The Virtual Tour Panorama as a Guide and Education Media of the Historic Objects at Datu Luwu Palace

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ABSTRACT

Datu Luwu Palace is one of the cultural tourist destinations located in Palopo City, South Sulawesi in which there are various kinds of historical objects. Datu Luwu Palace is not always open in general and the visiting hours are uncertain making people who want to visit feel lazy because of uncertainty. So, a system is needed that can help tourists make visits and facilitate the work of the manager of the Datu Luwu Palace. The purpose of this study is to design and implement a system that can help tourists to know about historical objects virtually while making it easier for managers to introduce and educate them about historical objects. This data was obtained through Field Research and Library Research. The System Development Method used is the MDLC (Multimedia Development Life Cycle) method and for testing this system using the Questionnaire method. The results of this study show that this research can produce a system application that facilitates the performance of the manager and helps tourists see historical objects through virtual tours. The feasibility test results from the implementation of the system that has been made show results that are "very feasible" to use, obtained from the results of the average percentage of Expert and Tourist respondents, which is 86.70%.

1. INTRODUCTION

1.1 The rationale for the study

Currently, innovations in the field of technology continue to develop more and more advanced and in line with the development of the characteristics of modern society, one of the things that are currently developing technology is the Virtual Tour [1]. Virtual Tour is an innovation that can position the user into an image object and is able in terms of cultivating temporary awareness and cultivating perception, capturing and checking virtual information [2]. Virtual Tour is a demonstration of an area that includes various series. To create a 360-degree panoramic photo, it is necessary to suture or stitch the various series of images that will be demonstrated in an area or environment [3]. With a virtual tour, it can provide an experience to its users like being in an area even though they are only sitting in front of a monitor screen [4].

Virtual tour technology is currently widely used in the field of tourism [5]. Langkanae Luwu Palace is one of the cultural tourist destinations addressed at Jalan Landau No. 18, Batupasi, North Wara District, Palopo City, South Sulawesi, built around the 1920s, but during the colonial era was burned down by Dutch colonial forces and then rebuilt by the Regent who served in 1971 whose architecture was European [5]. Langkanae Luwu Palace used to function as the place of the government of the Luwu Kingdom, but over time this place changed its function to become a museum to commemorate all the struggles of heroes while preserving the culture of the Luwu Kingdom [6]. In Langkanae Luwu Palace, various kinds of historical objects have historical value and uniqueness that are interesting to know [7].

Datu Luwu Palace is currently only guarded by an insider who at the same time serves as a tour guide which can cause the palace guards to be overwhelmed when many visitors come to the palace at the same time. The existence of the location of the Langkanae Luwu Palace, which is still rarely known to the public, is one of the factors for the lack of tourists to come to visit. The dissemination of information and promotions about such attractions is sorely lacking, the palace is not always open in general, visiting hours are uncertain and sometimes guards are absent in the palace premises and even closed. Of course, this causes people to rarely visit [8].

In previous studies, they used markers to be able to see information about heirloom objects and of course, visitors still had to go to the location of the Langkanae Luwu Palace. The disadvantages of this study visitors or users have to download applications besides that the application can only run or can be used on the android operating system [8].

Based on these problems, researchers are interested in conducting research which is hoped that this system can help visitors to be able to see directly the historical objects contained in the Datu Luwu Palace as well as help the management of the Batara Guru Museum of Datu Luwu Palace

to be able to introduce and educate historical objects through a website-based virtual tour system that can be run or accessed at any time as long as the internet network is available even though it is in other areas even far away from the museum.

2. THEORY

2.1 Virtual tour

A virtual tour (also called a panoramic tour) is a simulation of a place that exists, usually consisting of a collection of panoramic photos, a collection of images connected by hyperlinks, or videos, and or a virtual model of the actual location [9]. You can also use other multimedia elements such as sound effects, music, narration, and writing [9]. Unlike the actual tour, the virtual tour is usually accessed through a desktop computer, information kiosk, or other electronic media [5].

Another opinion explains that the Virtual Tour is a demonstration of an area that includes various series. To create a 360-degree panoramic photo, it is necessary to suture or stitch the various series of images to be demonstrated in an area or environment [10]. With a virtual tour, it can provide an experience to its users like being in an area even though they are only sitting in front of a monitor screen [4].

Likewise, according to the research [11], Virtual Tour is a technique to deliver a virtual tourist experience using 360-degree images or videos that allow visitors to explore a location interactively.

Based on some of the opinions above, it can be concluded that Virtual Tour is a technology that combines a series of images or videos so that it displays a 360-degree panorama that can make users feel as if they are somewhere even if they are only in front of a monitor screen. Users can find out the information contained in a place even if they do not visit the location directly.

2.2 Panorama

A panorama is an image depicting a wide-angle view projected onto an outer layer of space, a circle, a cube shape, or any other surface that includes perspective [12]. This auspicious place, otherwise called the place of projection, is where we can imagine the observer's eye is located. The top hub is the shaft on which the direction of view is rotated so that the entire 360-degree climate can be seen. The method involved with creating a view can be divided into two stages: the projection of the eye onto some sort of projection surface, then at that moment, plotting that surface into a flat image, usually a square shape.

Various projections include panoramas, where the projection controls a two-dimensional (2D) medium into a three-dimensional (3D) structure to form a space that is then given View control from the first individual point of view so that it can overcome or virtualize the 2D Items that appear genuine to the application user. Types of projections that include panoramas include:
1) Cylindrical panorama

A cylindrical panorama is a view that takes the form of a roundabout like a cylinder. It consists of one image that is very wide or wide covering all environments. This type simulates as if the user is placed directly in the focal point of the circle, and the user can be able to see around on a flat plane, 360 degrees [13].

2) Spherical panorama

A spherical panorama is a panorama that looks round. It consists of an explicitly created overarching picture, so it can very well be shaped like a ball. This type simulates as if the user is placed right at the focal point of the ball, and allows the user to see openly in any direction [14].
3) Cube panorama

A panoramic cube is a 3D square-shaped image, consisting of 6 images, on each side of the shape. This type simulates as if the user is firmly placed in the middle of the block, and the user can be able to see six sides, namely front-back, left-right, and top-down [15].

2.3 PanoraGo

PanoraGo is a cloud-based virtual tour software, which helps create, supervise, manage, and filter a large number of virtual tours in just one account.

PanoraGo is equipped with features that will help create a virtual tour with the alluring, quality, and needed. Virtual tours from PanoraGo there are many advantages, for example, the ease of sharing via a link, QR Code, or embed into the website, having the option to install it on a server or hosting, many features, lightweight and fast and simple to share.

The advantages of using PanoraGo to create a virtual tour are as follows:
1) Full Features: Users can create impressive and interesting virtual tours with a wide variety of features in the PanoraGo.
2) Lightweight and Fast: The virtual tour is uploaded or loaded in background mode when the user navigates between one room and another.
3) Easy to Share: Users can share virtual tours in various forms such as links, QR Codes, embeds, and downloads.
4) Responsive: A virtual tour display that is responsive or adjusts on each device so that it can be accessed on various devices.
5) Reports: Comprehensive or comprehensive statistics that can be linked to google analytics.
6) Intuitive: Even with a myriad of many features in it, PanoraGo can still be easy to use.

PanoraGo supports all 360 cameras (in equirectangular format), you can take pictures with 360 cameras, DSLRs, or Smartphones by combining images with 3D software [16].

2.4 Multimedia

Multimedia is the utilization of computer devices to present and combine text, graphics, audio, and moving images (video and animation) [17]. Multimedia is a combination of information or media to convey data with the aim that the data is introduced more interestingly [18]. Multimedia is the use of computer devices to present and combine text, sound, images, animation, and video with tools and connections so that users can explore, connect, create, and convey [19]. It can be concluded that Multimedia is a combination of several media such as text, sound, images, animation, video, and others, into one unit so that it can produce very interesting information.

2.5 Historical objects

Historical objects are objects left by previous people that have actual cultural functions and types that are the result of activities, deeds, and works of art. An object is said to be a

historical object if it has historical, scientific, religious, or economic value [20].

2.6 Museum

A museum is a place to store, maintain, secure, and utilize material objects made by humans as well as nature, and the environment [21]. The museum as a forum for saving the nation's cultural heritage in charge of collecting, preserving, maintaining, and exhibiting to the public all the works of humans and the natural environment, is also a means of education and communication [22]. Museums as an open foundation in the fields of education, culture, and tourism must be developed to protect authentic, natural, and cultural heritage, so coordinators and administrators must have high ability and honesty [23].

3. LITERATURE REVIEW

Previous research conducted by Laswi and Andryanto [8], implementation of an Augmented Reality-based tour guide application that can project 3D objects into an Android smartphone, this research utilizes Augmented Reality technology and the application is android-based. In the next research event, Othman et al. [24] made a virtual tour that can be displayed on an Android smartphone, both studies used the Android operating system as a tourist information medium so that the shortcomings of the research can only be accessed on the Android operating system, besides that the availability of applications is relatively limited.

Several other studies on virtual tour research use voice guidance that can provide information related to the condition of the museum location [25], simulation of virtual tours in virtual museums that can be used to see culture and history with interactive digital that can be integrated with virtual reality technology [26], the shortcomings in this study are the absence of interaction between tour guides and tourists, the absence of an interface that supports video guides or face-to-face features between the tour guide and the tourist.

From some of the studies above, the researcher intends to develop existing research, the system that will be built in this study is a 360-degree panorama virtual tour at the Datu Luwu Palace by utilizing several features of Photo 360 that has been taken from Datu Luwu Palace, supporting the Map to find out the location of the Datu Luwu Palace, the Gallery Feature displaying several photos, the Virtual Meeting Feature makes it easier for tour guides and tourists to meet face to face. The feedback form feature that can be used by tourists to share messages or impressions from the experience of virtual tour users to the virtual tour manager, the Social Media Share Feature makes it easier for users to share information, as well as a video guide that can also guide tourists who visit the Datu Luwu Palace Virtual Tour.

4. MATERIALS AND METHODS

4.1 System development methods

The system development method used is the MDLC (Multimedia Development Life Cycle) method is a methodology used in the development of multimedia applications. This method is suitable for multimedia-based applications because it can include everything needed to develop multimedia applications. If in the process of making there is data needed but it is still lacking or damaged, then you can retrieve the data needed again. Because this methodology allows the data collection and creation stages to run parallel or simultaneously [27]. The advantages of the Multimedia Development Life Cycle (MDLC) method are that it facilitates the development of multimedia in a structured and systematic way, and has clear and ordered stages that can minimize errors and failures in multimedia development [28, 29]. The characteristics of MDLC consist of six stages of multimedia development, namely Concept, Design, Material collecting, Assembly, Testing, and Distribution [30, 31]. MDLC emphasizes the involvement of users in each stage of multimedia development.

The stages of the MDLC (Multimedia Development Life Cycle) method are as follows:

The first stage: Concept, determines the reason or purpose for which a system is created and who will use the program (identification audience), type of use, application purpose, and general details. So, researchers created a virtual tour system of historical objects at Luwu Palace, and the application is presented in the form of a web so that it is easily accessible to anyone using computer devices or smartphones.

The second stage: Design, is to make a specification of the ins and outs of the application architecture, style, appearance, and material requirements for the manufacture of the application. So, researchers designed the appearance of the System interface layout.

The third stage: Material collecting, is the collection of materials that are to the needs of the work. These materials include photos, videos, texts, and others. This stage can be worked out in parallel with the assembly stage.

The fourth stage, the Assembly, is the manufacture of all multimedia objects or materials. Application creation based on storyboards, flow charts, and navigation structures that originated at the design stage.

The fifth stage: Testing, tests the capacity, capability, and performance of the application, whether it is as expected or not. Here it is reviewed whether all links, buttons, and other features can function properly. Here researchers use questionnaire testing.

The sixth stage: Distribution, after the system passes the test, the system will be channeled through one of the hosting and domain providers so that the website-based virtual tour system can be accessed by users, especially tourists and the manager of the Batara Guru Museum of Datu Luwu Palace.

4.2 Population and samples

This study involved 41 respondents divided into two groups, namely the Expert Group (consisting of Multimedia Experts and History Experts) and the Tourist Group. The Expert Group consisted of two respondents, a Multimedia Expert with experience in creating multimedia content and a History Expert who works as a tour guide at Batara Guru Museum. Meanwhile, the Tourist Group consisted of 39 respondents who were tourists visiting Batara Guru Museum.

In selecting respondents, we used specific criteria such as experience, knowledge, and interest in multimedia and history. The Expert Group was selected based on expertise and experience in multimedia and history. Meanwhile, respondents from the Tourist Group were selected based on criteria such as visiting Batara Guru Museum, interest in

history, and experience in using multimedia content during tourist activities. The involvement of both groups is expected to provide broader and more detailed information on the user experience and perception of multimedia content during tourist activities at Batara Guru Museum. Therefore, this research can provide benefits for the development of multimedia content that is more suitable for user needs.

4.3 Instruments for data elicitation

First, conducting an interview session with the manager of the Datu Luwu Palace about the obstacles faced and the system that has been running, as well as documenting in the form of photos of historical objects contained in the Batara Guru Museum of the Datu Luwu Palace complex, the interview can make it easier for researchers to design the system and develop a better prototype so that the system can later be used. Second, the questionnaire used is the "USE Questionnaire" to measure the feasibility of the system carried out on the measurement of user experience usability, there are several measurement criteria carried out on the virtual tour system, namely measuring the level of application feasibility based on four research variables, namely the usefulness variable, ease of use, ease of learning, and user satisfaction which aims to measure the feasibility of the system.

4.4. Analytics data

In this study, the feasibility assessment was conducted using a Likert Scale model which has been proven to be valid and reliable in previous research [32]. The Likert Scale model used consists of five scores, namely "Strongly Agree", "Agree", "Neutral", "Disagree", and "Strongly Disagree". Furthermore, the results obtained from the questionnaire were processed using a measurable strategy, to obtain objective and accurate values in assessing the feasibility of the system being developed. Information regarding the assessment scale used in this study can be seen in Table 1.

Table 1. Grading scale

Valuation	Description	Score
SA	Strongly Agree	5
A	Agree	4
N	Neutral	3
D	Disagree	2
SD	Strongly Disagree	1

The data obtained from the study will be analyzed and converted into a feasibility scale based on Table 2. This table provides a classification of the results based on the percentage score obtained from the feasibility assessment. The percentage score is calculated from the Likert Scale model with five scores, namely "Strongly Agree", "Agree", "Neutral", "Disagree", and "Strongly Disagree".

Table 2. Feasibility scale

Angka %	Classification
<21	Very Unworthy
21-40	Not Worth It
41-60	Neutral
61-80	Proper
81-100	Very Decent

The result of the feasibility percentage can be calculated using the formula:

$$Eligibility\ Percentage = \frac{Respondent\ Score}{Maximum\ Score} \times 100 \qquad (1)$$

This formula is used to calculate the feasibility percentage at each stage of system development. The maximum score is the total score that can be obtained from each assessment category. For example, in the reliability category, the maximum score is 5, which means that each respondent can give a score between 1 and 5 to assess the reliability level of the system.

5. THE EXPERIMENTS AND RESULTS

5.1 System analysis

5.1.1 Analysis of running systems
The current system at the Batara Guru Museum of Datu Luwu Palace can be seen in Figure 1:

Figure 1. Running system

Visitors come directly to Datu Luwu Palace, then visitors meet a Tour Guide and are guided to the Batara Guru Museum of the Datu Luwu Palace Complex to see historical objects.

5.1.2 Analysis of developed systems
The application was developed based on Virtual Tour, to facilitate the performance of the manager and make it easier for visitors or tourists to see historical objects through virtual tours to be a media guide and education that can show the shape of historical objects clearly with the 360-degree Virtual Tour technique. With this virtual tour, visitors can immediately see the shape of historical objects that will be seen by accessing the website, as seen in Figure 2.

Figure 2. System analysis to be developed

5.2 System design

After completing the analysis activities, the next step is to conduct system design or software design. The main goal of system design is to provide a framework for the form and process of the software, ensuring that it adheres to the predetermined rules and standards established during the analysis phase.
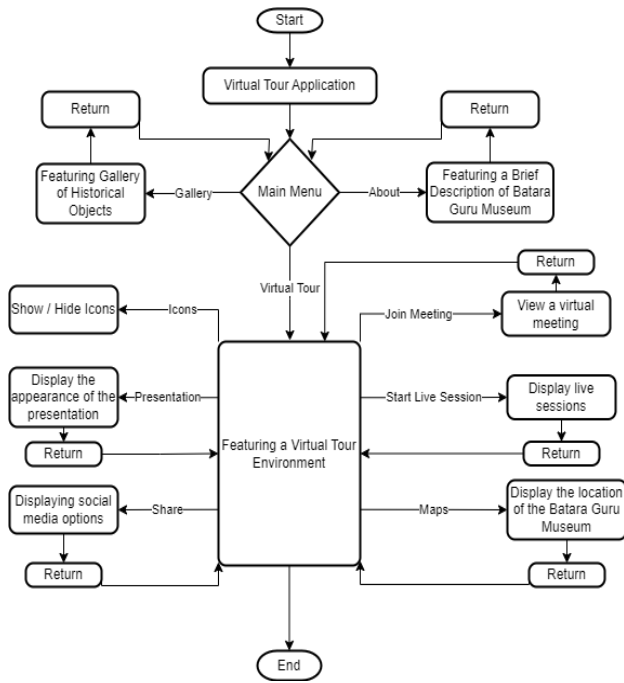

Figure 3. Flowchart system

The complete explanation of the system flowchart design as shown in Figure 3 is as follows:

5.2.1 Menu virtual tour
When the user accesses the Virtual Tour menu, there will be a virtual tour environment of the Batara Guru Museum of Datu Luwu Palace. There are features that users can access, namely:
1) Icons: When the user selects the Icons to feature it will show/hide the icons.
2) Presentation: When the user selects the Presentation feature, it will display the presentation display.
3) Share: When the user selects the Share feature will display the social media option, and the user can share the virtual tour link to social media.
4) Join Meeting: When a user has the Join Meeting feature, users can have a virtual meeting with other users.
5) Start Live Session: When the user selects the Start Live Session feature the user can have a live session with other users.
6) Maps: When the user selects the Maps feature will display the location of the Batara Guru Museum.

5.2.2 Menu gallery
When the user accesses the Gallery menu, it will display a gallery of historical objects.

5.2.3 About menu
When the user accesses the About menu, it will display a brief description of the Batara Guru Museum.

5.3 Interface design

In Figure 4 the main page displays a virtual tour of 360-degree panoramic views of historical objects at the Batara Guru Museum of the Datu Luwu Palace complex which can be directly accessed by visitors when opening the website. In addition, on the main page, some menus can be accessed by visitors such as the Virtual Tour menu, Gallery, which contains photos of historical objects, and the About menu, which contains the Batara Guru museum, and there is a WhatsApp icon where visitors will connect to the WhatsApp application.

Figure 4. Interface design

5.4. Implementation application interface design

After designing the system interface, then implement the application interface design.

Figure 5. Virtual tour display

Figure 5 is a virtual tour of the Batara Guru Museum of Datu Luwu Palace. Here users can do a tour of the Batara Guru Museum virtually and can access various features in it.

Figure 6. Join meeting feature

Figure 6 shows the Join Meeting feature which functions to conduct meetings with the Batara Guru Tour Guide / Museum Guide and other application users with a maximum of 10 users.

5.5 Questionnaire evaluation

After calculating the overall respondent score from each aspect of the assessment, it can be combined in Table 3., Table 4, and Table 5:

Table 3. Multimedia expert percentage results

Aspects of usability	Respondent score	Maximum score	Percentage
Usefulness	26	30	86.67%
Ease of use	22	25	88.00%
Ease of learning	18	20	90.00%
Satisfaction	25	30	83.33%
Total	**91**	**105**	**86.67%**

Table 4. Percentage results of expert historians

Aspects of usability	Respondent score	Maximum score	Percentage
Usefulness	23	25	92.00%
Ease of use	20	25	80.00%
Ease of learning	14	20	70.00%
Satisfaction	22	25	88.00%
Total	**79**	**95**	**83.16%**

Table 5. Traveller percentage results

Aspects of usability	Respondent score	Maximum score	Percentage
Usefulness	1070	1170	91.45%
Ease of use	868	975	89.03%
Ease of learning	695	780	89.10%
Satisfaction	1063	1170	90.85%
Total	**3696**	**4095**	**90.26%**

Table 6. Average result of percentage of respondents

Respondents	Percentage
Multimedia expert	86.67%
Expert historian	83.16%
Local travellers	90.26%
Average	86.70%

In Table 6, it can be seen that after calculating the respondent's score and the maximum score then the percentage of each group of respondents is combined, the average percentage is 86.70%, and based on the feasibility table of the virtual tour system made, it is considered very feasible.

5.6 System advantages

The advantage of the application or system that has been made is that there is a video that functions as a guide explaining historical objects in the Batara Guru Museum. then the Virtual Meeting feature allows users to have meetings with the Batara Guru Tour Guide / Museum Guide or other application users. Furthermore, the Live feature is that users can go live with other application users. In addition, Virtual Tour is website-based so there is no need to download the application using only a web browser that is already available on the user's device.

6. CONCLUSIONS

6.1 Conclusions

From the results of this study, researchers can conclude that the Design of a Panoramic Virtual Tour System as a Media Guide and Education of Historical Objects at Luwu Palace which is web-based, can make it easier for tour guides to introduce and educate museum visitors about historical objects and for users or visitors can help find out about historical objects in the Batara Guru Museum without having to come directly to the museum or virtually.

The results of the feasibility test from the implementation of the system that has been made show results that are "very feasible" to use, obtained from the average percentage of Expert and Tourist respondents of 86.70%, this data was obtained from the test results by sharing a google form link and a questionnaire sheet containing a statement to determine whether or not this system is feasible to use.

6.2 Suggestion

To improve the quality of the next research, several improvement ideas can be done. These include improving the website's appearance, enhancing the quality of panoramic photos of the Datu Luwu Palace rooms, completing the image captions on the virtual tour, and improving the narrative to prevent it from being monotonous. It is also suggested that the system considers the functions of human-computer interaction and multilingual selection to make it more user-friendly and accessible to a wider audience.

Improve the website's appearance, it can be done by creating a more attractive website that catches visitors' attention, such as by adding interesting features, more appealing designs, and more modern designs. Meanwhile, enhancing the quality of panoramic photos of the Datu Luwu Palace rooms, it can be done by taking higher-resolution photos and using better equipment to produce clearer and sharper images.

In addition, another suggestion is to complete the image captions on the virtual tour by adding captions to each object and providing clearer information, so that visitors can better understand the history behind the objects. Finally, to avoid monotony during the virtual tour, adding variation to the narrative and using audio-visual techniques can be done so that visitors do not feel bored and are more interested in following the virtual tour.

By implementing these improvements, it is expected that the next research will produce better results and provide greater benefits for the development of culture and tourism in the region. Additionally, by considering the functions of human-computer interaction and multilingual selection, the system can be made more user-friendly and accessible to a wider audience.

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APPENDIX

The evaluation of multimedia experts, historians, and tourists towards the virtual system of datu luwu palace tour scores stand for "Strongly Agree", "Agree", "Neutral", "Disagree", and "Strongly Disagree."

No.	Statement	SA	A	N	D	SD
Usefulness						
1	This app helped me see historical objects at the Batara Guru Museum virtually.					
2	This app can save me time.					
3	This app can save me travel costs.					
4	The application has an attractive appearance.					
5	This app suits my needs.					
6	This application is very useful.					
Ease of use						
7	The app is easy to use.					
8	The app is easy to understand.					
9	The steps of using the app are very simple.					
10	Using this app does not require too much effort.					
11	I can use this app without written instructions.					
Ease of learning						
12	I learned this app quickly.					
13	I can easily remember how to use this app.					
14	The use of this app is easy to learn.					
15	I am quickly skilled at using this app.					
Satisfaction						
16	I am satisfied with this. Application					
17	I am willing to recommend this app to friends.					
18	Using this app is a lot of fun					
19	The app works according to what I want.					
20	I feel this app is what I need.					
21	I like using this application.					