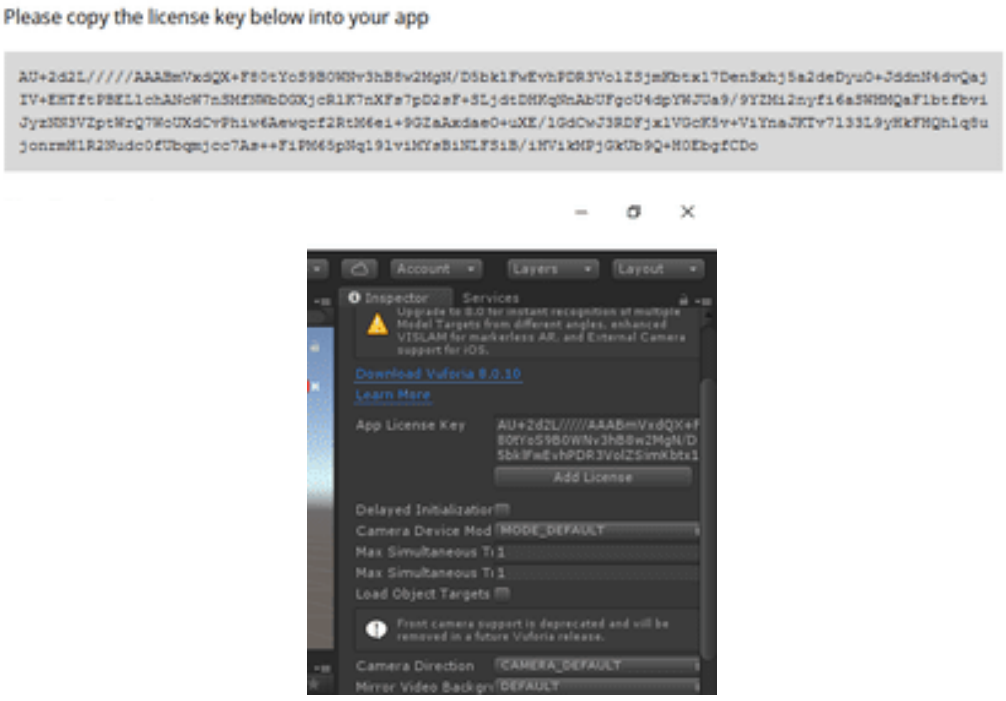


Figure 5. License key

6. Importing the Object into the Marker

After entering the marker, the #D object is inserted into the marker that has been imported via AR camera shown in **Figure 6**.

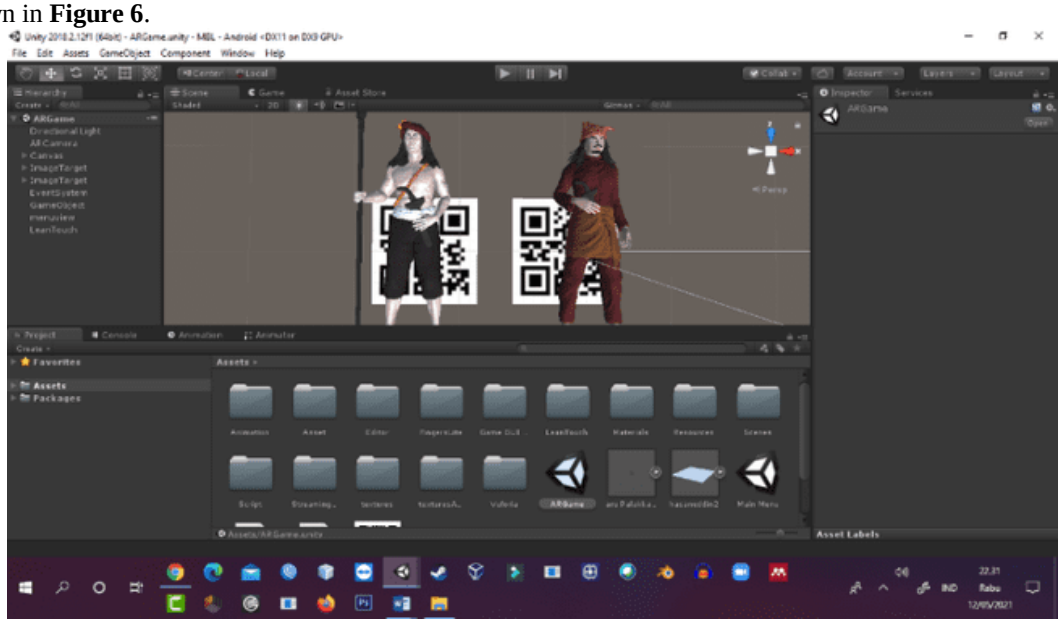


Figure 6. Importing the Object into the marker

To change the scale of 3D objects and rotate 3D objects that have been displayed through markers, **Figure 7** script is needed:

```
if (fingers <> null)
        begin
                total <-- Vector2.zero; nilai <-- total
                count <-- 0;
                for (i <-- fingers.Count - 1; i >= 0; i--)
                        begin
                                finger <-- fingers[i];
                                if (finger != null)
                                begin
                                        total <-- finger.ScreenPosition;
                                        count <-- 1;
                                end;
                        end;
                                if (count > 0)
                                begin
                                        center <-- total / count;
                                end.
        end.
        return false;
}
// Gets the last average ScreenPosition of the fingers
if (fingers <> null)
        {
                total <--Vector2.zero;
                count <-- 0;
                for (i <-- fingers.Count - 1; i >= 0; i--)
                        {
                                finger <-- fingers[i];
                                if (finger <> null)
                                        {
                                                total <-- finger.LastScreenPosition;
                                                count <-- 1;
                                        }
                                }
                                if (count > 0)
                                {
                                        center = total / count; return true;
                                }
        }
```

Figure 7. Source code to change the of 3D and rotate the 3D object

B. System Implementation

1. Display on Application

When the application is run, the main menu will appear, which consists of the "Mulai" button to enter AR mode, the "Tentang" button to enter the application maker's information, the "Bantuan" button to see how to use the application, and the "Keluar" button to close the application shown in **Figure 8**.

Figure 8. Main Menu Display

After entering the Tracking Marker menu, the recognized marker will display a 3D object that can be rotated and scaled with the help of gestures on the screen of the device used. To see the story of hero in video form, press the “Play” button at the bottom of the application shown in **Figure 9**.

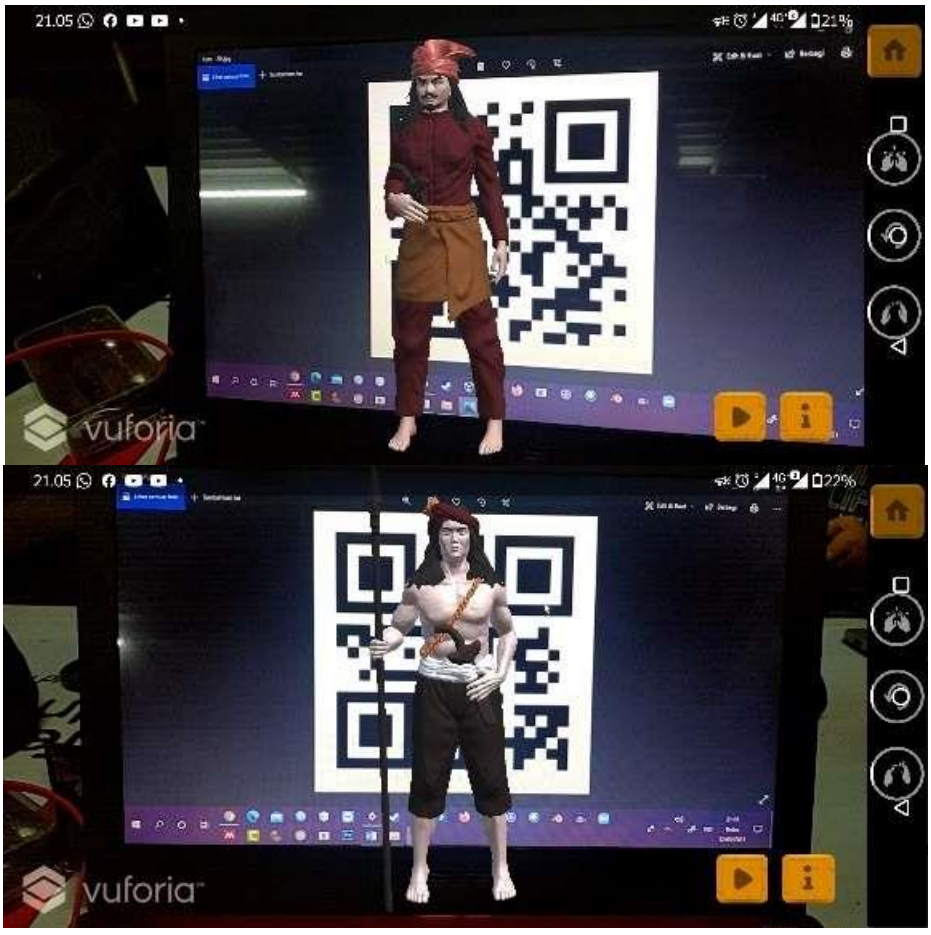


Figure 9. Display of 3D Object

After pressing the play button, a scene will appear that plays video and sound as well as shows an additional description of the tracked hero. The Description menu displays birth history, biographies and some important related information shown in **Figure 10**.

Figure 10. Description Menu

2. Application Testing

System testing on the Android-Based Museum Bawah Langit application that uses Augmented Reality Technology employs the Black Box testing method. After all errors are corrected, the next step is validation testing. Validation testing is considered successful if the software functions as expected by the user. Software validation is a collection of black box test series. The stages of testing carried out are explained as follows:

a. Distance Testing

The detection distance test is carried out to determine the level of stability and the limit of the farthest detection distance captured by the AR Camera.

Table 1. Distance Test

No	Distance (cm)	Figure	Explanation
1	5cm		Object is undetected

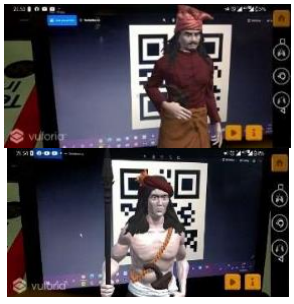
No	Distance (cm)	Figure	Explanation
2	6cm		Object is undetected
3	10cm		Object is detected and looks stable
4	20cm		Object is detected and looks stable
5	30cm		Object is detected and looks stable
6	40cm		Object is detected and looks stable
7	1 m		Object is detected and looks stable

From the results of the distance test shown in **Table 1**, it can be concluded that the camera will detect the object at minimum distance of 10 cm and a maximum of 1 m. At that distance, the marker will be clearly identified, so a 3D object from the hero object will appear.

b. Light Testing

Light testing is carried out to determine the level of stability that can be detected by the camera with the intensity of bright and dark light when the camera is spotted. The light test is detailed in **Table 2**.

Table 2. Light Testing

No	Light Intensity	Figure	Explanation
1	1 lx – 10 lx		Object is undetected
2	11 lx – 20 lx		Object is detected

3	90 lx – 100 lx		Object is detected and looks stable

Light test results indicate that the camera can identify objects well in bright light and cannot identify objects well in dark light. Objects will appear at room brightness level greater than 10 Lux.

c. Marker Testing
Marker testing is carried out to find out whether objects appear only on markers specified in the Android-Based Museum Bawah Langit application using Augmented Reality Technology shown in **Table 3**.

Table 3. Marker Testing

Tested Case	Expected Result	Result	Validation
Tracking Marker 1	The object appears according to the tracking marker Object 1		[✓] Success [ ] Fail
Tracking Marker 2	Objects will appear in according to the results of tracking marker 2		[✓] Success [ ] Fail
Inappropriate Tracking Marker	The expected result the application does not display any object from the marker that has been recorded		[✓] Success [] Fail

Conclusion

The application of Augmented Reality to the digital orientation sign system on the statues in the Museum Bawah Langit Makassar City is very useful for the public in getting an explanation of each statue. The explanation given is very attractive because the system produces three-dimensional output equipped by description of each statue. System testing is carried out by applying black box testing, which consists of AR camera distance testing, light testing and marker testing. In distance testing, the camera will optimally detect the object at minimum distance of 10 cm and a maximum of 1 m. On the other hand, using light testing, the object will appear at a room brightness level greater than 10 Lux.

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