

Implementation of a Web Based Campus Virtual Tour for Introducing Telkom University Building

Doan Perdana¹, Arif Indra Irawan², Rendy Munadi³

School of Electrical Engineering
Telkom University, Telekomunikasi Street, Bandung, Indonesia. (+6222) 7564-108.

¹ doanperdana@telkomuniversity.ac.id, ² arifirawan@telkomuniversity.ac.id, ³ rendymunadi@telkomuniveristy.ac.id

Abstract - Telkom University (Tel-U) ia known as one of the biggest private Universities in Indonesia which was launched in August 2013 with extensive land, relatively large study program buildings and many available parking spaces. One technique to attract prospective students and display the cultural behavior in Tel-U is a virtual tour. Virtual tours construct a sequence of videos or images of particular place to create 3D panoramic view. Tel-U has developed a 3D web based virtual tour using 3DVista which was successfully implemented in 3 buildings: female dormitory building, swimming pool facility and male dormitory. The performance analysis used JMeter tools, with some parameters of 1000 number of users, round up period of 5 seconds and repeated 3 times. It showed a response time under 1.8 mS and an error rate of 0.24 percent, while the GTmetrix measurement of the virtual tour application has YSlow score of 90 and Page speed score of 77 which indicates that the web application has a fast response.

Keywords - Virtual tour, 3DVista, Education, panoramic view.

I. INTRODUCTION

The panoramic image can be built from Image Stitching or 3D Modelled interactive walkthrough [1]. This panoramic image is often used to provide information for someone who wants to visit a tourist spot through the website. At present, the concept of e-Panorama has been developed, namely in the form of campus virtual tour or can also be called a website-based panoramic image that connects one photo with the other photo so as to produce information for its users. Virtual Tour can help internet users feel the real environment that is there so as to increase the use of the Internet more comprehensively [2].

Telkom University (Tel-U) known as one of the biggest private University in Indonesia which is launched in August 2013 with extensive land, relatively large study program buildings and many available parking location. Though Tel-U is a new University, Tel-U focus in ICT based education and research to become closer to the South-East Asian region community. In the present case, a virtual campus tour which provide information of the Tel-U area aims to develop virtual visit to introduce environment cultural education and research to prospective student.

In this phase of the research, campus virtual Tour is built using sequence of photo which combined together so image from each direction of the Telkom University location can be viewed in 360 degree panoramic photo. This panoramic photos are formed using the 3Dvista application. In addition, this system also adds the narration guide to explain the situation and give useful information from the particular location. To make narration guide on the application, Balabolka is used as text to speech software and to be saved into an WAV file format. The audio file will be played (play)

when the particular location is selected. The final result of this study is a prototype of campus virtual tour application for the Telkom University area that runs on the website.

The rest of paper is organized as follows. Related work about this issue is described in Section II. The requisite and features of our proposed virtual tour is explained in Section III. The current implementation is described in Section IV. The result of this works is described in Section V. Lastly, The paper conclusion and our future work is described in Section VI.

II. RELATED WORKS

Based from previous research, research about virtual tour in the Telkom University using web-based system have not been done. However, virtual tour research in educational field has been conducted by other universities both inside and outside the countries which have a purpose to introduce their cultural and building campuses. In domestic country area, RF Rahmat *et all* [3] implements virtual reality in Universitas Sumatera Utara (USU) to provide information about buildings in USU environment. In Colombia, Giraldo *et all* [4] implements virtual tour using augmented reality at the University of Quindio (UQ). In Mauritius, Moloo *et all* [5] create virtual tour using SketchUp and WebGL framework to provide 3D virtual environment. Cosido *et all* [6] creates 3D modeling prototype in University of Cantabria. Fujita *et all* [7] uses Mobile Robots to enhance virtual tour and create realtime environmet to viewers. Espinueva [8] implements virtual tour system implements an information kios using touch screen Device in Laguna State Polytechnic University. Maines *et all* [9] campus virtual tour is presented through application game and the last Pick *et all*

[10] collaborative 2D/3D virtual tour is presented using digital camera.

According to Szeliski R [11] who presented how to use photo stitching using high resolution photos, photo-stitching techniques are interesting technique because it lighter when compared to virtual reality. At Tsinghua University, photo stitching is also used to create virtual environments which are made from static images made using inverse projection [12].

Based on the previous research studies described above, this research is one of the solutions in solving real problems faced by Indonesian people, especially related to the field of information and communication technology. The form of information which constructed and packaged using images and animation to display the real conditions of an institution's environmental conditions is expected to produce an interactive system for the user so the implementation of campus virtual tour based on web can in-line with Telkom University's flagship research strategic plan in the field of Information and Communication Technology, which is have to be able to provide solutions of existing communication and information. This research also is expected to be a role model for the web-based campus virtual tour system in Indonesia and can show the active role of Tel-U in the development of ICT technology especially in strengthening the digital economy on the big issues of smart building that have developed rapidly, especially in developing countries.

III. VIRTUAL TOUR DEVELOPMENT

The purpose of this work is building web-based campus virtual tour which showing the entire area Telkom University in 3D visualization so new student will be more connected with our cultural and physical facility. The 3D panoramic photo can show 360 degree image for each room in each building and containing audio narration guide which is give handy information about the room. The creation of this 3D panoramic photo will be integrated to official web campus.

This web-based application is created using use case which consists of one actor as an application user and there are three use cases that is display the geographic location, select the building and display virtual tour guide. The figure 1 below shows the use case of this work.

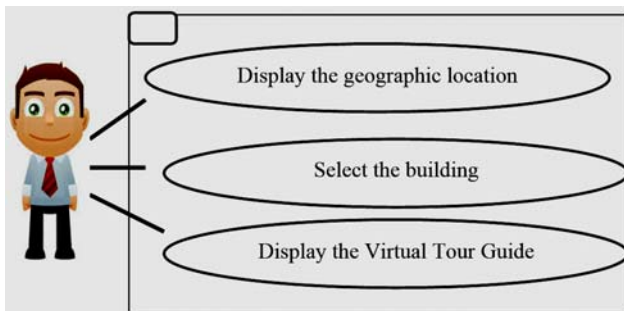


Fig 1. Uses Case Diagram of the System

Materials which used to build 3D panoramic photos of each building room which taken from various angles (front, back, right and left side, then top and bottom) and connected with others rooms to produce full panoramic building photo is high resolution photos. The audio narration is taken with the help of Balabolka software which can convert a typing text into speech information data. A prepared text narration is entered into the Bolabolka then the speech information data is saved using wav format.

For full implementation of this virtual tour, this research is divided into 3 phase as follows:

a) The implementation using local host: This first step of this research creates 3D photo in 3 building in Tel-U namely female dormitory building, swimming pool facility and male dormitory building. The 3D panoramic photos covers the entire room in the buiding. We can move to another room in the building by clicking some arrow shape in the particular location in 3D panoramic photos. The last process is the deployment of this 3D virtual tour using local host.

b) The implementation using intranet : The second step is creating anohter 3D buiilding photo such as School of Engineerng Tel-U building, Laboratorium building, Tel-U Rector building and etc and will be implemented using geographic area and it will be integrated with the Tel-U official information system. This system is planned so the user can access this system using Tel-U intranet. In this phase, student of Tel-U will be used as a tester of this system.

c) The implementation in official Tel-U website: The last phase of this work is the integration to Tel-U official website and will be tested in Internet for optimize the systems This testing and optimization is intended to determine the capabilities of the campus virtual tour so user from around the world can enjoy the stable access of the system.

IV. RESEARCH DESIGN AND SCENARIO

The result of the preliminary campus virtual tour research is developed using PHP with MySQL database and to create 3D panoramic photo is successfully created by 3DVista, the audio narrative is successfully created by Balabolka software and is successfully deployed in local host. 3D panoramic photo and audio narrative are used as media material for the campus virtual tour application running well on the web application.

The main page of the web application consist of the picture of 3 buildings which have mentioned above. Every time we choose one of the picture, we will be directed to front terrace of 3D photo panorama building. 3D photo panorama and audio narrative run simultaneously when the user chooses each room of the building of in web applications The figure 2 below shows the main page of the local host web which used to access each of the building on the website.

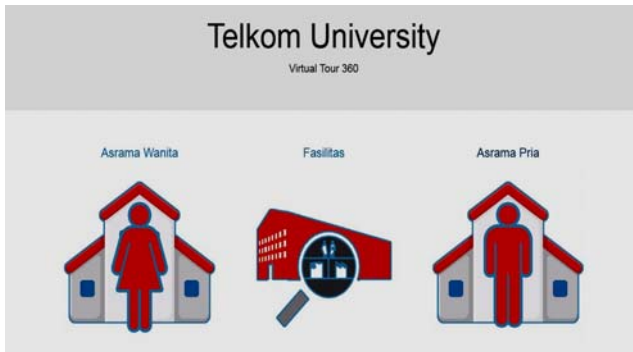


Fig 2. Main page of the System

A. Female Dormitory Building

Tel-U female dormitory consist of 8 building where each building consist of 4 floor. Among the 8 buildings, the Dona building, one of the 8 buildings was taken to produce 3D panoramic photo. From 4 floor of that building, only the 1st and 2nd floor is taken to create 3D panoramic photo. Each room on that floor has been built 3D panoramic photo. The shape arrow is guided user to moving into another rooms. Figure 3 show us the 3D panoramic photo in front terrace and figure 4 show us the main lobby of female dormitory building.



Fig 3. Front Terrace Female Dormitory Building

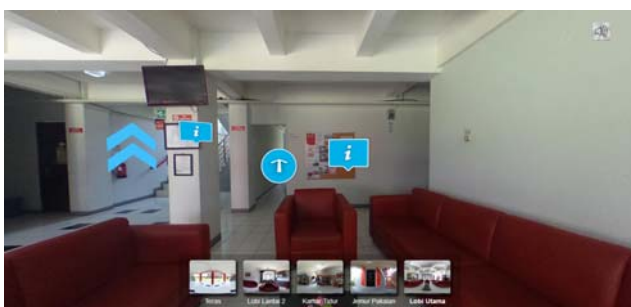


Fig 4. Main Lobby Female Dormitory Building.

B. The Swimming Pool Facility

The second building which taken into 3D panorama photo object is the swimming pool facility. This facility is located on ground floor of 10 floors building which used as lecture place. Beside swimming pool, 3D panorama photo of utilities room, and bicycle parking area also included in this section. Same as female dormitory, shape arrow is a handy tool to help user explore this facility. Figure 5 shows 3D panorama photo of the front entrance of swimming pool facility and figure 6 shows 3D panorama photo of indoor swimming pool area.



Fig 5. Front Entrances to Swimming Pool



Fig 6. Swimming Pool

C. Male Dormitory Building

The last buildings which taken as 3D panoramic photo object is male dormitory building. This dormitory is like female dormitory buildings which consist of 10 buildings with each of them have 4 floors. The Sekel building is taken as 3D panoramic photos. All of other features of this 3D panoramic photo is same as in the female dormitory building. Figure 7 shows sample 3D panorama photo towards the Sekel building and Figure 8 shows the 3D location of the ladder which toward to the 2nd floor of the building.



Fig 7. Front Terrace Male Dormitory Building

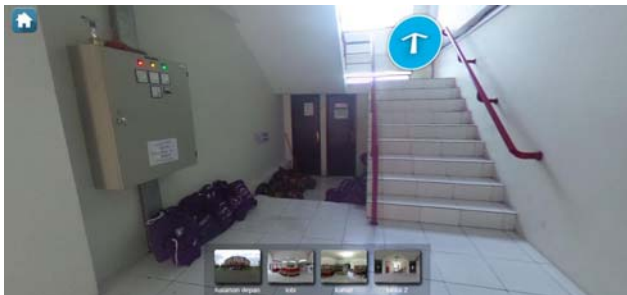


Fig 8. Stair to 2nd Floor of Male Dormitory Building

V. PERFORMANCE ANALYSIS AND TESTING SCENARIO

To test the performance and functionality on the construction of 3D panoramic photo applications based on web are divided into three parts. The first test is functional testing, the second test is stress testing and the last test is performance testing.

A. Functional Testing

The first part is functional testing on 3D virtual tour web applications. Functional testing is vital part of any web-based project which refers to tests that verify specific actions or functions of the code. This is usually found in the requirements code documentation, even though some work development methodologies are from use cases or user stories.

To test the web functionality, web browser is used to explore all feature off the web application such as the audio narration guide, link to move into building, link to another room in a building, the link to go to main page and the 3D functionality view. The test show us that web application running well as the specification that is intended. The results of application functionality testing is documented into form of Table I opposite.

B. Stress Testing

The second part of the test is stress testing. Stress Testing which used to get the strengths, availability and reliability of

virtual tour application. This test is done by the help by open source application, Apache JMeter. This open source software is made with pure Java application and is designed to test functional behavior and measure performance of the web application. In this test, the recorder option which is the easy way to create a test plan is used. The prepared procedure of this test is achieved by JMeter which configured as a proxy so JMeter can view some pages on web browser. The last step is to configure the number of thread which used 5, 10, 50, 100, 500 and 1000 number of thread. At this point, the configuration is completed and ready to run our test plan. Clicking on the "Start" button, on the bottom of the Script After starting the testing the application, each of the feature of the web application is accessed and make sure to rotated 3D panoramic photo before leaving a room

TABLE I. TETING THE FUNCTIONALITY OF VIRTUAL TOUR APP

No.	Functionality	Expected Result	Result
1.	Link heading to female dormitory 3D panoramic photo	The link can go to female dormitory building	✓
2.	Link heading to swimming pool 3D panoramic photo	The link can go to swimming pool facility	✓
3.	Link heading to male dormitory 3D panoramic photo	The link can go to male dormitory building	✓
4.	Link heading to 3D panoramic photo for each rooms in female dormitory	The link can go to each room in female dormitory	✓
5.	Link heading to 3D panoramic photo for each rooms in swimming pool facility	The link can go to each room in female dormitory in swimming pool facility	✓
6.	Link heading to 3D panoramic photo for each rooms in male dormitory	The link can go to each room in male dormitory	✓
7.	3D panorama photos in each rooms	3D panorama photos in each room can rotate more than 360 degrees	✓

The purpose of this stress test measurement is to analyze correlation between the influence of the number of threads on the parameters of response time, error rate and throughput. Response time is used to predict user experience in using a virtual tour. Throughput is measured measure how many units of information can a system process in a set period of time to see number of concurrent users. Error rate to measure the percentage of problem request (error) compared to all request to measure how many threads which can be handled by web applications to perform adequately [13].

Figure 9 shows a comparison picture between response times to the number of users who access the application. Maximum response time as shown in figure 9 which shown when the total number of thread is 500 has response time no more than 2 seconds which correspondence to [14] can be categorized as a responsive web application.

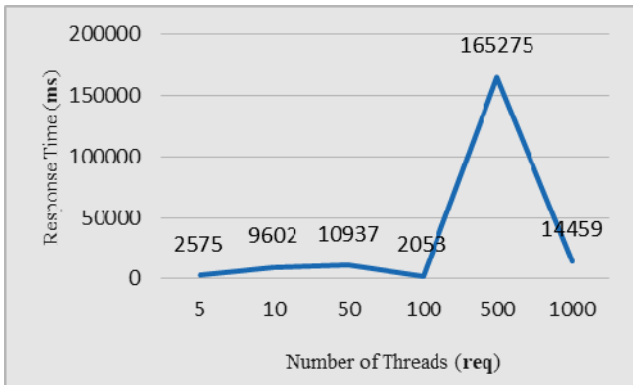


Fig 9. Response time vs number of threads

Throughput which measure how much bandwidth is required to handle a request is compared to the number of threads is shown in Figure 10. The highest throughput is shown in number 1000 thread that is equal to 35.8 request/sec and the lowest on the number of thread 500 that is equal to 3.2 request/sec.

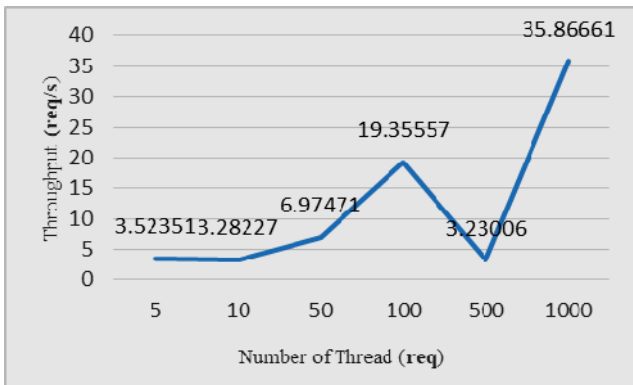


Fig 10. Throughput vs number of threads

Quality of the information such as voice, image, video or data very influential with the error rate in this case information loss is outcome from decreased performance from web applications in serving users. Comparison of the error rate to the number of threads that can be seen in Figure 11 which shown that the largest error rate occurs in the number of thread 100 that is equal to 0.94% and the lowest error rate occurs the number of threads 10 is 0.16%. According to standard [14] virtual tours provide a good error rate of less than 1%.

C. Performance Testing

Performance test have a goal to understand how virtual tour applications behave under heavy load conditions. In the first test, the author use Apache Jmeter with the setting of request parameter are: Number of Threads is 1000, Ramp up Period is 1 second and loop count is 3. Based on that configuration, the website application will serve 3000 requests which expected to describe the number of user who

will use the web application. The parameters which used in this testing are response time, error rate, throughput, received KB and sent KB which documented in Table 2. Response time is the total of time that takes for client send a request to server and get that response. Error is the percentage of errors samples in all samples (total samples). Throughput is total number of request per unit of time (sec, mins, and hours) send to server during test and the last is received/sent KB is measured throughput in Kilobytes per second [15].

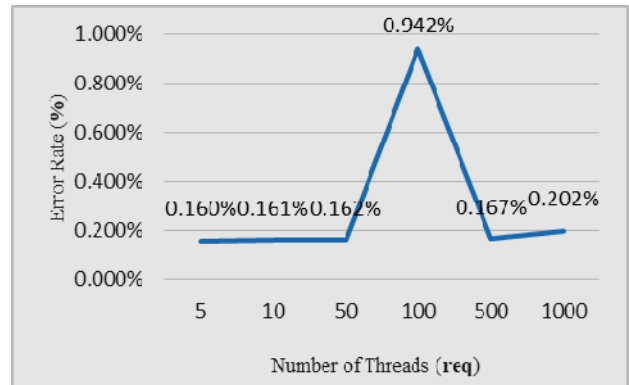


Fig 11. Response time vs number of threads

TABLE II. TETING THE PERFORMANCE OF VIRTUAL TOUR APP

No	Average				
	Response time	Error	Throughput	Receive d KB/s	Sent KB/s
1.	1716 mS	0.24%	83.1/sec	315.51	92.22

The web application result are response time which have response time less than 1.8 seconds indicating that the web application is running fast, error rate which is quite low at 0.24%, and throughput which is quite good at 83.1 request / sec. Low bit rates which received by JMeter indicating that file size which sent by web server is small with that size can web server can have a good server response time [16].

In the second test of the performance testing, the author use free tool called GTmetrix [17]. GTmetrix [17] evaluate the front-end structure of web application to guarantee that it is delivered as optimally as possible to virtual tour visitors. The result of test showed that the virtual tour that made by the authors has YSlow score 90 and Page speed score 77 which indicated that the web application has a responsive web pages.

VI. CONCLUSION AND FUTURE WORK

The virtual campus was developed using 3D vista software and Balabolka was deployed in a local host. There are 3 different locations which have 3D panorama photo such as female dormitory building, swimming pool facility and male dormitory. It shows that the web application has less than 1.8 mS and error rate 0.24 percent and from

GTmetrix measurement the virtual tour application has YSlow score 90 and Page speed score 77 which indicates that the web application has a fast response time. In the next paper, the system will be integrated with geographic location, will be deployed to intranet and also will be developed with more 3D panoramic photo buildings.

REFERENCES

- [1] K. Latham, W. Hurs, N. Shone, A. E. Rhalibi and Z. Pan, "A Case Study on the Advantages of 3D Walkthroughs over Photo Stitching Techniques," in 2016 International Conference on Virtual Reality and Visualization (ICVRV), Hangzhou, 2016.
- [2] N. Ibrahim and N. A. Wahab, "Developing and Evaluating a Virtual Tour Prototype Using Photo-Stitching Technique," in 2010 Second International Conference on Computer Engineering and Applications, Bali, 2010.
- [3] R. F. Rahmat, Anthonius, M. A. Mughtar, A. Hizriadi and M. F. Syahputra, "Virtual reality interactive media for universitas sumatera utara – a campus introduction and simulation," in The 2nd International Conference on Computing and Applied Informatics (ICCAI) 2017, Medan, 2017.
- [4] F. D. Giraldo, E. Arango, C. D. Cruz and C. C. Bernal, "Application of augmented reality and usability approaches for the implementation of an interactive tour applied at the University of Quindío," in 2016 IEEE 11th Colombian Computing Conference (CCC), Popayan, 2016.
- [5] R. K. Moloo, S. Pudaruth, M. Ramodhin and R. B. Rozbully, "A 3D Virtual Tour of the University of Mauritius using WebGL," in 2016 International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT), Chennai, 2016.
- [6] Ó. Cosido, L. Terán, Ó. R. López, M. Sarachaga, M. Campi, R. Catuogno, N. G. Gutiérrez and E. M. Latorre, "3D tour through university spaces for the management and dissemination of the cultural heritage of the University of Cantabria," in 2015 Digital Heritage, Granada, 2015.
- [7] M. Fujita, Y. Tokiwa, O. Ohashi and Y. Kato, "A Virtual Campus Tour Service Using Mobile Robots," in 2014 28th International Conference on Advanced Information Networking and Applications Workshops, Victoria, 2014.
- [8] J. E. Espinueva, "High-information dissemination system using touch screen device for Laguna State Polytechnic University — San Pablo city campus," in 2017 IEEE 15th Student Conference on Research and Development (SCORED), Putrajaya, 2017
- [9] C. Maines and S. Tang, "An Application of Game Technology to Virtual University Campus Tour and Interior Navigation," in 2015 International Conference on Developments of E-Systems Engineering (DeSE), Duai, 2015
- [10] S. Pick, A. Bönsch, I. Tedjo-Palczynski, B. Hentschel and T. Kuhlen, "Poster: Guided tour creation in immersive virtual environments," in 2014 IEEE Symposium on 3D User Interfaces (3DUI), Minneapolis, 2014
- [11] Szeliski, R. (2005) Image Alignment and Stitching. Retrieved July 25, 2008 from <https://www.caam.rice.edu/~zhang/caam699/pfiles/Im-Align2005.pdf>
- [12] M.-M. C. P. T. A. S. S.-i. H. Tao Chen, "Sketch2Photo: Internet Image Montage," ACM Transaction on Graphc Vol. 28 No.5, p. 124, 2009.
- [13] Jmeter.apache.org. (2018). Apache JMeter - User's Manual: Glossary. [online] Available at: <https://jmeter.apache.org/usermanual/glossary.html> [Accessed 8 Oct. 2018].
- [14] International Telecommunications Union. Recommendation G.1010:End-user multimedia QoSS Category. Geneva, 2002.
- [15] Riski Muktiarto, N.A., Perdana, D., Negara, R.M., Performance analysis of mobility impact on IEEE 802.11ah standard with traffic pattern scheme, International Journal of Communication Networks and Information Security, 2018
- [16] Putra, M.A.P., Perdana, D., Negara, R.M., Performance analysis of data traffic offload scheme on Long Term Evolution (LTE) and IEEE 802.11AH, Telkomnika (Telecommunication Computing Electronics and Control) , 2017.
- [17] gtmetrix.com.(2018). Frequently Asked Question. [online]. Available at: <https://gtmetrix.com/faq.html> [Accessed 4 Oct. 2018].