The Development of Dynamic Virtual Tour at Subak-Tabanan Museum

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Abstract. The development of a Dynamic Virtual Tour at the Subak-Tabanan Museum is an information system needed by the Tabanan Regency Culture Department as a medium of information and archives for the Subak Museum to become a cultural tourism destination. The use of digital-based information media at the Subak Museum still needs to be improved, so digital information media is needed in the Cultural Department of the Regional Technical Implementation Unit of the Subak Museum in particular. This information system will invite users to enjoy and see how the environment at the Subak Museum. The users or virtual tour visitors can follow the panorama displayed so that it is felt to be an experience as if they were in the Subak Museum. A Dynamic Virtual Tour at the Subak-Tabanan Museum is developed using the waterfall method. This method has four stages, namely the stages of analysis, design, development and testing. In the content expert test, the coefficient value is 1.00, and the results from the media expert test get a coefficient value of 1.00. So that the content expert test and media expert test can be categorized as "Very High" with "Very Valid" criteria. In the response test using the User Experience Questionnaire (UEQ) method, the attractiveness results get 2,338 results on the indicator showing a positive direction, clarity on getting 2,275 results on the indicator showing a positive direction, efficiency getting 2,342 results on the indicator showing a positive direction, accuracy getting 2,238 results on the indicator shows in a positive direction, the stimulant gets 2,338 results on the indicator showing a positive direction and novelty gets 2,300 results on the indicator showing a positive direction. The results of the presentation of the User Experience Questionnaire (UEQ) assessment showed a positive impression of the development of the virtual tour.

Keywords: subak museum, virtual tour, 360 degree, photography.

1 Introduction

The Subak Museum is a museum located in the Tabanan-Bali area. The Subak museum exhibits a collection of traditional agricultural tools used in farming and the traditional Balinese irrigation system called Subak. Subak is a Balinese irrigation system organization and is an example of local wisdom widely known worldwide [1].

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Subak is a word that comes from the Balinese language. The term first appears in the Pandak Bandung inscription dated 1072 AD. The word subak refers to a unique social and religious institution, having its own set of democratic associations of farmers in regulating the use of irrigation water for rice growth. Subak, for the Balinese people, is not just an irrigation system but also a philosophy of life for the Balinese people themselves. In the Balinese view, Subak is a direct reflection of the Hindu philosophy of Tri Hita Karana (the three causes of goodness), which promotes a harmonious relationship between the individual and the spirit realm (parahyangan), the human world (pawongan), and nature (palemahan).

Preservation of culture today requires a way of conveying to the public, with one of the efforts for cultural preservation being through museums. The results of an interview with one of the subak museum tour guides explained that before the pandemic, many tourists were visiting the subak museum, tourists who came not only domestic tourists, foreign tourists who also visited the subak museum. After the pandemic hit, the Subak museum was finally closed temporarily during the pandemic, so all visiting activities were canceled to avoid unwanted crowds. However, if there are tourists who come, they need to confirm their visit to the subak museum first.

Based on the explanation from the Head of the Subak-Tabanan Museum, after the Covid-19 pandemic, it decreased. In 2020 only 555 visitors. Continue to drop again to 156 visitors. Even at the pandemic's peak, the Subak Museum was closed as directed by the Covid-19 Task Force. People who want to visit the museum will be limited to the locations visited. It said that at the exhibition room location, it is only allowed to accept a maximum of 30 people who will visit the exhibition room. At the open exhibition room location, it agrees with a maximum of 50 people who will visit the open showroom. Previously, seminars had been held to receive more visits. About 100 people were allowed to visit the subak museum during the pandemic, but on the ground, it could not be carried out to receive 100 people.

The use of technology in the subak museum could be better aplicated so that the subak museum still needs to catch up with other museums in Indonesia. The use of technology in the form of existing social media, such as Instagram, as a promotional medium to attract tourists who want to come to the Subak museum. In addition to social media, dissemination in photos or brochures distributed to travelers will include the Subak museum as a list of tourism visits. The Subak Museum has wanted to develop a 3D dimensional breakthrough that displays the artifacts.

The use of technology in museums has been widely applied. The November 10 Museum in Surabaya, East Java, is now equipped with modern hologram technology. This technology features three-dimensional visualization to explain historical documentaries. The National Museum has digital assets that the public can access through the National Museum Virtual Tour, online exhibitions, and virtual tours on Google Art. [2].

The Wayang Museum also applies technology in the form of Google Arts & Culture. The use of such technology is intended for an in-depth way of exploring the world's art, history, and wonders, which continues to develop technologies that help preserve and share culture across the globe and enable curators to create engaging exhibitions online and offline [3]. Augmented Reality & Virtual Reality is also applied to Museums in Indonesia as Virtual Tour. As museums worldwide offer their content through two basic methods: the simple display of their artwork through a content viewer or through specially designed 2D or 3D virtual exhibitions in which the pieces and views are static [4].

Based on this explanation, the researcher was motivated to develop a Virtual Tour application that displays the atmosphere and condition of the Subak museum with a 360 panorama which will assist in the process of documenting the Subak Museum as a digitalization-based conservation of Balinese cultural heritage, in which the author conducted research entitled "Development of the Subak Museum". Dynamic Virtual Tour at the Subak-Tabanan Museum".

2 Method

The development of a Dynamic Virtual Tour at Subak-Tabanan Museum used the SDLC (Software Development Life Cycle) software development life cycle in the form of a linear sequential or waterfall model. The SDLC method of the waterfall development model was a sequential software development process, where each stage must be completed first before entering the next stage, which was seen as a flow of water that continues to flow through the existing stages, namely analysis, design, implementation and testing. The following figure illustrates the waterfall model.

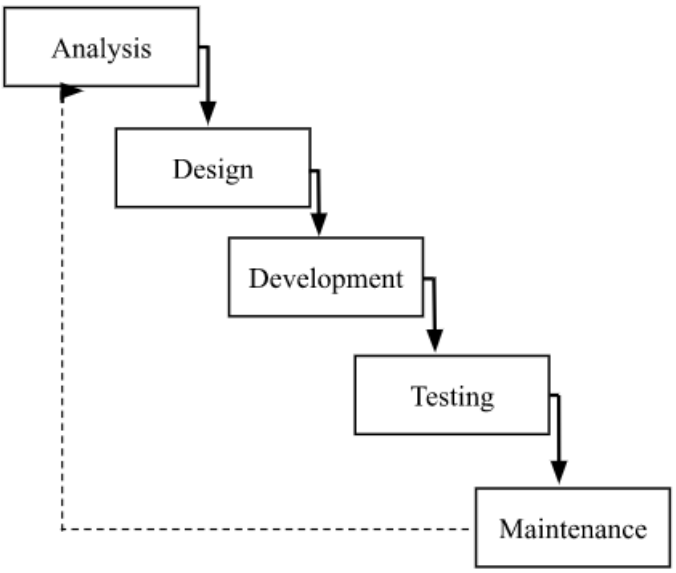

Fig. 1 Stages in the Waterfall Model according to [5]

The analysis stage was a complete collection of information and needs, then analysed and defined the needs that must be met by the information system to be built. At this stage, the search for references regarding the theories needed and how to apply them in Web-based technology was carried out.

The design/design stage was to design the Virtual Tour Development. In the Development of a Dynamic Virtual Tour at the Subak-Tabana Museum, a functional software model was designed, software design constraints, scenario design, and software interface design.

The development stage for use in making Virtual Tours. In the Development of a Dynamic Virtual Tour at the Subak-Tabana Museum, after determining what was needed in the next

planning/design, the researcher turned it into a signal that will be carried out in the development of the Virtual Tour.

The testing phase was carried out to know the shortcomings and weaknesses, and errors of the developed Virtual Tour Development so that the Virtual Tour Development can still be improved to reduce the mistakes that occur before being released to the broader community.

The maintenance phase is carried out after the testing phase is complete. The maintenance phase aims to be able to fix errors in the software, which are only detected when the software is used. Adaptation to a new environment, such as an operating system or a computer system development, demands. If the user successfully uses the software. Maintenance is intended to improve its capabilities, such as providing additional functions, improving performance, etc.

3 Result

Based on the analysis of "Development of a Dynamic Virtual Tour at the Subak-Tabanan Museum," several processes will be implemented for system requirements, which were divided into two: functional and non-functional requirements. In terms of operational needs, there were the following: The information system could display panoramic views. For non-functional requirements, there were the following: In the panoramic view, the admin can choose the host spot to manage the information that will be determined on the virtual tour of the Subak Museum.

At the design stage, the Use case diagram design was used to describe the system's functions from the point of view of the use (actor) [6]. The Use Case Diagram of Subak-Tabanan Museum Virtual Tour Development can be seen in Figure 2.

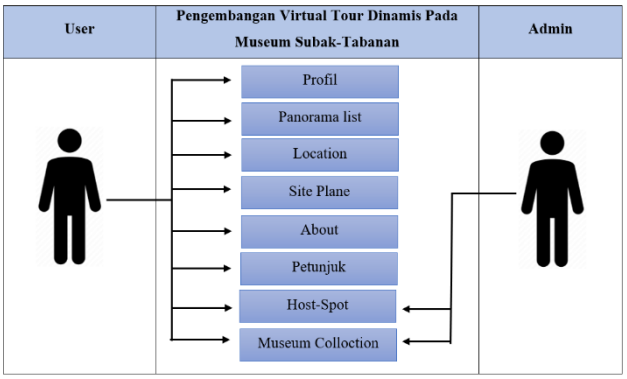

Fig. 2 Use Case of Subak-Tabanan Museum Virtual Tour Development

User access the Subak Museum Virtual Tour Information System. Users will enter the initial view of the Subak Museum Virtual Tour Information System. Users will enter to see a 360 panorama at the Subak Museum. In addition to viewing the panorama at the Subak museum, users can choose the menus contained in the virtual tour: the profile, panorama list, location, site plane, host spot, and museum collection. Users can select the profile soft button so that user can view the profile of the Subak Museum. Users can choose the panorama list soft

button to see the panoramas in the Subak Museum. Users can select the soft button location to see the Subak Museum's location via google Maps. Users can choose the soft button site plane to see the building plan of the Subak Museum. Users can select the host-spot soft button to view the information specified on the panorama from the Subak Museum. Users can select the museum collection soft button so users can view the collections from the Subak Museum.

Admin accesses the Subak Museum Virtual Tour Information System. Admin will enter the initial view of the Subak Museum Virtual Tour Information System. Admin will enter to see a 360 panorama at the Subak Museum. In addition to viewing the panorama at the Subak Museum, the admin can login to the dashboard, which can control the content on the virtual tour. There are other menus, profiles, museum collections and host spots on the dashboard. In the dashboard view, the admin can choose the profile menu so the admin can determine how the profile content of the Subak Museum are. In the dashboard display, the admin can select the museum collection menu, so the admin can determine how the contents of the Subak Museum collection will be. In the dashboard view, the admin can choose the host-spot menu so that the admin can select the location and how the content of the Subak Museum's host-spot content will be.

Fig. 3 Illustration of Virtual Tour

In Figure 3 you can see an illustration of the use of Virtual Tours at the Subak-Tabanan Museum, where the user must access the Virtual Tour information system on a supporting device. After that, users can explore and get to know the layout of the Subak Museum building in a Virtual Tour.

In the development stage of the Subak Virtual Tour Museum, 3 software and 1 hardware were used. The software used was PT Gui, Panellum, and Browser, and drone hardware. Figure 4 was the result of applying PT Gui to unify images in each frame. Figure 5, was the result of implementing the Pannellum plugin, which is used to rotate the image to 3600. Figure 6, was the result of the application of the browser that was used to display the Virtual Tour information system. Figure 7, shows the result of the application of Drones that were used to take pictures in each frame.

Fig. 4 Implementation of PT Gui

Fig. 5 Implementation of the Pannellum Plugin

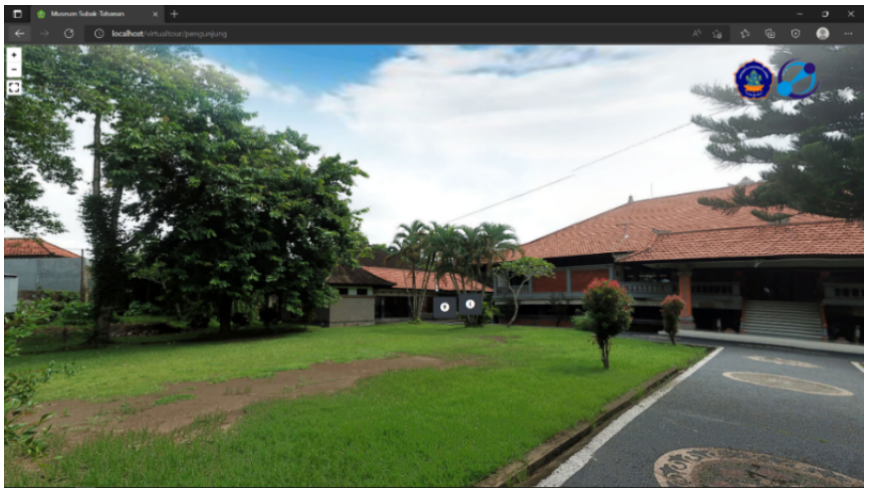

Fig. 6 Application to Browser

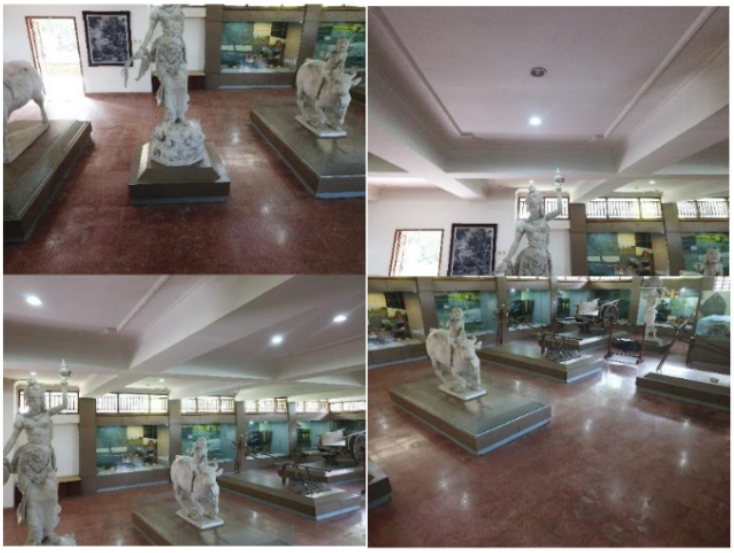

Fig. 7 The Application of Drones in Taking Pictures

Blackbox testing focuses on the functional requirements of the software, so Blackbox testing allows the software engineer to derive a set of input conditions that fully utilizes all the functional requirements for a program [7]. Blackbox test was addressed to respondents outside the researcher. The purpose of black box testing was to develop a dynamic virtual tour at the Subak-Tabanan museum. The Blackbox test that researchers had carried out was summarized into one table so that the overall results of this Blackbox test can be seen. The summary of the results of the Blackbox test can be seen in Table 1 as follows.

Table 1. Blackbox Result

Functional tested	Results
Information system displays panoramas and submenus	In accordance
The information system displays information about the profile	In accordance
The information system displays information about the panorama list	In accordance
The information system displays information about the location	In accordance
The information system displays information about the subak museum floor plan	In accordance
The information system displays information about the collections at the Subak Museum	In accordance
The information system displays information about the use of tools	In accordance
The information system displays information about the developer	In accordance
The information system displays the information contained in each host-spot	In accordance
The information system displays a form to login to admin	In accordance
Information system displays CRUD on museum collection	In accordance
Information system displays CRUD on host-spots	In accordance
The information system displays logout from tapila admin	In accordance

The questionnaire results showed that all the correct processes in the information system have been running well. The Content Expert Test was a test that aimed to determine the content contained in the information system with the suitability of the content to the theme raised. The researcher involved 2 content experts from the Subak-Tabanan Museum staff. Researchers involved as content experts in this study because they were considered to have explicit knowledge about the Subak-Tabanan Museum, can be seen in Table 2 as follows.

Table 2. Content Test Results

Rating Points	EXPERT	
	1	2
The suitability of the panoramic place at the Subak museum presented on the virtual tour	In accordance	In accordance
Clarity of panoramic images on virtual tours	In accordance	In accordance
Clarity of the contents of the information text on the host-spot	In accordance	In accordance
Clarity of image content on information on host-spots	In accordance	In accordance
Clarity of video content on information on host-spots	In accordance	In accordance
Suitability in viewing information on profile	In accordance	In accordance
Conformity in viewing information on host-spot	In accordance	In accordance
Conformity in updating information on the host-spot	In accordance	In accordance
Conformity in editing information on host-spot	In accordance	In accordance

Conformity in viewing information in the museum collection	In accordance	In accordance
Conformity in updating information in the museum collection	In accordance	In accordance
Conformity in editing information on the museum collection	In accordance	In accordance

Based on the results of the assessment obtained from the two content experts written in the tabulation of the questionnaire assessment in Table 2, it can be seen that the content validity related to the virtual tour was developed using the Gregory formula as follows:

$$\text{Validitas Isi} = DA+B+C+D = 120+0+0+12 = 1212 = 1{,}00$$

After that, the results of the content expert validity calculations were adjusted based on the validity level criteria table, which showed the level of development validity with the acquisition of an average coefficient value of 1.00 included in the "Very High" category of validity with the "Very Valid" criteria. Based on the validity results obtained, the contents of the virtual tour contained in the development are already in the "Very valid" criteria.

Media Expert Test validates the accuracy of the resolution of the panorama displayed and the content of the information conveyed in the designed information system. The media expert test was carried out using a questionnaire involving 2 media experts from the Informatics Education Study Programme lecturers, which can be seen in Table 3.

Table 3. Media Expert Test Result

Rating Points	EXPERT	
	1	2
Button and colour compatibility	In accordance	In accordance
Compatibility of button and text layout	In accordance	In accordance
There are various options in the submenu and useful icons to assist users in using the virtual tour	In accordance	In accordance
There are various choices of submenus and icons	In accordance	In accordance
The suitability of the panorama in the virtual tour of the Subak-Tabanan museum	In accordance	In accordance
The reaction speed of each submenu button on the virtual tour	In accordance	In accordance
The information system cannot be changed by visitors	In accordance	In accordance
The information system can be changed by the admin	In accordance	In accordance
The information system is free from errors that can result in the termination of the information system	In accordance	In accordance

After that, the assessment tabulation was calculated to get the calculation results that will be used to find the level of validity of the interactive content. Based on the results of the assessment obtained from the two media experts written in the tabulation of the questionnaire

assessment in Table 3, it can be seen that the validity of the contents related to the virtual tour was developed using the Gregory formula as follows:

$$\text{Validitas Isi} = DA+B+C+D = 90+0+0+9 = 99 = 1{,}00$$

After that, the results of the calculation of the validity of the media experts were adjusted based on the table of criteria for the level of validity in Table 3, which showed the level of development validity with the acquisition of an average coefficient value of 1.00 included in the "Very High" category of validity with "Very Valid" criteria. Based on the validity results obtained, the contents of the virtual tour contained in the development are already in the "Very Valid" criteria.

Testing users were used to finding out responses from users after using the information system. User response tests will be done by giving a questionnaire. The method used in the user response test to measure the level of user satisfaction was the User Experience Questionnaire (UEQ) which was a survey data processing tool related to a user experience that was easy to apply, reliable and valid, which can be used to complement data from other evaluation methods with the subjective quality assessment [8]. The user response test will involve a minimum of 20 users using the information system to find out the responses from users through a user response questionnaire.

The overall data for the answers from 20 respondents with 26 responses each. The answer value used a rating scale of 1 to 7. Furthermore, the answers were converted into weighted answer scores. In order, the following pairs of scales and their weights are listed: (1, -3); (2, -2); (3, -1); (4, 0); (5, 1); (6, 2); (7, 3). From the 20 respondents' answers, the mean, variance, and standard deviation were calculated for each question. Furthermore, each question is color-coded according to its group: attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty. The results can be seen in Figure 8. Figure 8 shows the average score for each question in a negative, zero, or positive position. Then, show the average value of the whole question seen from the group. The mean impression values between -0.8 and 0.8 represent positive evaluation values, and values < -0.8 represent negative evaluations. So the Dynamic Virtual Tour Development at the Subak-Tabanan Museum has a positive impression (the value is close to 1 and so on) successively in the Attractiveness, Clarity, Efficiency, Accuracy, Stimulation, and Novelty Based on the validity results obtained, the user's response to the Virtual Tour development already had a positive impression (the value is close to 1 and so on) which means that the Virtual Tour development is in the "Valid" criteria.

UEQ Scales (Mean and Vriance)			
Attractiveness	↑	2.338	0.07
Perspicuity	↑	2.275	0.08
Efficiency	↑	2.342	0.02
Dependability	↑	2.238	0.06
Stimulation	↑	2.338	0.07
Novelty	↑	2.300	0.06

Fig. 8 Group Average Impression

4 Result and Discussion

The implementation of Blackbox testing focuses on functionality so that by testing the correctness of the information system process with 14 criteria, it was stated that there were no errors or discrepancies in the results of the process with testing from the first time the information system was running was valid. So the results of this Blackbox test produced process outputs that were in accordance with the test flow. The implementation of content expert testing focuses on knowing the content contained in the information system with the suitability of the content to the theme raised. The results of this content expert test produced process outputs that were in accordance with the test flow. The implementation of media expert testing focuses on aspects of media layout, display design to operations contained in the information system with the suitability of media layout aspects, display design to operations. The results of this media expert test produced process outputs that were in accordance with the test flow.

The last test tested the user experience using the Virtual Tour to inform the Subak-Tabanan Museum. The researcher used the User Experience Questionnaire (UEQ) testing method to try the response. The results of the response test stated that the development of the information system that the researchers did got a pleasant response in the use of the Subak Museum Virtual Tour, could be understood in the use of the Subak Museum Virtual Tour, creative in the development of the Subak Museum Virtual Tour, easy to learn in the use of the Subak Museum Virtual Tour, useful in introducing the Subak Museum Virtual Tour, fun in exploring the Subak Museum Virtual Tour, interesting in exploring the Subak Museum Virtual Tour, predictable in running the Subak Museum Virtual Tour, slow in running the Subak Museum Virtual Tour, creative in the development of the Subak Museum Virtual Tour , support the development of the Subak Museum Virtual Tour, both in developing the Subak Museum Virtual Tour, simple in running the Subak Museum Virtual Tour, encouraging in running the Subak Museum Virtual Tour, common in running the Subak Museum Virtual Tour, comfortable in using Virtu al Tour the Subak Museum, safe in using the Subak Museum Virtual Tour, motivating in the development of the Subak Museum Virtual Tour, meeting expectations in the development of the Subak Museum Virtual Tour, efficient in using the Subak Museum Virtual Tour, clearly in running the Subak Museum Virtual Tour, practical in running the Virtual The Subak Museum Tour, organized in running the Subak Museum Virtual Tour, attractive in using the Subak Museum Virtual Tour, user-friendly in running the Subak

Museum Virtual Tour, and innovative in the development of the Subak Museum Virtual Tour. After researchers got answers from respondents, the next stage was to carry out the calculation process. The first calculation was that the answers were converted into the weight of the answer values in sequence. After that, the mean, variance, and standard deviation were calculated for each question. From the results of the user response test analysis, it was found that the average percentage of the Virtual Tour information system for the Subak-Tabanan Museum had a positive impression. The calculation results stated that the Subak-Tabanan Museum Virtual Tour Information System has a positive impression.

5 Conclusion

Research on the Development of Dynamic Virtual Tours at the Subak-Tabanan Museum can be concluded as follows. The development of a Dynamic Virtual Tour at the Subak-Tabanan Museum used the SDLC (Software Development Life Cycle) software development life cycle in a linear sequential or waterfall model with four stages, namely the stages of Analysis, Design, Implementation and Testing, has been successful. In the implementation stage, 3 software and 1 tool are used: browser, pannellum, PT Gui, and drone. At the testing stage, media experts and content experts obtained valid results. User response, namely the general public to the Virtual Tour of the Subak-Tabanan Museum, received a good response. They were very interested and enthusiastic to try the information system by getting to know the collections in the Subak-Tabanan museum and feeling the atmosphere at the Subak-Tabanan museum virtually

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