Implementation of augmented reality to models sultan deli

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Abstract. Augmented reality is a technology that can provide visualization in the form of 3D virtual model. With the utilization of augmented reality technology hence image-based modeling to produce 3D model of Sultan Deli Istana Maimun can be applied to restore photo of Sultan of Deli into three dimension model. This is due to the Sultan of Deli which is one of the important figures in the history of the development of the city of Medan is less known by the public because the image of the Sultanate of Deli is less clear and has been very long. To achieve this goal, augmented reality applications are used with image processing methodologies into 3D models through several toolkits. The output generated from this method is the visitor's photos Maimun Palace with 3D model of Sultan Deli with the detection of markers 20-60 cm apart so as to provide convenience for the public to recognize the Sultan Deli who had ruled in Maimun Palace.

1. Introduction
Sultan Deli is one of the important figures in the history of Medan. But the people of Medan themselves are still less familiar with the Sultan of Deli who had ruled in Maimun Palace. This is based on the lack of documentation on Deli Sultanate which has been very old and less clear so that the introduction of Sultan Deli to the community is still minimal. Therefore it is necessary a technology that supports to be able to display the model of Sultan Deli and his royal bodyguard with details so that people can recognize the Sultan of Deli who ever ruled. The technology is one of them is by using augmented reality technology.

Multimedia in a technology can complement the technology [1]. Multimedia has an important role in all aspects, because multimedia is a trigger (trigger) to get something 'more' from the topic being studied. One of the multimedia that will provide the convenience is modeling the object. Modeling the object changes the two-dimensional shape into three dimensions so that the object will appear more real. Augmented Reality can combine systems of three-dimensional and two-dimensional objects with the real world. Augmented Reality makes it easy for users to understand and recognize the existing cultural heritage. With a very interesting Augmented Reality function, the application of Augmented Reality technology to the introduction of Sultan Deli who once ruled in Maimun Palace is needed.

The implementation of augmented reality for cultural preservation especially in modelling historical ground such as palace has been conducted before. They area Darul Arif Palace in Serdang Sultanate [9], Tanjung Pura Palace [11], Historical Building in Medan City [10] and Historical Game [12]. Augmented Reality The Sultan of Deli can display three dimensional models from Sultan Deli along with his royal bodyguards coupled with camera features that allow visitors to Maimun Palace to be able to take pictures with the three-dimensional model. Sultan Deli is loaded in three dimensions through this application.
provides an overview for users to know the history of the Deli Sultanate in the Palace Maimun. The Deli Sultanate in Maimun Palace is one of history in the city of Medan so that the augmented reality application of Sultan Deli can provide optimal function for its visitors. Augmented Reality Technology Sultan Deli is expected to provide optimal results and in accordance with the design of the Augmented Reality.

2. Identification of Problems
The documentation of the photo of the Sultan of Deli in Maimun Palace is still very minimal, unclear and very old. The available images are still black and white. By utilizing one of the existing photographs as a reference of this research then formed the model of Sultan Deli and royal bodyguards including clothing with detail using 3D model applications so that visitors Maimun Palace can know more clearly than the photos in the Palace Maimun it. Models formed into three dimensions will be displayed via smartphone with augmented reality technology. Augmented reality technology will be built using the camera feature so that visitors can take pictures with the model of Sultan Deli. Through this application is expected to provide optimal function for visitors Maimun Palace.

3. Previous research
Prince et al [2] conducted an interactive augmented reality research with users viewing markers as a reference for displaying 3D camera screen. The result of this augmented reality gives subjects a real part of the 3D scene.

Zollner et al [3] developed augmented reality to present cultural heritage. In each of these cultural heritages, interactive information is provided and raises videos related to the cultural heritage located at the study site. The creation of augmented reality uses mixed reality.

Croatia DSP Studio and Momentum Studio [4] designed augmented reality by creating a 3D animation of a famous figure in Croatia precisely in the city of Sibenik. Juraj Dalmatinac who is a famous sculptor in the city. This application presents the history of the city and allows to take pictures with Juraj Dalmatinac.

4. Research methods

4.1. Augmented reality
Augmented Reality is a technology that combines two-dimensional and three-dimensional objects into a real environment that is then projected in real-time. Augmented Reality is a combination of real and virtual objects in a real environment, running interactively and real-time and there is integration between objects in three dimensions of virtual objects that are integrated in the real world. Merging of real and virtual objects is possible with the appropriate display technology. Interactivity is possible through certain input devices, and good integration requires effective tracking [5]

4.2. Maimun Palace
In 1890, Sultan Ma’mun Al Rashid moved the central government of Deli Deli back to Medan. In 1876, Sultan Ma’moen Al-Rashid established a magnificent palace called the Maimun Palace. The first stone building of Maimun palace was laid by Sultan Makmoen Al Rashid on August 26, 1888, the construction of this palace took almost 3 years, and began to occupy on May 18, 1891 [6]. At that time the capital Deli was officially moved to Medan. Maimun Palace is the Palace of Greatness of Deli Sultanate with its yellow color (yellow is the color of the Malay kingdom) and typical Malay architectural style on the east coast. It is one of the most famous landmarks in Medan, the capital of North Sumatra. It has an area of 2,772 square meters, and has 30. Satisfied with Van Erp's work, he later returned Van Erp to design Masjid Raya Al-Mashun [7].

4.3. General Architecture
The general architecture of Augmented Reality Sultan Deli can be seen in Figure 1.
This stage describes the general architecture of the application as shown in Figure 1:

- **User**
  This stage is the use of augmented reality applications on an android-based smartphone.

- **System**
  This application system begins with an augmented reality application that implements the camera feature and will detect a marker with a tracking system. After tracking the marker, it will connect to the 3D model that will be displayed. The 3D model will adjust the position and orientation of the marker so that it appears on the user's smartphone screen.

- **Output**
  The resulting output is a photo file with the format. JPG (JPEG, JPE). This file will be saved to the storage inside the smartphone.

4.4. **Methodology**
The methodology of Augmented Reality Sultan Deli application can be seen in Figure 2.
• **Input**
  This stage uploads the marker into the app as a detector to show 3D models that have been created.

• **Process**
  This stage is a three-dimensional model processing process created through an image of Sultan Deli and will be incorporated into an augmented reality application. Models will be created using 3D applications such as Blender, Zbrush, Facegen, and DAZ. Application Augmented Reality Sultan Deli will be shaped AR camera that is augmented reality with photo capture feature. 3D model processing results will be inserted into the AR camera so that the smartphone screen will display the 3D model.

• **Output**
  The resulting output is a photo file with the format. JPG (JPEG, JPE). The photo file is a visitor's photo with the 3D model of Sultan Deli.

4.5. **Making Marker**

Making markers is done by creating an image that will be used as image tracking. The image will be uploaded to the Qualcomm Developer website. Files that have been uploaded will be rated quality by the system. All markers that have been uploaded through vuforia will generate source code in the form of an XML file. This XML file is a configuration of Vuforia against markers that have been uploaded. In making marker required a JPG file to be uploaded to Vuforia.

The marker that has been made will be placed in the Maimun Palace at the appropriate location as shown by Figure 3.

![Figure 3. Marker location.](image)

The marker will be placed on seven points and at any point will only show one 3D model of Sultan Deli. The map of where the marker is placed is shown by Figure 4. In Figure 4. shows the plot of the marker location to be placed inside the Maimun Palace. As seen in Figure 4., then the number 1 is a marker of Sultan Lamanjiji which is located just under the photo of Sultan Mahmud Lamanjiji Perkasa Alamsyah. Number 2 is a marker of Sultan Mahmud Al Rashid who sits on a couch of relics of the previous Deli Sultanate. Number 3 is the marker of Sultan Ma'moen Al Rashid just above the collection of kris of the Sultan of Deli. Number 4 is a marker of Sultan Osman Al Sani Perkasa Alamsyah beside a cabinet relics Sultan Ma'imoen. Number 5,6,7 is a marker of the royal guards.
4.6. Objects Creation

3D modeling is done with some 3D tools. Modeling is done by utilizing photos of Sultan Deli as a reference in this study. Modeling the face of the Sultan deli is formed by adjusting the photo of Sultan Deli as in the picture.

The technique used in making this face model is fitting and generating. By determining the points on the neutral image then the image will be generated into a 3D object. The next step is modeling the body and clothing in detail. The body is formed by adjusting the character to the Sultan Deli model as shown in Figure 6.

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**Figure 4.** Marker location plan.

**Figure 5.** The making of the face of Sultan Mahmud Lamanjiji.

**Figure 6.** DAZ Studio 3D Models.
The model is then adjusted to the original form. This stage is done morph and fit process to make adjustments to the original character.

![Figure 7. The Sultan's 3D Apparel Model.](image)

In Figure 7, the Sultan's clothing is made by arranging the shape of the object to form a clothing object. With mask and hide point techniques can remove unneeded geomotor so that the clothing model will be formed more realistically. The mask technique is used to mark the part of the object for change, and the hide point is to remove the geometry portion marked by the mask. Details and colors adjusted with the photo of Sultan Deli so as to produce a real object.

![Figure 8. Sultan cap model.](image)

At the stage of making hats or caps of the Sultan performed texturing process is to make the details of the cap that will be made so that the Sultan's hat will be worn more realist look.

![Figure 9. Detail sarong with texture atlas.](image)

Detailing of sarong is done with texture mapping. The previous texture was made into a bitmap that was edited in such a way that the final model looks more real. The next stage is to do mapping which means to mapping texture (bitmap) to a three-dimensional object. [8]
The last stage is the incorporation of all three-dimensional objects by arranging the position and orientation of objects within a scene. The result of the 3D model is then exported into the FBX form so that it can be inserted into the Unity 3D application so that the three-dimensional object created can be merged into the application AR Camera made in Unity 3D.

4.7. Interface Creation and Augmented Reality
After making 3D model of Sultan Deli hence required designing interface by using Unity 3D. The design is made by using tools and scripts that have been provided by unity.
The built-in interface page is an info page aimed at displaying the information of the Maimun Palace and the ever-ruling Sultan of Deli, the Ar page aims to showcase augmented reality apps, and the help page aims to guide application usage. On the page Ar formed an augmented reality application created using package vuforia, which then in the innovation into augmented reality with the camera feature (screencapture).

5. Result and Discussion
After testing the application by following the test plan, the results of the trial are stored as evidence that the application has successfully passed the test phase.

Test results obtained include:
- Application of AR Camera in marker detection done with distance and certain condition.
- Augmented Virtual Stage application can be run well with menu display and AR Camera with AR Camera Application results in form in JPG format like.

![Detection of markers.](image1)

The explanation of Figure 12. is the result of a test on the detection of a marker in which the marker can only be detected at a distance of 20 -60 cm apart from that the markable surface area can be detected only until the marker 25% marker is closed. The rest of the smartphone can not detect the marker attached.

![Result of marker detection.](image2)

In Figure 13. It appears that the smartphone managed to detect markers so that it displays the model of Sultan Deli Mahmud Lamanjiji Perkasa Alam.
6. Conclusions and Recommendations

6.1. Conclusion
After passing the stage of implementation and testing of the system, then there are some conclusions found in this study, namely:

- Application of augmented reality Sultan Deli can display the model of Sultan Deli who has ruled in the Palace of Maimun like Sultan Lamanjiji Perkasa Alam, Sultan Mahmud Al Rashid, Sultan Ma'moen Al Rashid, Sultan Osman Al Sani Perkasa Alamsyah and bodyguard of the kingdom in three dimensions complete with Clothing details.
- By detecting markers with a distance of 20 cm - 60 cm then the device can read marker and show Sultan Deli 3D well.
- Application Augmented Reality Sultan Deli able to display system AR Camera for screencapture.

6.2. Suggestion
The author wants to give some suggestions for research in the field of Augmented Reality next, namely:

- Using hardware that is very supportive due to rendering and manufacturing process that requires large RAM and VGA.
- Using the official and paid DAZ Studio plugins to generate more interactive three-dimensional objects such as the addition of more realistic animations or details.

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