

The Implementation of Augmented Reality in Keraton Kanoman's Museum

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ABSTRACT

Museums generally display historical objects such as heirlooms and artifacts. To observe this object more clearly visitors usually touch the display case or even hold the objects directly. The implementation of new normal behaviour expects people to avoid either direct or indirect. This study aims to find an alternative solution for reducing contact in museum, in this case by implementing the Augmented Reality (AR) technologies as one of the solutions for reducing contact in museums. By implementing it in form of mobile application that using Android operating system supported by Unity AR Foundation and ARCore. This research conducted at Keraton Kanoman in Cirebon City. The results of performances test show that 4 out of 10 objects displayed and can run 60 Hz refresh rates and 60 fps. However, the AR/VR development in Android is still limited due to ARCore incompatibility issues, the device proofs to run smoothly without having significant refresh or frame rates drop.

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1. INTRODUCTION

Museums generally display historical objects such as heirlooms and artifacts. Which are usually displayed on the display case, or only given a barrier. To observe more clearly, visitors usually touch the display case or even hold the objects directly. With the implementation of the new normal, people are expected to follow the new rules. One of which is reducing contact with objects that are often touched by other people. It is hoped that it can reduce the spread of other bacteria or viruses, not only COVID-19.

Augmented Reality (AR) can be a solution for visitors to reduce direct contact[1]. Information on heirlooms is displayed virtually. Such as similar 3D objects and infographics for these heirlooms, so that visitors are expected to reduce direct contact to comply with the new normal implementation. The AR technologies also could help to create more immersive experience in the museums, rather than walking around and examining the exhibit.

The AR technologies are no strangers to museum, usually to entertain and enhance visitor experiences. In 2015 at Natural History Museum of London, tried and tested the possibility of using AR to play scientific documentaries instead of building a theater room, the documentaries can be played in

handheld devices, Animated 3D models of extinct creatures were played in handheld devices[2]. Also in 2018 New York's Museum of Modern Art use AR to brightly-lit Jackson Pollock gallery on museum fifth floor, for some visitor the gallery remains the same as usual, but for the visitor with the MoMA Gallery Application and viewed the painting from the app, and they could see Pollock's painting mixed to the point that sometimes can't be recognized[2].

And in Barcelona, the Casa Batlló building designed by famous Catalan architect Antoni Gaudí, also use the AR technologies. In this building the AR is implemented with help of projectors, so that the visitors can see the layout of the original building. The projectors also making the wall "move and wave" dynamically, it really improves the visitors' experience[2].

2. METHOD

The heirlooms used in this research belong to Keraton Kasepuhan's Museum which is in Cirebon City. The heirlooms first are sorted, and 3D scanned, then they are converted as virtual objects. Next a mobile AR app is created. Next in the implementation, the Mobile AR app will be used by the visitors to scan the targeted images/objects. Which will display the 3D objects on their devices. The illustration of how the application work is shown in Figure 1.

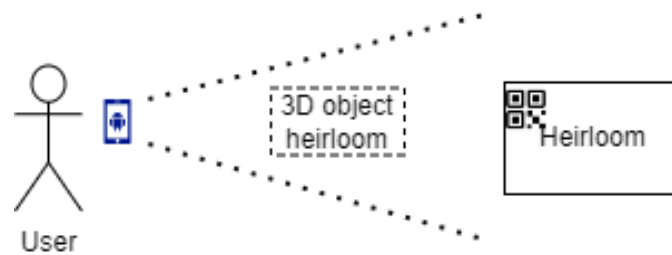


Figure 1. Illustration of app ways of working

2.1. Augmented Reality

Augmented Reality (AR) is a technology that adds digital visualization on a real environment interactively that combines real and digital objects in the form of 3D[3]. The AR application firstly began in form of Helmet Visual Display (HMD) for military pilots[4]. The helmet displayed some valuable information such as the altitude, speed, and others. Nowadays the AR application can be found in many things, such as on face filter in Instagram and Tik Tok, and on the game Pokemon GO that allows you to catch Pokémon in real world background and locations[5].

2.2. Unity AR Foundation

AR Foundation is a package in Unity Game Engine that allows multi-platform XR development. The package only serves Unity developers to use, but it does not implement the XR[6]. To implement this some separate package(s) are needed to install, such as ARCore XR plugin for Android, ARKIT XR plugin for iOS, and Windows XR plugin for Hololens.

2.3. ARCore

ARCore is a Software Development Kit (SDK) developed by Google and is open-source launched in 2018 with the aim to rival the ARKit SDK developed by Apple[7]. The ARCore has 3 main features:

- Motion Tracking
This feature tracks the phone's position in the real world and in real-time
- Environmental Understanding
Used to scan and detect size, and the surface condition
- Light Estimation
To estimate and adjust incoming light

2.4. Design and Development

The AR Foundation owns a lot of scripts to help to develop AR/VR applications. In this case we will use Image Tracking in this mobile app. As we can see in Figure 2, the Image Tracking script can track n amount of image target. However, the script can only load one virtual object. In this case we will use QR Code as the image target for it is uniquely identified and can be generated easily [8].

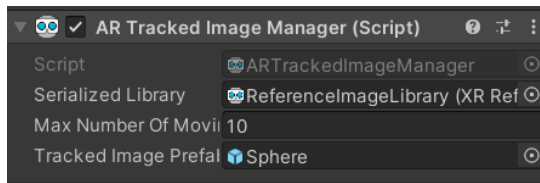


Figure 2. Default AR Tracked Image Manager Script

Thus, an additional script is written and imported to Unity to supplement it. The additional script written in C# language and expected can load n amounts of virtual objects. As we can see in Figure 3, the additional script can load 10 virtual objects.

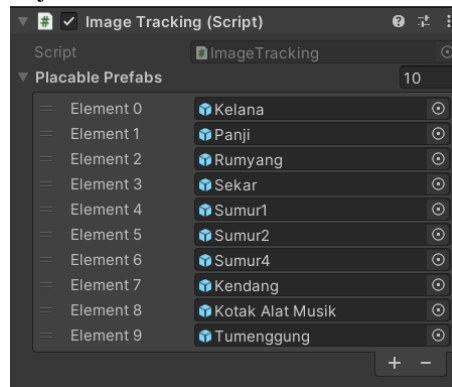


Figure 3. Additional Image Script

The workflow of the app is that whenever supposed target image is detected, then the script's algorithm will identify whether the target image is found on target image database, if the target image is found on database, the algorithm will then search the virtual object's database. It searches the object that has similar name from the target image database. When the object has been found, the object will be displayed. The flowchart of this work flow can be seen in Figure 4.

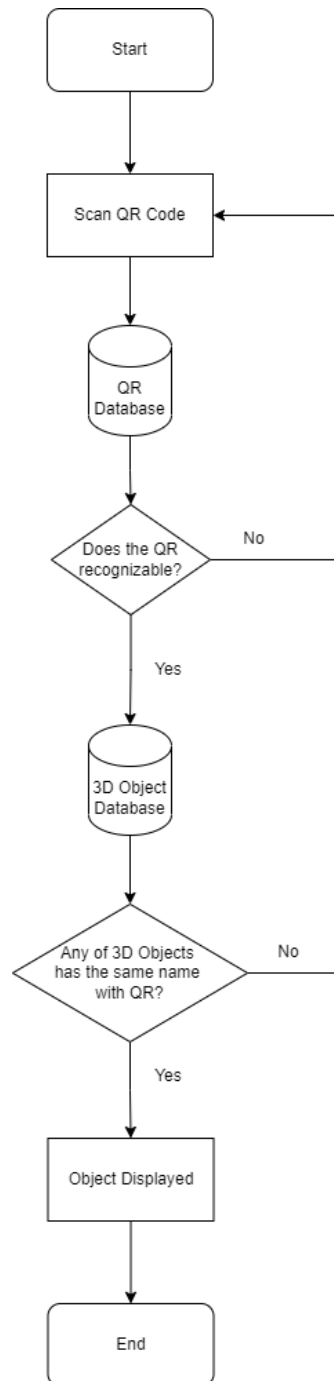


Figure 4. Mobile App Flowchart

2.5. Research Methodology

This research uses two ways in collecting the data. Both Qualitative and Quantitative methods. Qualitative approach is exploring and understanding between individuals or group(s) and ascribe it to a certain problem[9]. While Quantitative approach is testing objective theories while examining relationship among the variables, then the variables can be measured so that the data can be analyzed[9].

The parameters for qualitative methods in this research is using the study case, in this study case there are 10 3D objects available and we will be examine numbers of items that can be loaded, and numbers of item that loaded correctly. While the parameters for Quantitative methods are the numbers of frame rates and refresh rates displayed while running the app. The app then will be run 30 times over, so that the result of the test can be more comprehensive.

3. RESULTS AND DISCUSSION

In this section, we will take a look at the results of testing in various devices and conditions of the mobile AR app. The testing is conducted with black-box testing method, that is a method of test that examines functions or features in a program[10]. Sometimes Black-box testing method can also be referred as specification-based testing.

3.1. Device Used in Testing

According to the ARCore official documentation[11], the minimum requirement is Android 7.0(Nougat). ARCore also has a list of supported devices[12] that already being tested. In Figure 5 we will see the details of devices for testing the mobile AR app.

Table 1. Device used in testing

No	Device Name	Android Version
1	Samsung A22 5G	11
2	Infinix HOT 11S	11
3	Oppo A12	9
4	Vivo 1819	9
5	Realme 5i	10

3.2. Test Result

In Figure 5 we can see the sample of running application, the 3D object is displayed after recognizing the QR Code.

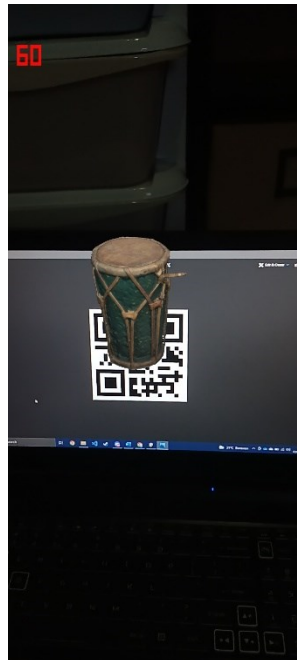


Figure 5. Running App

After being tested 30 times, the result is shown in Figure 7. The only device that can run the mobile app is “Samsung A22 5G” while the other devices can not run the mobile app because of the ARCore compatibility issue. These compatibility issues are not because of their Android Version is outdated, or their hardware specification is underwhelmed, but rather because these devices have not obtained the ARCore certification process yet.

Mostly 4 3D objects can be loaded in 1 running sequence, averaging 3.83 loaded objects. The maximum number of loaded objects in 1 sequence is 6 while the minimum number of loaded objects is 1. The correctly loaded objects also 4 3D Objects in 1 running sequence, averaging 3.67 correctly loaded object. While also loaded 6 objects in 1 sequence at maximum, while loaded 1 object in minimum. The frame rate steadily goes around 60.2~60.4 fps while the refresh rates is 60 Hz without dropping.

Table 2. The result of device testing

Samsung A22 5G				
No	Frame Rates(fps)	Refresh Rates (Hz)	Loaded Objects	Correctly Loaded Objects
1	60.2~60.4	60	3	3
2	60.2~60.4	60	5	4
3	60.2~60.4	60	3	3
4	60.2~60.4	60	4	4
5	60.2~60.4	60	2	2
6	60.2~60.4	60	6	4
7	60.2~60.4	60	4	4
8	60.2~60.4	60	4	4
9	60.2~60.4	60	4	4
10	60.2~60.4	60	3	3
11	60.2~60.4	60	3	3
12	60.2~60.4	60	5	5
13	60.2~60.4	60	6	6
14	60.2~60.4	60	1	1
15	60.2~60.4	60	4	3
16	60.2~60.4	60	4	4
17	60.2~60.4	60	5	5
18	60.2~60.4	60	3	3
19	60.2~60.4	60	2	2
20	60.2~60.4	60	4	4
21	60.2~60.4	60	4	4
22	60.2~60.4	60	4	4
23	60.2~60.4	60	5	5
24	60.2~60.4	60	4	4
25	60.2~60.4	60	5	5
26	60.2~60.4	60	3	3
27	60.2~60.4	60	5	5
28	60.2~60.4	60	3	2
29	60.2~60.4	60	4	4
30	60.2~60.4	60	3	3

4. CONCLUSION

While not all the 3D objects are loaded by the tested device, averaging just 4 out of 10 available objects, the frame rates and refresh rates are acceptable. At default the refresh rates for Android Devices is between 60 Hz to 90 Hz, as for frame rates the near 60 fps, and at 60 fps or more is considered running smoothly[13], while below that or if the fps is terribly dropped it is considered *laggy*.

The ARCore also does not compatible to some Android Devices even though the devices meet the minimum requirements. This can make the Android environment is not suitable for developing AR/VR applications. It is recommended that both the ARCore Development Team and Android phone brand solve these issues immediately, so that AR/VR developers could bring more of AR/VR experience for more people.

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