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Implementation of Augmented Reality as an Information Media for the Collection of the Popa-Eyato Museum

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Abstract

Museums are facilities that display historical objects and provide information to the public and visitors. However, the presentation of information in the museum to the visitors is far from proper due to the lack of details. The guides provided in the museum are not quite engaging. More than that, the information provided is only in the form of a sheet of paper stuck in the collection. This present study aims to develop information media using augmented reality technology. The method used in this research was the Multimedia Development Life Cycle (MDLC), which had six stages, viz. concept, design, material collecting, manufacture, testing, and distribution. This research develops an application that works as a medium of information related to museum collections using augmented reality, which is more interactive and visitors can use to obtain information from the collection. In addition, this application can visualize 3D and in real-time ethnographic objects in the museum.

***Keywords**: augmented reality; collection; ethnographic; museum*

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PENDAHULUAN

Technological developments in the current era are increasingly rapid in several aspects, including Augmented Reality (AR) technology, which has made several contributions in various fields, including advertising, marketing, construction, and entertainment. Museums are an example of AR technology's adoption as a medium of information. Museums are defined as buildings to exhibit collections of historical objects and as an education for the visitors. Further, each museum's existing collections have some information on display (Vitono et al., 2016).

There are many historical collections at the Popa-Eyato Museum in Gorontalo Province, and visitors can view and learn from the writings in the collection. Additionally, visitors will be accompanied by a guide to explain information related to the museum collection. In providing information for museum collections, there is a problem where the information obtained by visitors is not optimal due to the schedule of visits to the museum, which receives more than 50 visitors every day. Hence, only a few will be accompanied by a guide.

This study aims to develop the informatic media to be more interactive by utilizing AR technology that uses smartphones as a medium in providing information related to museum collections to visitors. AR technology can be a solution related to information on museum collections and museum collections, and it also helps to make attractive visualizations to persuade the visitors. Azuma (1997) defines AR as a medium for combining real and virtual objects in a real environment and running interactively in real-time. Further, according to Chari et al. (2008), AR improves user perception and interaction with the real world; virtual objects convey information that users cannot directly perceive with their senses. The virtual object's information assists the user in learning the information in the museum. Furht (2011) stated that AR is an indirect vision of the real world that has been enhanced by adding virtual information based on real-time. In brief, AR aims to simplify information in the virtual world from the environment to view the information directly and then display it based on the real world. In addition, according to Haller et al. (2007), AR is the development of technology that combines real-time digital content created by computers in 3D.

From previous research on the use of AR technology in museums, which Soraya (2018) conducted, AR applications have been produced that aim to be a promotional medium for museums. The selection of AR media is more effective, exciting, and communicative in its delivery so that the public more easily understands it. Utilization of AR technology, museum collections are presented virtually with 3D objects in the form of text and images and displaying parts of the museum collection and their descriptions. The museum collection is designed according to its original form so that the public can know the original form of the collection. Then each collection is equipped with a marker, as for Saputra (2014), applying an AR application that functions as a medium of information related to collections of ancient fossils and can be done for replicas of real objects rather than fossils. AR is used in building information applications for recognizing ancient fossils; thus, it becomes more interesting and interactive, whether it be displaying videos or 3D animations and even being able to apply sound as support by using supporting hardware, namely a cellphone, visitors show the cellphone to the fossil skeleton object with camera facilities. Furthermore, Harto (2017) produced an AR application as an educational medium that can display 3-dimensional objects, text, and audio. AR can help the public find out the contents of the description of the documentary photos in the museum in an informative, interesting and educative way.

The use of AR can assist museum visitors in learning about the museum's collection (Pramana et al., 2018). AR is a technology that is currently evolving and in demand, according to Brata et al. (2018), and it offers new prospects as an alternate medium for recognizing things in museums. When AR is used in museums, it produces virtual information presented to visitors (Yudiantika, 2013). Meanwhile, according to Haryani and Triyono (2017), AR technology can increase user perception and interaction between the virtual and real worlds. AR can be an interactive technology that can be used to introduce cultural heritage assets to the public since it has three characteristics: interactive, real-time, and 3-dimensional objects.

AR technology can visualize two-dimensional and three-dimensional objects for real. In AR technology a marker is needed to recognize and detect objects, this technology is very suitable for the above problems, which can make it easier for visitors to get detailed information related to existing collections, and get good visualization, through the camera on the Android smartphone and then displays some information related to the collections in the museum (Novitasari, 2020). Djafar and Novian (2021) state that AR can display 3D information in real-time and a marker is needed as an intermediary through each user's Android smartphone. By utilizing AR technology, museum collection objects look more informative, assisted by using good visualization of existing collections (Wulansari and Waluyo, 2010).

METODE

The method used in this research is the Multimedia Development Life Cycle (MDLC), this method has six stages, namely concept, design, material collection, design, application testing, and distribution (Binanto, 2010). The flow of stages can be seen in Figure 1.

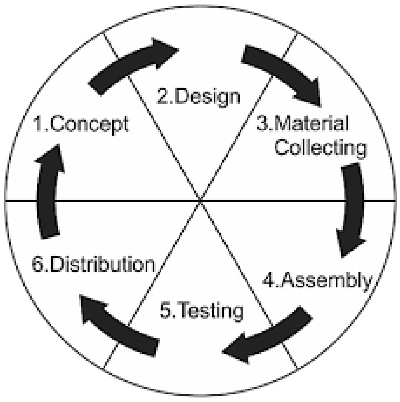


Figure 1. MDLC (Binanto, 2010)

1. Concept

   The purpose of this study is to use AR technology as a medium of information for the collections of the Popa-Eyato museum in Gorontalo Province. This stage begins with determining the purpose of making this application, the target user of the application, and what materials will later be displayed on the application.

2. Design

   In the second stage, there is a design, namely the concept that has been made previously in the early stages has been finalized, the purpose of this design stage is to make detailed specifications of the AR application to be made, this stage will create an application flow designed using Unified Modeling Language (UML).

3. Material collecting

   The third stage involves gathering reference materials in the form of images and display pieces. Following the design stage, the material will be gathered by observing the study area and seeking references connected to museum collections, which will then be visualized via AR.

4. Assembly

   The next stage is the merging of digital elements, markers, and the results of 3D object designs, as well as a marker database in this case based on the previous stage, namely the design and use of information obtained from the collection of materials, creating applications using the Blender application, Unity 3D, and the Vuforia SDK, and using the C # programming language in the Unity 3D engine at this stage of manufacture.

5. Testing

   The next stage is testing, which involves checking the accuracy of the marker and whether or not the application is running properly. In this case, the test is carried out using white-box and black-box methods; white-box testing is used to check the structure of the program code used in the application, while black-box testing is used to check the application's functionality; in this case, the test will be carried out on the button.

6. Distribution

   The last stage in the MDLC is Distribution, at this stage where applications that have been declared good, following the objectives of the research and application development, will be distributed to museum visitors and museum staff, at the distribution stage, questionnaires are also distributed using SUS (System Usability Scale) to determine the user's perception of the application.

HASIL DAN DISKUSI

From the results of the research conducted, the AR application design became a development as a medium in providing collection information to museum visitors.

The system architecture is a way of working on AR applications to display virtual 3D visualization of objects; here is the system architecture that has been designed as shown in Figure 2.

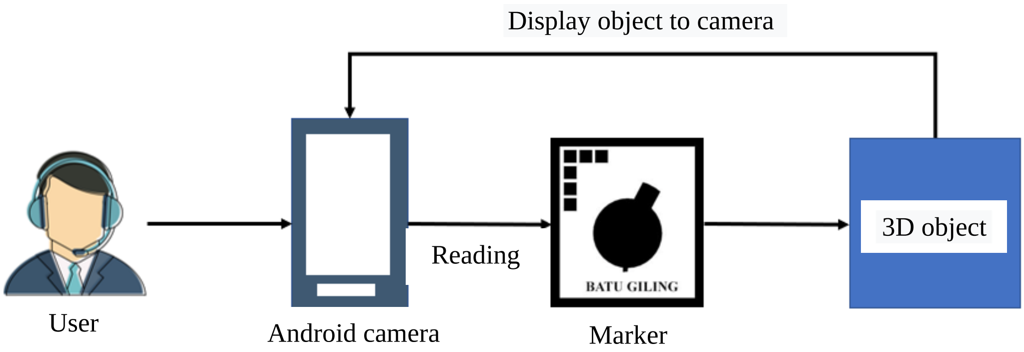


Figure 2. AR application system architecture

1. Users can use an Android smartphone to open the app, which will then display the AR camera.
2. The application displays the menu, the application menu is the AR start menu, the user guide menu, the application information menu, and the museum information menu.
3. In the AR start menu, the application will access the AR camera to scan existing markers and display 3D objects from museum collections, museum information, and collection galleries.
4. The user manual menu demonstrates how to use the application.
5. The application information menu shows details about the program's creation.
6. The museum information menu contains museum information and displays videos from the museum profile.

This study results in an augmented reality application with multiple menus, including an augmented reality start menu, usage instructions menu, application information menu, and museum information menu. The menu is designed to be as simple as possible so that users can reach it quickly.

Concept

The initial stage is to produce a concept where users will use smartphones and run AR applications, through these applications users can scan directly using markers that have been provided then through the smartphone screen the application will display information from the scanned collection. This application is designed using the C# programming language used in the Unity 3D Engine.

a. Functional requirements

The purpose of functional requirements is to present an overview of the features or functions that AR as a medium of information must implement. The functionalities required are:

- The marker-tracking function where markers are available for scanning objects
- The function of displaying objects, the object will be displayed when the marker is successfully read by the AR camera
- The function provides information based on the scanned object.
- The ability for the scanned object to emit narrative or sound.
- The function of displaying general information and videos related to the museum.

b. Non-Functional Needs

The following are the recommended hardware specifications:

- A 2,2Ghz Smartphone Processor
- 4GB RAM
- Minimum 16GB internal storage on Android device.
- The operating system must be at least Android 5.0 or Lollipop.

User needs, AR-based collection information media applications can be used by visitors and museum employees since the application is designed to be as simple as feasible to use.

Design

The purpose of the application's design is to ensure that the requirements for the application creation process are well prepared. UML (Unified Modeling Language) diagrams are used in the application design to depict the interaction between objects.

Material Collection

In the material collection, data is collected based on the application's needs, such as information about the collection to be displayed, which is in the form of a collection description and images. After obtaining the information, the material will be created to be used in the 3D Unity application the creation of applications. Using Vuforia as a database to store marker images that will be designed through the Photoshop application for creating AR applications.

Assembly (Creation)

At this stage, the application design is carried out, in the form of making markers, and 3D objects and combining some of the information obtained from the previous stage.

a. Marker Making

The marker is made using the Photoshop application, the marker is designed according to the number of objects that will be displayed in the application, then the marker is made into a database on Vuforia as shown in Figure 3.

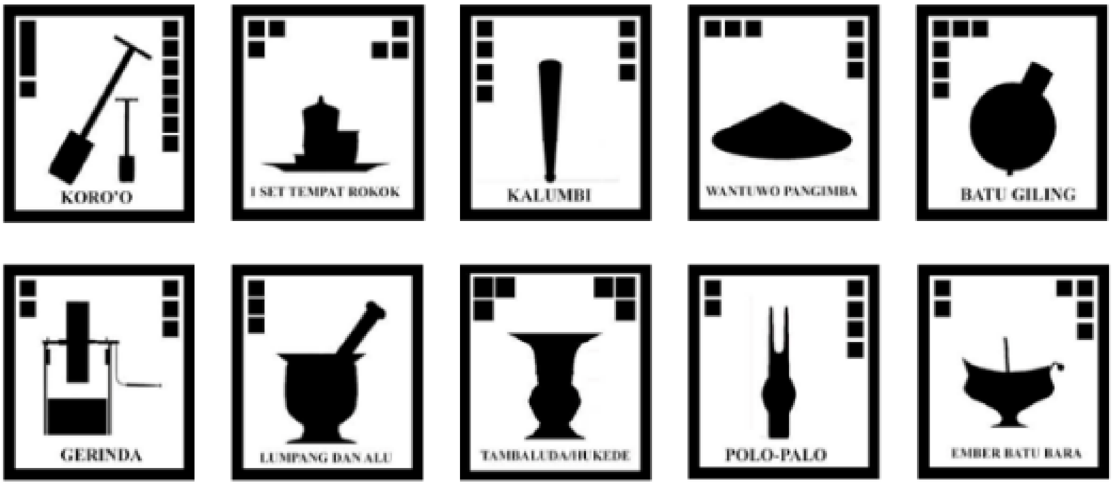


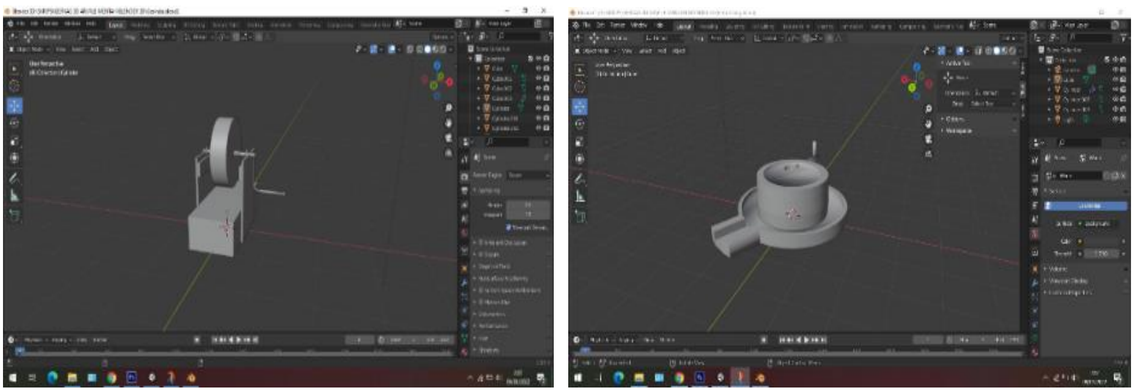
Figure 3. Marker

b. 3D Object Creation

In making an AR application like the one in Figure 4a and Figure 4b, a very important component is a 3D object. The object is created using the Blender application which is taken from the original object reference, then the objects that are visualized are made into the object, export the file in FBX format so that it can be read in Unity 3D.

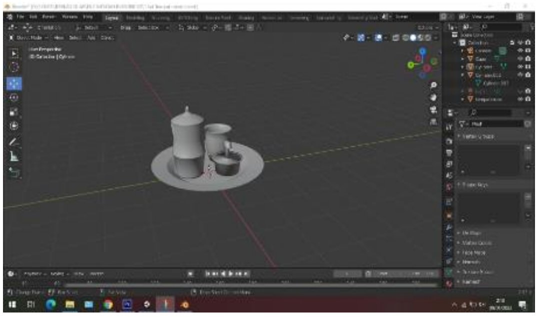
The objects that are visualized are:

a. Grinding
b. Millstone
c. Cigarette Holder
d. Coal Bucket
e. *Kalumbi*
f. Koro'o
g. *Polo-palo*
h. Set Mortar and Pestle
i. Wantuwo Pangimba
j. *Tambaluda*

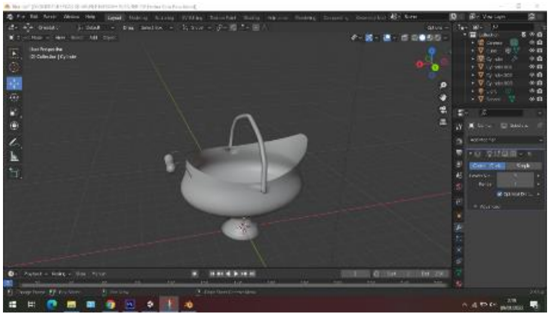


(a) Grinding (b) Millstone

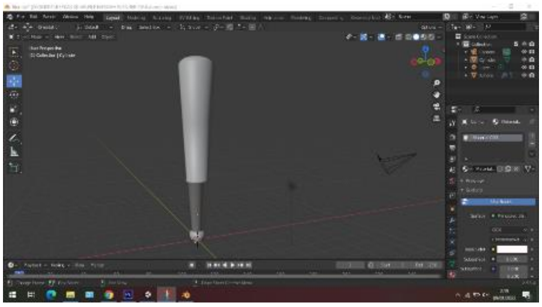
Figure 4a. 3D object design



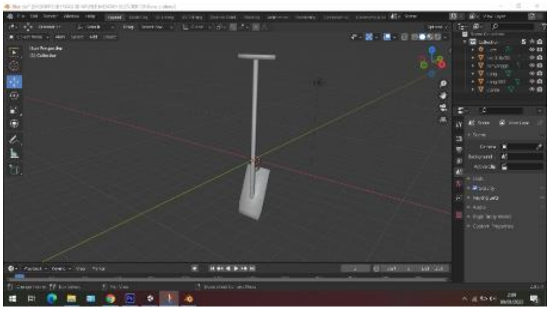
(c) Cigarette Holder Set



(d) Coal Bucket

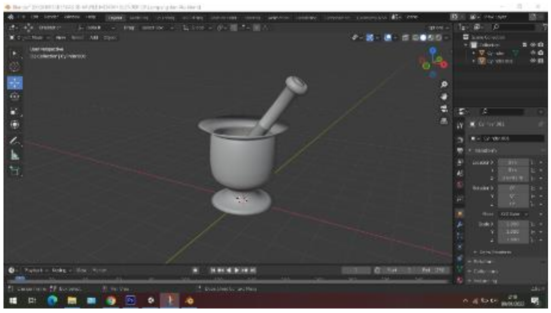


(e) *Kalumbi*

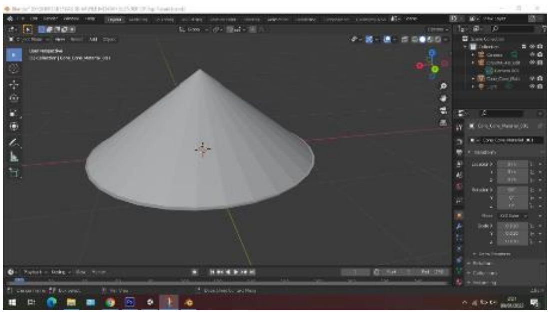


(f) *Koro'o*

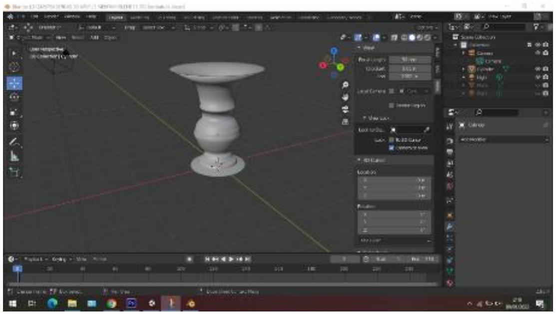
(g) *Polo-palo*



(h) Mortar and Pestle



(i) *Wantuwo Pangimba*



(j) *Tambaluda*

Figure 4b. 3D object design

c. Database Creation

The created markers are then stored in Vuforia to generate a marker database; to access the database, you must first log in to the Vuforia website; after that, the markers are uploaded to the Vuforia website; finally, Vuforia will combine all of the markers and create a package database with each target image.

d. Application Development for Augmented Reality

All materials will be incorporated into the Assets unity in this design, and then each interconnected component will be merged (Figure 5).

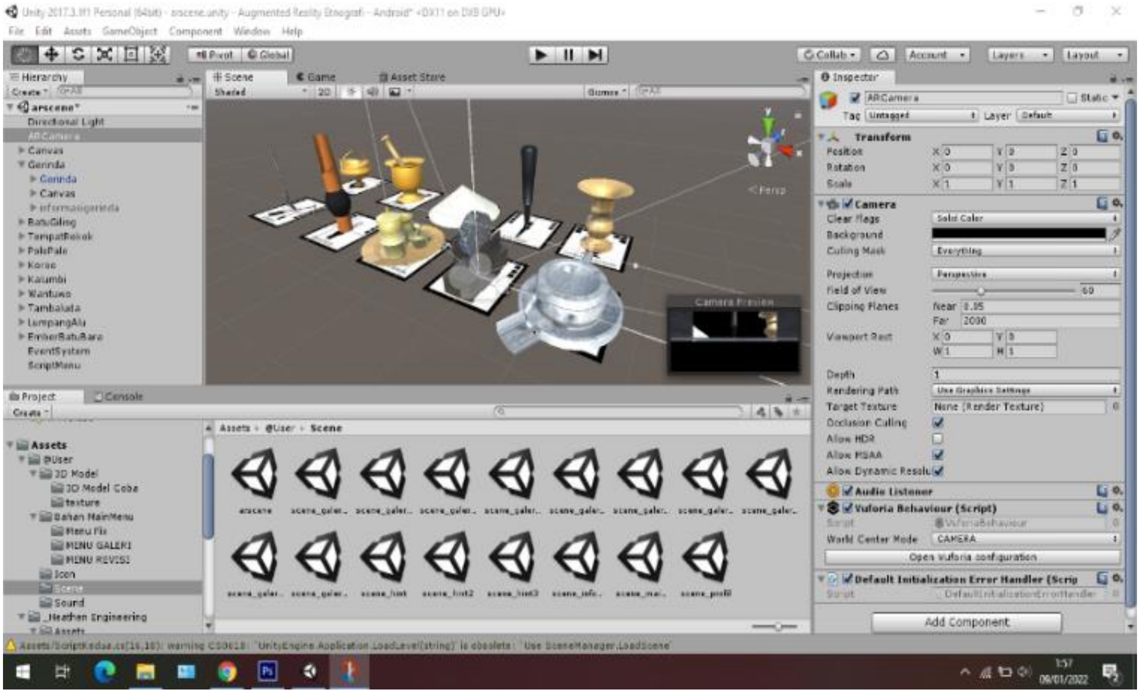


Figure 5. Merging markers and 3D objects

Testing

Application testing is carried out at this stage, and it helps to test the application's major functions to see if they work as planned. The test to be carried out is Black box testing.

1. Black-box Testing

   This test is used to check an application's functionality; in this case, testing will be done on the button's function to the marker detecting function to display 3D objects, using test cases as shown in Table 1, Table 2, namely testing marker detectors, buttons, menus, and functions.

Table 1. Marker detector test

No	Test	Result	Details
1	*Tambaluda* Marker Detection		Succeed (Markers can display objects in 3D well)
2	Millstone Marker Detection		Succeed (Markers can display objects in 3D well)

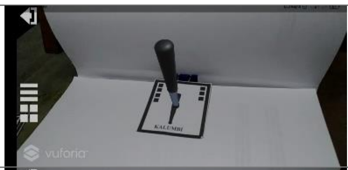
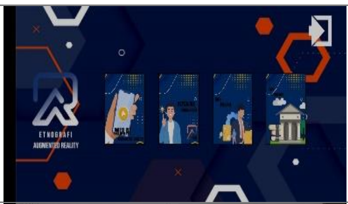
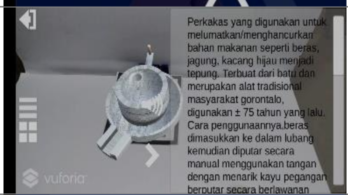
No	Test	Result	Details
3	*Kalumbi* Marker Detection		Succeed (Markers can display objects in 3D well)
4	*Wantuwo Pangimba* Marker Detection		Succeed (Markers can display objects in 3D well)

Table 2. Button test

No	Test	Result	Details
1	Testing the Menu Button towards the main menu.		Succeed (Main Menu is displayed when the enter button is pressed)
2	Testing the Information Button on the Augmented Reality Start Menu, and the Sound Button		Succeed (The Information Menu Button displays object info and the Sound Button can output a narration of the information).
3	Gallery Button Test		Succeed (Gallery Can be viewed after a marker has been detected)
4	Testing Menu Button Instructions for Use		Succeed (Instructions for Use can be seen).

Distribution

After the testing and creating phase is done, the program is published in the .apk format thus the program is ready to be installed on Android devices. Next, the application is uploaded and stored in cloud storage to make it easy to access and install. Meanwhile, the marker image file will be posted to cloud storage as well as the .apk file.

SUS Score Analysis

At the distribution stage, questionnaire sheets were also distributed using SUS. SUS can be used to conduct independent technology testing on hardware, software, websites, and even mobile devices (Ependi et al. 2017).

The process of calculating the results of application testing has several stages as follows:

- Every statement in an odd number will be deducted by one from the score (X-1)
- Each statement is numbered even from the score minus the score from 5 (5-X)
- Add up the values of the odd and even statements and then multiply the total score by 2.5.
- The calculation of the SUS value was done by adding up the total score of each respondent. The average value of the evaluation results is obtained from the total score divided by the number of respondents involved.

Of the 30 respondents involved, a total assessment of 2,140 was obtained which was then divided by 30 the number of respondents, so the average score was 73.3. Based on the final result of the respondent's assessment, which then determine the grade, which is done by dividing it to two stages, namely: Acceptability Ranges, Grade Scale, and Adjective Ratings (Figure 6) (Bangor et al, 2009), then the second stage is in terms of the SUS Score Percentile Rank, as shown in Figure 7 (Broke, 2013).

Acceptability Ranges, Grade Scale, Adjective Ratings.

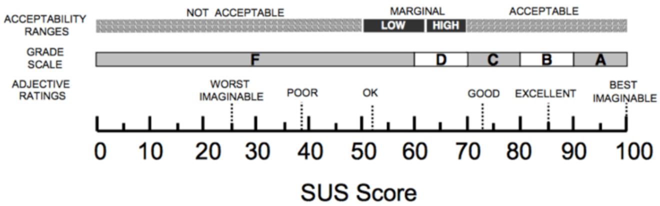


Figure 6. Assessment results determination (Broke, 2013)

Based on the average from the results of the questionnaire calculation, it is obtained 73.3. Therefore, the acceptability range level is included in Acceptable, the grade scale level is in C, and the adjective rating is in a Good category, which means the application can be accepted by users and is easy to use.

SUS Score Percentile Rank

The determination of the SUS score percentile ranking is as follows (: 1) A grade ≥ 80.3; 2) 74 ≤ B < 80.3; 3) 68 ≤ C < 74; 4) 51 ≤ D < 68, and 5) F < 51. The results of the respondent's assessment obtained a value of 73.3, according to the second stage of assessment included in grade B. Thus, at the distribution stage using SUS, users can see the AR Ethnography application received a score of Good, indicating that this application can be used well by users and is acceptable.

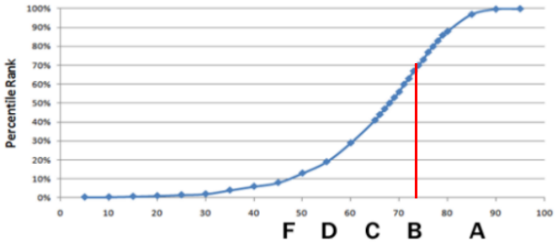


Figure 7. SUS score interpretation

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CONCLUSION

The implementation of AR in the museum collection provides a new alternative to the use of technology by providing several interactive menus and arrays such as displaying 3D objects, information media, and narratives from each object. The outcomes of the application are in the form .apk which is then installed on each user's Android smartphone. The average value of user satisfaction calculated from the questionnaire data using the System Usability Scale (SUS) is 73.3, indicating that acceptance is in the Acceptable category, the grade scale level is on the C scale, and the adjective rating is in a Good category. The interpretation of the SUS score percentile rank is grade B, which has a Good adjective rating.

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