The evaluation on a mobile augmented reality application as therapy media

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Abstract. ARdoa is Mobile Augmented Reality (MAR) application used as a therapy media for children with Autism Spectrum Disorder (ASD). The content of this application is daily prayers for Muslim children, and it is designed in the form of audio-video animation. This paper is aimed at discussing the evaluation and testing of the development process of MAR ARdoa. Technical evaluation and testing are conducted on several aspects, specifically testing the detection and tracking. Moreover, the method used in the process is to identify the distance, surface area and ideal conditions for the utilization of this application. The completion of the test is based on whether or not the content appearing on the marker has been made. From the evaluation and testing process, it is obtained ideal distance, surface area and conditions for the utilization of MAR ARdoa that can be used as standards for its development.

1 Introduction

Technology has a great potential to be used as a tool in the provision of support in the field of education for people with ASD [1]. Some researchers have been undertaken as part of the development and support for people with ASD, in form of games [2], [3] interactive visual support applications [4] as well as other supporting applications [5], [6], [7], [8], [9]. Of some developed applications, most of them are mobile-based applications. With its *ubiquitous,* mobile technology especially mobile phones and tablets is expected to be one of the tools in the treatment of children with ASD [10]

Augmented Reality (AR) is an application that can combine virtual objects in the real world [11]. AR has a great potential to attract, inspire, and motivate users to explore and controlling of different perspectives [12]. Hopefully, MAR Ardoa can be used as an alternative therapy media and enrichment for therapy media for children with ASD. This study discusses the testing of MAR Ardoa [13] of some technical aspects. The purpose of this test is to identify how to apply an ideal MAR Ardoa technically.

2 Supporting theory

Methods tests applied in this study are adapted to those proposed by Ibanez and Figures [14]. The tests are based on the capabilities of a device (smartphone) in identifying the target image and displaying the content that has been created.

The first test is done by testing MAR Ardoa on the device (smartphone). The next test is a test based on the rating target image obtained on the web vuforia, wherein an image the target rating indicates whether or not a marker is detected by all the AR system [15]. The next test is the test for the detection. This process is performed to determine the ability of the application to recognize the target image. Some of the tests performed are time, distance, and surface area range testing.

3 Testing methods

3.1 Testing device

The testing methods are adapted to the methods proposed by Ibanez and Figure [14] with some additions, focused in detection characteristics. MAR Ardoa prototype is tested using three smartphones with different specifications. The two smartphones, i.e. Xiaomi redmi 4x and Samsung J5 Prime have similar specifications; whereas, Andromax, has lower specifications. This kind of testing is conducted in order to examine the effects of the device specifications used for Ardoa application.

Table 1. Device specifications.

Device	Specifications
Xiaomi redmi 4x	CPU Octa Core 1.4 GHz Cortex 435 Android 6.0.1 (Marshmallow) Chipset Qualcomm Snapdragon 435 Camera 13 MP Ram 3 GB 5-inch, 720x1280 pixels
Samsung J5 Prime	CPU Quad Core 435 1.4 GHz Cortex Android 6.0.1 (Marshmallow) Chipset Exynos 7570 Quad

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Device	Specifications
	Camera 13 MP Ram 2 GB 5-inch, 720x1280 pixels
Andromax A	CPU Quad-core 1.1 GHz Cortex A7 Android 5.0 Lollipop Chipset Qualcomm MSM8909 Snapdragon 210 5MP Camera Ram1 GB 4.5-inch, 480x800 pixels

MAR Ardoa is installed on the three devices described in the table 1 above, and it is found out that all three devices can run the application smoothly without any interruptions. Although all three of these devices have differences on RAM specifications, camera, and the screen, the results displayed by those three can be said to run in accordance with the needs. Moreover, the contents (prayer before studying, having meals and going to bed) of MAR Ardoa can run smoothly.

For further testing, the testing process is done by using a smartphone that has significantly different specifications. Based on the specifications in the table, then only 2 smartphones used for the testing process are Xiaomi redmi 4x and Andromax A.

In this test, the marker used is printed on A4 sized paper with an image size of 19.46 cm x 19.92 cm. The printing process is done in Color and Gray Scale settings. Each test is repeated for 3 times, then their average is used as the final result.

3.2 Image rating target testing

Testing the target image rating is obtained from the Ardoa target image upload process on Vuforia website.

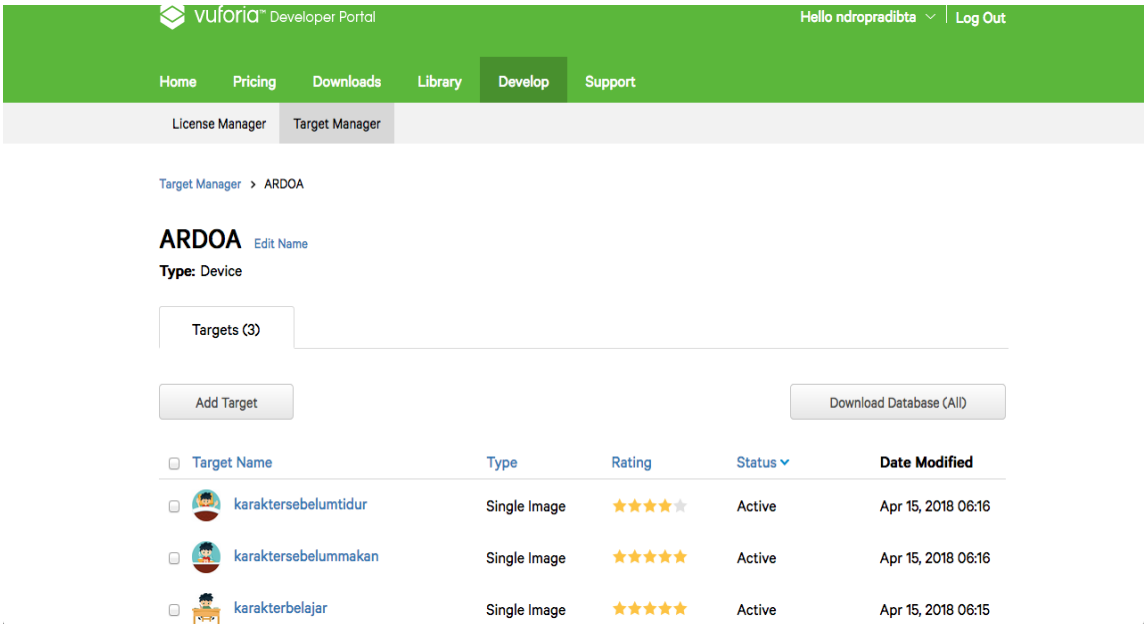

Fig. 1. Image target manager.

The rating number of stars shows a good detection quality. The more the number rating of the star is, the better the image of the target is detected.

Table 2. Image target and rating.

Image Target	Rating
	★★★★★
	★★★★★
	★★★★☆

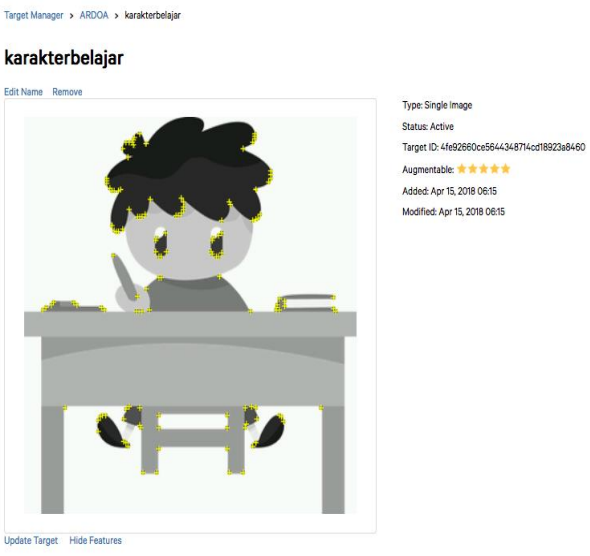

Fig. 2. Feature of studying character.

Figure 2 showing a studying character, and from the results shows the 5-star rating. Thus, it can be concluded that the image marker that is used for this character has good details. It can be seen from the picture that there are a lot of features showing points.

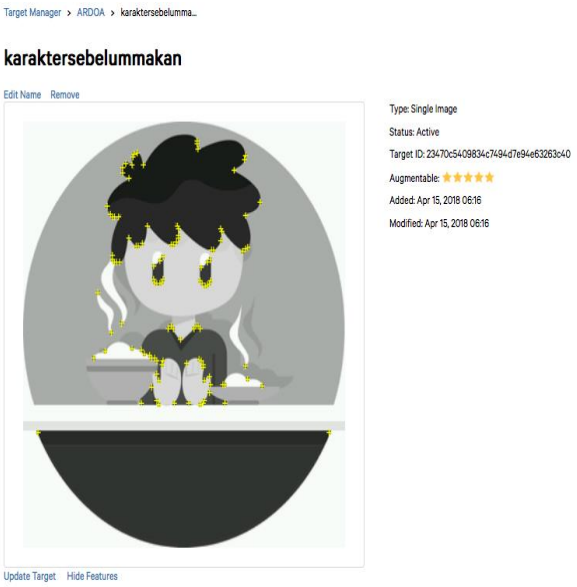

Fig. 3. Feature of before having meal character.

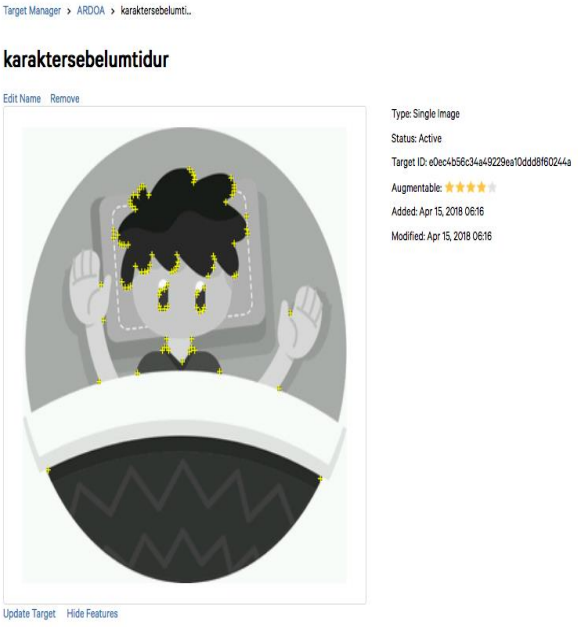

Fig. 4. Feature of before going to bed character.

3.3 Testing the detection of

3.3.1 Testing of color printing

The detection testing is done by printing the target image on A4 sized paper with the target image size of 19,46cm x 19,92cm. The printing is done in color and grayscale color settings. The test results show that in the color and grayscale color settings, both devices can display the contents contained in the target image both with and without any constraint. For the subsequent testing process, the target image used is the target image in grayscale color settings.

3.3.2 Testing of detection time

The detection time testing is conducted to determine the time required for the smartphone to recognize the target image created. The testing is done by opening the MAR Ardoa on the smartphone, then directing its camera at a particular target image. The test is considered successful if the target image can display the contents according to the target image. From the early detection testing process of the target image, it is obtained that the average time is <2 seconds for all devices.

Table 3. Detection time testing.

Device	The average time
Xiaomi redmi 4x	<2 seconds
Andromax A	<2 seconds

3.3.3 Testing of the minimum distance detection

The testing of minimum distance detection is conducted to obtain the minimum distance the device in recognizing the target image. The testing process is done by putting the target image at its farthest distance then continually the smartphone approaches the target image. The test is considered successful if the smartphone can detect the target image.

Table 4. Minimum distance detection testing.

Device	The average distance
4x Xiaomi redmi	100 cm
Andromax A	68 cm

3.3.4 Testing of surface area

The testing process is done by covering a specific area of the target image with the parameters of 25%, 50%, and 75%. Moreover, it is done by dividing the target image by folding it into 4 parts.

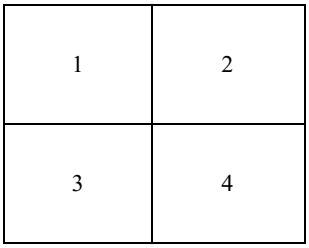

Fig. 5. The distribution of surface area.

Later in the process of the surface area testing, the paper is folded and scanned using the smartphone. The test is considered successful if the smartphone can detect the target image and audio content display the corresponding video.

Table 5. The surface area covered.

Area covered	Description
	The surface area is 0% covered
	The surface area is 50% covered (visible areas 1 and 2)
	The surface area is 50% (of the visible area 2 and 4) covered
	The surface area is 75% (of the visible area 1) covered

Table 6. The surface area of studying character.

Covered area	Status	Description
25%	emerging	Image targets can be detected
50%	emerging	Image targets can be detected
75%	emerging	Image targets can be detected

Table 7. The surface area of before having a meal character.

Covered area	Status	Description
25%	emerging / no	In area 1, 2, the content appears, while area 3, 4 content cannot appear
50%	emerging	Image targets can be detected
75%	emerging	Image targets can be detected

Table 8. The surface area of before going to bed character.

Covered Area	Status	Description
25%	cannot appear	In 3 and 4 area, the contents cannot appear
50%	appear/can not	In 3 & 4 area, the content cannot appear, while the content 1 & 2 content can appear
75%	appear	the image target can be detected

4 Conclusion

Based on the results of testing that has been done, it can be concluded as follows:

- MAR Ardoa can run well on all three different smartphones. This shows that the difference specification does not provide the difference in the performance of MAR Ardoa.
- The differences from the use of the device (camera) specification are found at the early detection of the target image. It takes a different minimum distance at 2 devices (68 and 100 cm). The best distance is use 30-40 cm (assuming the target image is printed on A4 sized paper)
- The image targets used in MAR Ardoa can be detected well, although with a different color setting. This suggests that whether or not the target image on vuforia rating is not based on color [16], but based on the features contained in the target image.
- The image features also affect the testing process of the surface area [17]. In the particular target image, the closure of the surface area by 75% causes the target image is not detected, it is because in certain parts (25% of which is visible) there are not many image features.

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