

The Development Of Web 3d Application For Virtual Museum Of Lampung Culture

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ABSTRACT

Lampung Museum is an institution that preserves a collection of artifacts and other artistic, cultural, and historical objects as well as providing the scientific and essential research about Lampung Province. As one of the public services, Lampung Museum aims to provide an essential information about the local culture and artifacts in Lampung. Unfortunately, most information can only be accessed manually, so the digital form of the museum content is expected, which leads to the research. The research is supported by the Web3D, hence it could help the Museum to provide more interactive and exciting cultural education to the public. The virtual museum was built by using WebGL, a 3D graphic Programming Interfaces and it was supported by HTML5 and JavaScript. Virtual Museum acceptance testing is presented with descriptive statistics. The results of has shown that 88% of people agreed that the virtual museum is useful or beneficial, with up to 90% of respondents agreed that the virtual museum could accelerate their speed of work and 86% of the respondents agreed that virtual museum is user-friendly, with up to 89% of the respondents agreed that it is easy to comprehend and use as well

Keywords

Web3D, Virtual Museum, WebGL, Public Service, Lampung Museum.

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Introduction

Based on the State Minister for the Empowerment of State Apparatus article no. 63/2003, public service is all of the types of the services conducted by both central and regional Government Institution, the State Owned Enterprise or the Regional State Enterprise, either in products or services to accommodate the society needs or the implementation of the regulation. A museum aims to serve the public needs by collecting, conserving, serving and researching, as well as providing the cultural education about the local artifacts for the public. Specifically, the Lampung Museum is a place to preserve, protect, maintain and utilize the cultural heritage of Lampung Province, Indonesia. Nowadays, the information about Lampung Museum is available on the official website of Lampung Tourism Institution, but it doesn't provide the information about the ancient artifacts of Lampung. There is a growing concern among the visitors mainly from outside of Lampung that the information about the artifact is not available online, making it costly to do the research about Lampung culture. Based on the research of Chamdy & Indrojarwo (2013), there is 56.5 percent of the website visitors intend to access a detail information about the artifacts, while 18.5 percent claimed they want to acquire the new knowledge and the rest 13 percent has accessed the website merely for fun. The role of museum website has no longer are they simply a source of visitor information, but they frequently host searchable databases of images and models and even complete virtual exhibitions (Erolin, Jarron, & Csetenyi, 2017). It is known that Online visits to museum websites are now far outpacing physical visitation (Dodge, 2016). A museum surely can adapt the Web3D technology to provide a virtual museum system (Zhao, 2012). It has a potential to create an effective

education atmosphere and support a cultural education exclusively with a more specific feature along with the 3D support. The virtual museum is an application that supported by the Web3D system as a medium to deliver information about history and culture so that its online visitors could feel as if they are visiting the real Museum (Zhao, 2012). Web3D is designed to digitize the artifacts in the museum with a purpose to integrate and visualize the 3D effect on the web browser that applied the WebGL and HTML 5 to enable users to gain access to the cultural heritage in the form of 3D virtual artifacts (Santos, Serna, Stork, & Fellner, 2014). Web3D as a supporting element to build the virtual museum enables the non-engineer users to explore the 3D artifact as the information resource of Lampung culture. Therefore, now the public can interact with the inside content of the virtual museum for the educational, research and recreational purpose.

This study aims to apply the theory of web 3D with a combination of approaches so that it can be tested for increasing museum visitors. Furthermore, it is expected to increase the visitor's satisfaction for the public service of the Lampung Museum.

Literature Review

The Web3D is an application that enables a website to display the 3D objects for its users (Hendry, 2011). Web3D is applied to simulate the 3D form of the objects thus they are able to interact with the users (Zhang, 2010). According to the graphical computer perspective, the 3D object has three sides including x,y,z (Diehl, 2001). where the users can rotate them on the web browser as like the WebGL (Parisi, 2014). The WebGL is a technology that enables its users to draw, display and interact with three-dimensional

computer graphics (3D) in the web browser (Matsuda & Lea, 2013). The advantage of the WebGL is it's easy to use where the developers could create the 3D graphics by using only a text editor, JavaScript, web browser and the standard web technology (Parisi, 2014), (Matuda & Lea, 2013). WebGL is a part of the HTML5 technology using OpenGL ES language that is able to be combined with other web contents, making it suitable for the dynamic nature of the 3D web application that applied JavaScript programming language and it will be fully integrated with any well-known web browsers (Parisi, 2014). The WebGL doesn't require an installation, some web browsers such as Firefox, Google Chrome 4.0 and its newer version, Safari 10.6 and its newer version, the Opera 12 and its newer version have access to the WebGL automatically (Cantor & Jones, 2012).

The virtual museum is an application that is based on the Web3D technology as a medium for conveying information about the historical and cultural heritage by enabling its users to explore its content as if they are exploring the real museum (Zhao, 2012). Moreover, the application of virtual museum aims to improve the accessibility of the museum and its artifacts, thus it will become an interesting and interactive learning medium with the intention of preserving and developing a cultural heritage (Worang, Wenas, Prasida, & Tanaamah, 2014). The virtual museum is an interesting medium with a great appeal for various groups of visitors where it can promote the museum by providing information about the exhibition or displaying the artifacts in 3D form by using the Web3D technology. Various groups of the visitors including the students and the tourists could learn as well as entertain themselves. It can be a fun activity that able to attract the users to participate and involve in promoting the museum (Jankowski & Decker, 2013), (Styliani, Fotis, Kostas, & Petros, 2009). The virtual museum is accessible in a web browser owing to WebGL and HTML5 applied technology (Santos et al., 2014). The custom of using the new technology and new ways to interact in the virtual museum is one of the keys to approaching the public, especially young people who would feel more comfortable using new media to interact with the cultural content (Carrozzino & Bergamasco, 2010).

Research Methodology

The research about the implementation of the web 3D based technology in the virtual museum has been directed by using the Research and Development (R & D) methods and was conducted at Lampung Museum as a case study. R & D is a research method that enables the researchers to deliver a particular product and test the effectiveness of it. The data were obtained by means of interviews, observations, literature reviews and questionnaires. The Virtual Museum itself is built by using the WebGL 3D graphics API which is supported by the HTML 5 canvas and JavaScript. The User Acceptance Test approach was applied to test the effectiveness of the Virtual Museum, the perceived usefulness and ease of use refers to the Technology Acceptance Model was applied to measure the level of the acceptance of Virtual Museum technology from the users perspective and also to measure how user-friendly the technology is. The indicators of the perception of usefulness

and the perception of the easiness can be seen in Table 1 (Davis, 1989).

Table 1: The indicators of the perception of usefulness and the perception of the easiness

No	Perceived Usefulness	No	Perceived Ease of Use
1	<i>Work More Quickly</i>	1	<i>Easy to Learn</i>
2	<i>Improve Job Performance</i>	2	<i>Controllable</i>
3	<i>Increase Productivity</i>	3	<i>Clear and Understandable</i>
4	<i>Effectiveness</i>	4	<i>Flexible</i>
5	<i>Make Job Easier</i>	5	<i>Easy to Become Skillful</i>
6	<i>Useful</i>	6	<i>Easy to Use</i>

Results And Discussions

The Analysis of the Current functional activity

The final analysis of the functional activity in Museum of Lampung was obtained by observing and interviewing the participants. The current functional activities that associated with the provision of the information about the cultural artifacts in Lampung Museum is shown by a flowchart to illustrate the plan to develop the business process and to build the information technology system. The analysis of these functional activities is illustrated in figure 1.

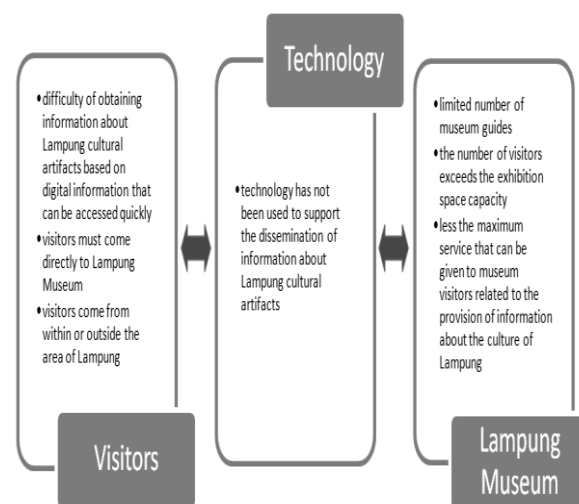


Figure 1: The Functional activities

The Evaluation of the Current Functional Activities

In the current system, people are required to visit the museum in order to obtain the artifacts' data, making the research process slower and costly, mainly for the researchers from outside of Lampung. Lampung Museum has a permanent exhibition space, where every fifty visitors are assisted by two guides, but as the number of visitors keeps increasing, more guides are needed. The lack of resources in the museum has caused the ineffectiveness in the information delivery process. So does the absence of the technological assistance. Therefore, it is necessary to develop an information technology system to provide a faster and effective way in delivering the information of the cultural artifacts to the public.

System Requirements Analysis

Based on the result obtained by interviewing the participants, a virtual museum is expected to offer these following capabilities:

1. The ability to display ten types of the artifact collections that are selected by users.
2. The ability to display the artifact collection based on their types or categories.
3. The ability to deliver a detailed information for each artifact selected by users.
4. The ability to display the collection of artifacts in 3D, where the users can interact with them.
5. The ability to provide user-friendly features so the users could navigate the system easily.

The virtual museum must be able to display the intended page correctly, and able to show the information along with the 3D artifacts in less than 10 seconds.

3D Object Creation Technique

3D objects of the Lampung artifacts are created by using the close range photogrammetry concept with the help of Agisoft PhotoScan Professional software. Photogrammetry is a method to measure and interpret an object that recorded in the photographs in various angles. It aims for reconstructing three-dimensional objects in the form of digital or graphic (Luhmann, Robson, Kyle, & Harley, 2011). A 3D object is made by approximately 33 photographs taken from various angles. After the photos were taken, they had been converted into 3D objects by using the Agisoft PhotoScan Professional. Then, the 3D objects were published into files in .dae (Collada) or .obj (object) extension, accompanied by texture.jpg files. Afterward, the (.dae) extension files were imported into the software Coppercube to be published in (.html) extension so that the 3D objects can be run properly in a web browser. The results of exporting the files from Coppercube will create a (.ccbjs) extension files with the additional JavaScript Library (copperlicht.js) which is also a Copperlicht API. The 3D file exporting process can be seen in Figure 2.

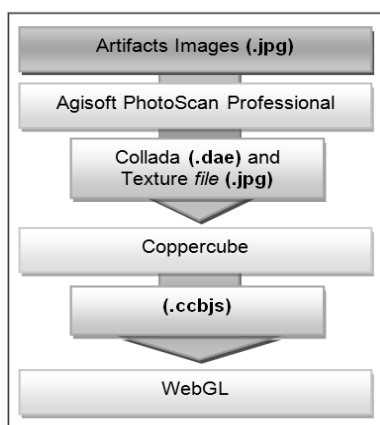


Figure 2: The process of exporting the 3D File

Functionally, the virtual museum is illustrated in the form of *use case diagrams* that can be seen in Figure 4.

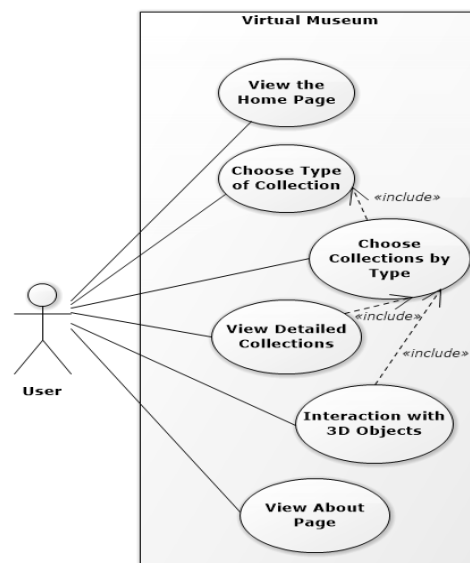


Figure 4: The Use Case Diagram

The display application or user interface is a display of the virtual museum for the targeted users that has been adapted with the functional system design. The display is still in the form of the static web created by the HTML 5 and JavaScript. The detailed collection page is a page that contains detailed information about an artifact selected by the users. It can be accessed via the category page, where the users are given the option to select the collection types. Each of the page consists of a textual information about the collections or artifacts along with the 2D or 3D images of those artifacts. Not all the images are available in 3D due to the technical difficulties in taking photos of the certain shape of objects from various angles and translating them into 3D forms. The display of a detail page collection can be seen in Figure 5.

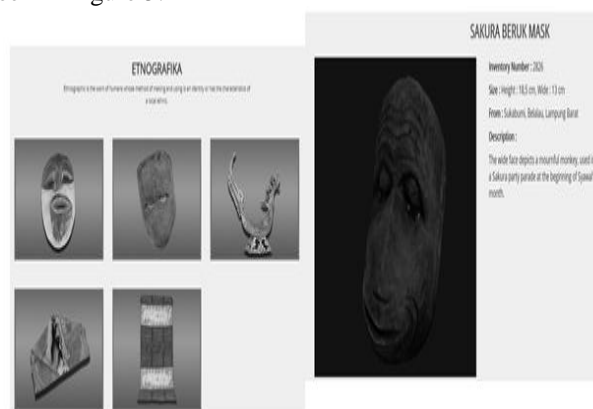


Figure 5: Collection Detail Page

The Test Result

a. The Functional Testing

The functional testing of the virtual museum is run by using the UAT (user acceptance test) approach with a black-box testing method, where the staff of Lampung Museum playing roles as the virtual museum online visitors. The testing was done to evaluate the level of the functionality, feasibility, the quality of each page and the overall quality of

the virtual museum software. The test results or the conclusion based on the verified acceptance-criteria document could be seen in Table 2.

Table 2: The Acceptance Criteria and Test Results

No	Acceptance Requirement	Critical		Test Result	
		Yes	No	Accept	Reject
Functionality					
1	Virtual Museum should be able to display 10 types of collections that can be selected by the user.	√		√	
2	Virtual Museum is capable of displaying artifacts in 3D objects.	√		√	
3	Virtual Museum is able to display detailed information about the artifacts.	√		√	
Performance					
4	Virtual Museum is able to display information quickly.	√		√	
Interface Quality					
5	Virtual Museum is able to display the appropriate website page correctly.	√		√	
Overall Software Quality					
6	Virtual Museum should be user friendly.	√		√	

The results of measurements of the average numbers of the accepted criteria have shown a hundred percent match with their critical requirement. Based on these results, it can be concluded that the virtual museum design plan has fulfilled the needs of the Lampung Museum.

b. Acceptance Testing

The acceptance testing of the Virtual Museum performed by using two factors, refers to the Technology Acceptance Model, that is based on usability and ease of use which are then made in the form of a questionnaire. There are 31 respondents conducted the Validity Test using a significance of 5%, with r table values (0.355) < calculated r value, which means the questionnaire is said to be valid. The results table of the validity of the questionnaire can be seen in table 3.

Table 3: The results table of the validity of the questionnaire

Question Number	calculated r value	information
1	0.468	Valid
2	0.731	Valid
3	0.706	Valid
4	0.734	Valid
5	0.665	Valid
6	0.598	Valid
7	0.497	Valid
8	0.730	Valid
9	0.694	Valid
10	0.661	Valid
11	0.597	Valid
12	0.782	Valid

Then the reliability of the questionnaire was tested and the Cronbach Alpha value was 0.875. The result is that the

alpha value is greater than 0.7. So the instrument can be said to be reliable.

The participants of the test are the Lampung Museum visitors who want to learn about the cultural artifacts of Lampung. Data from the questionnaire were processed into a percentage of Virtual Museum acceptance presented in the form of descriptive statistics. There are 69 respondents participated in the test. From the data of the participants responds based on the usefulness perception, it could be seen that the total actual score of 2552 is in the ideal score *ranges*, 2898 for the strongly agreed category and 2484 for the agreed category. So, we could draw a conclusion that 88% of the respondents agreed that the virtual museum is very helpful. Furthermore, from the data of the participants' responds based on the user-friendly levels, it could be seen that the total actual score of 2503 is in the of ideal score *range*, 2898 for the strongly agreed category and 2484 for the agreed category. So, we could draw a conclusion that 86% of the respondents agreed that the virtual museum is user-friendly.

The system implications of this study include aspects of hardware, software and infrastructure. In the hardware aspect, to access the virtual museum design need a standard hardware, but it is recommended that additional Video Graphic Accelerator (VGA) Cards with a minimum capacity of 2GB, this is due to the use of WebGL technology inside the virtual museum which works by utilizing computer hardware capabilities to render objects 3D via a web browser. The scope of the software aspects needed in this study reaches the software requirements to run a virtual museum, basically the software needs only require a web browser like Firefox 4.0 and above, Google Chrome 11 and above, Safari 10.6 and above and Opera 12 and above that already have access to WebGL. Whereas in terms of infrastructure, the virtual museum requires large hosting space, due to the formation of 3D objects that reach 10MB for each 3D object. The virtual museum technology built is still in the form of a static web and has not been integrated with the database, so the virtual museum has not been able to add content dynamically and cannot search data about artifact information. Therefore, it is expected that further research can develop virtual museum technology into a dynamic web that can add content dynamically and can search data about artifact information.

Conclusion

A virtual museum can be built by applying the concept of Web3D by using WebGL technology which is a 3D-graphics *Application Programming Interfaces* (APIs) that is capable to render the 3D objects with the support of the HTML5, Javascript, and the photogrammetric techniques. The created virtual museum shares the information about Lampung cultural artifacts in 3D form, so that the virtual museum users could retrieve the digital information about the cultural artifacts in Lampung, whether in text or picture form and be able to interact with them. According to the theory that stated by Zhao (2012). the implementation of the virtual museum can be used as a source of information and an interactive learning media in order to introduce and preserve the Lampung culture. Based on the test results of the functionality, performance, interface and software

quality, in overall project by using the *User Acceptance Test* (UAT) approach with *black-box testing* method, we could draw a conclusion that showed that the six acceptance criteria that have been defined by the National Museum of Lampung during the interview process are one hundred percent match by the criteria from the users.

The results of technology acceptance test has shown that 88% of people agreed that the virtual museum is useful or beneficial, with up to 90% of respondents agreed that the virtual museum could accelerate their speed of work and 86% of the respondents agreed that the virtual museum is user-friendly, with up to 89% of the respondents agreed that it is easy to comprehend and to use as well.

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