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Design of Web-based Laboratory Virtual Tour 360º Application

Didik Dwi Prasetya

Department of Electrical Engineering, Faculty of Engineering, State University of Malang, Indonesia

didikdwi@um.ac.id

***Abstract*—The laboratory has an important role and function in supporting the learning process. In addition to its main role as a learning facility, the laboratory is also one of the benchmarks that reflect the identity of the institution. Unfortunately, there are still many institutions that have complete laboratory facilities but are not known by the public. Therefore, it is necessary to have a system that able to publish laboratory facilities attractively and easily accessible. This research proposes a design of web-based laboratory virtual tour 360º application as an appropriate solution to provide an interesting and communicative publication media. Utilization of web-based applications can be a medium of publication as well as practical promotions that can be accessed widely whenever and wherever without depending on space and time. With the introduction of laboratory facilities by the wider community, the identity and credibility of the institution becomes well known.**

Keywords—laboratory; virtual tour; 360º; web; publishing media

I. INTRODUCTION

In general, a laboratory (or a lab) is a place or space to produce something. A laboratory is a facility that provides controlled conditions in which scientific or technological research, experiments, and measurement may be performed. Laboratories are usually created to enable the conduct of scientific activities in a structured and controlled manner. Thus, it can be concluded that the laboratory is a place equipped with equipment and materials to conduct experiments or research and produce something. Laboratories usually are subject to all kinds of institutional regulations, including limited access times [1].

Laboratories may be owned by academic and non-academic institutions. Nevertheless, the term learning lab usually refers to a location in a school, such as a classroom or dedicated section of the library, where students can go to receive academic support, or to the programs school create that deliver academic support. Laboratory work is almost ubiquitously seen as being of great importance to science education, by some as almost the defining characteristic of this component of the school curriculum [2].

The laboratory has an important and strategic role to support the learning process and as an effort to raise institutions in the global environment. In addition to its main role as a learning facility, the laboratory is also one of the indicators that reflect the identity of the institution. The laboratory has been given a central and distinctive role in science education, and science educators have suggested that there are rich benefits in learning from using laboratory activities [3]. According to Wang [4], the laboratory is the heart of the modern university, laboratory is cultivating high quality talents in colleges and universities, the development scientific research important base.

In fact, there are many institutions that have complete laboratory facilities but are not well known to the public. This is due to the lack of publicity aspects that are well organized. As a result, the identity of the institution becomes less visible and even less considered its existence. Publication or promotion is an importance aspect as a strategic asset of the organization [5]. Therefore, it is necessary to have a system capable of publicizing laboratory facilities attractively and easily accessible. The problem of this publication is also found in the Department of Electrical Engineering State University of Malang (UM).

Referring to the urgency and the existing potential, this paper proposes the development of web-based laboratory virtual tour 360º application as an appropriate solution to provide an interesting and communicative publication media. In contrast to the presentation of flat images in general, this application is able to present the visualization of moving 360º lab images so that it looks live and resembles the original. The development of communicative and interactive communications media based on Information and Communication Technology (ICT) is highly relevant to the laboratory's vital role.

Laboratory experimentation plays an essential role in engineering and scientific education. Furthermore, they provide additional benefits such as supporting distance learning, improving lab accessibility to handicapped people, and increasing safety for dangerous experimentation [6]. Virtual instruments and distributed systems are of great interest to create advanced and flexible teaching and experimentation environments for measurement technologies at limited costs. The availability of simple and efficient technological supports to dissemination and remote use of virtual systems becomes attractive to increase the diffusion of experimental practice disregarding the number of students and their location as well as the variety of instruments and measurement procedures directly available for experimentation [7]

Utilization of ICT in the education environment is an appropriate solution in the digital era today. Utilization of web-based applications can be a medium of publication as well as practical promotions that can be accessed widely whenever and wherever independent of space and time. With the publication of laboratory facilities to the public, the identity and credibility of the institution become well known. The result, this application is expected to help improve the quality of service institutions.

II. WEB-BASED LABORATORY VIRTUAL TOUR

Although the term of "virtual tour" is widely used, until now there is still no formal definition used as a reference. The researchers provided a varied definition. According to Cho [8], virtual tour can be defined as a tour through a virtual environment where one experiences "telepresence". Steuer [9] defined telepresence as "the sense of being" in an environment by means of communication medium. Virtual tour is a computer presentation of a place and it shows the geometrical properties of that area [10]. This 360-degree panoramic application provides people to look in any direction, see a full circle of the area and walk around by clicking on the hotspots. In the simplest of terms, a virtual tour is a journey in a virtual environment [11].

In contrast with regular images that look flat, virtual tour presents a panoramic panorama-like images actually. Panorama expresses a wide view that is unbroken or truncated. This view can initially only be generated using a specialized camera. But now with the development of ICT (especially computers) has changed everything, even computer-based applications tend to be more effective and efficient. In realization, virtual tour is widely applied to various fields, especially tourism. In addition, virtual tours can also be implemented to support education and learning services.

A. Product Description

The proposed product is a 360º virtual tour lab software application to help improve the quality of education services. This application provides visualization of communicative laboratory images.

The requirements for the system design can be explained as follows:

1. Presents a laboratory photo gallery from various points of view.
2. Displays a laboratory panorama images dynamically.
3. Perform grouping of images to facilitate the content search.
4. Provide an information search pages

This design modeling uses UML notation approach by utilizing use case diagram. The use case diagram shows how users interact with the system. A use case diagram is composed of use cases and actors. Use cases represent the functional requirements where an actor is a role played by a user [12]. The use case diagram form is shown in Figure 1.

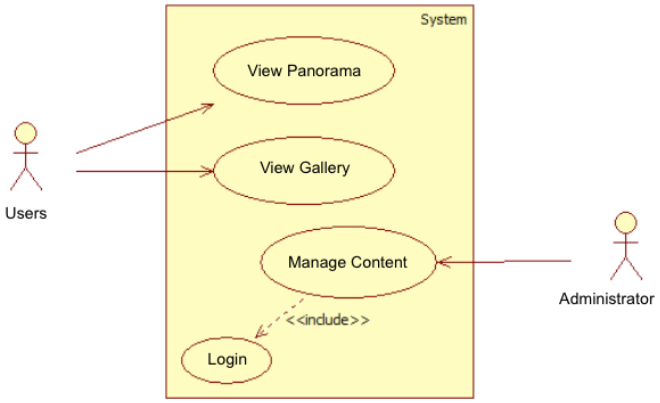

Fig. 1. Diagram Use Case

Actors or users who will interact with this application consist of two categories, public users and administrator. Public users can access the application without having to sign-in first, while the admin must go through the authentication stage.

B. Architecture Design

This virtual tour lab application is built using web technology and is distributed over the Internet network. More details on the system architecture development design are shown in Figure 2.

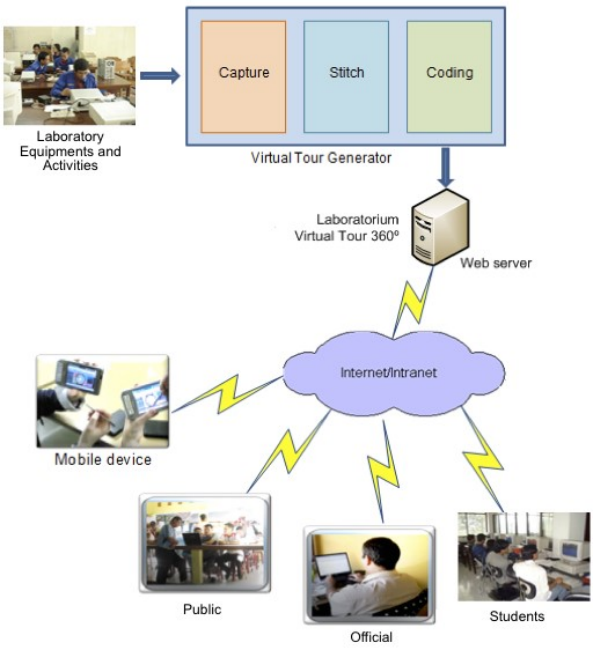

Fig. 2. Design of System Architecture

Web sites with web experiments, especially online laboratories, mostly include a rationale of the research at hand and give an explanation of what experimental psychologists are doing. This might well heighten the visibility of research [13]. The web app approach allows anyone connected to the Internet network to access the 360º panoramic laboratory images.

Referring to the architectural design, there are three main stages that are performed to produce virtual tour laboratory applications.

- Capture panoramic images

  This stage will shoot of tourism locations per section/angle.
- Stitch panorama image

  Stitch stage aims to combine parts of a photo image to panoramic image.
- Coding

  This implementation or coding stage aims to process panoramic images that have been stitched to become more immersive.

On the 360º virtual tour, a panoramic simulation form is provided in full to a 360-degree viewing angle. To get this picture, we can use modern cameras that almost all provide panoramic shooting feature. Another approach used to produce a panoramic view is through stitching techniques, which "sew" pieces of the image into a full view panoramic picture. This approach requires software application to produce 360-degree panoramic images. After the panorama material is complete, the next step is to provide operations to control panoramic images, such as rotating, zooming, and minimizing images.

C. Research Design

Before go to the realization stage, a framework in the form of a research design should be developed to support this activity. A research design is “an action plan for getting from here to there, where ‘here’ is the initial set of questions and ‘there’ are the set of answers” [14].

Referring to the characteristics of the product, this study uses waterfall model of software development which consists of five stages, communication, planning, modeling, construction, and deployment [15]. Although this model is known as old model, but it is still reasonable and widely used. The selection of this model is based on very well-known requirements, stable product definition, and understood support technology.

The stages of waterfall development model can be described as follows: 1) Communication stage is the initiation of the project and aims to explore the product application requirements specification; 2) Planning phase includes estimation, scheduling, and trace product results. Here we also create an interface design of application; 3) Modeling aims to analyze and design the product application; 4) Construction is an activity to translate the results of the modeling stage to a form of product applications and at the same time product testing results; 5) Deployment stage aims to broadly distribute products that can be used by the target users of the product.

The phases of the waterfall model of software development carried out systematically and sequentially. Each stage in this model is related, the next stage requires the previous stages as input, and so on until all the stages completed. Waterfall process model is suitable when the product requirement specifications are already known. As in this paper, the requirement for the development of document template already well defined and understood.

D. Product Design Testing

Testing is an activity in which a system is executed under defined conditions and the results are observed and evaluated. Testing is performed as a verification that the developed software can meet the earlier requirements specification and run in accordance with the scenario that has been described. The main purpose of the testing phase is to find unidentified errors.

The testing procedure starts from the unit or module to the whole software product. Test cases written in a format that has the result statement accepted and rejected. This product testing conducted by engineers as an expert judgement who have the relevant competence. The testing procedure performed by observing the product and revising it based on the instruments that have been provided.

In this paper, product design testing is limited in functionality testing using black-box method. Testing is done by looking at the output of the software based on the input provided. To support the implementation of product testing, required a description of the test procedures and test cases. This testing stage is successful when all items on the test case have been declared accepted.

III. RESULTS

The main activity of the implementation stage is to translate the results of analysis and design to a machine-readable product design form. At this stage, aspects related to the behavior and structure of the system are represented as they will be built.

At this stage will be implemented virtual lab tour application using HTML5, CSS3, PHP, and jQuery library. Once the application design is successfully created, the next step is to perform design test.

Each use case contained in the use case diagram represents software functionality. Therefore, the implementation of the interface in the developed application has a close relationship with the use case diagram. The basic reference used in this step is to generate a user interface for each use case that is directly related to the actor.

The design development of this application focuses on the interface design that looks simple and clear. The design of this application is deliberately not providing many menus, except the main menus in accordance with this function. Thus, users can access the application without any difficulty. The display form of the main page implementation is shown in Figure 3.

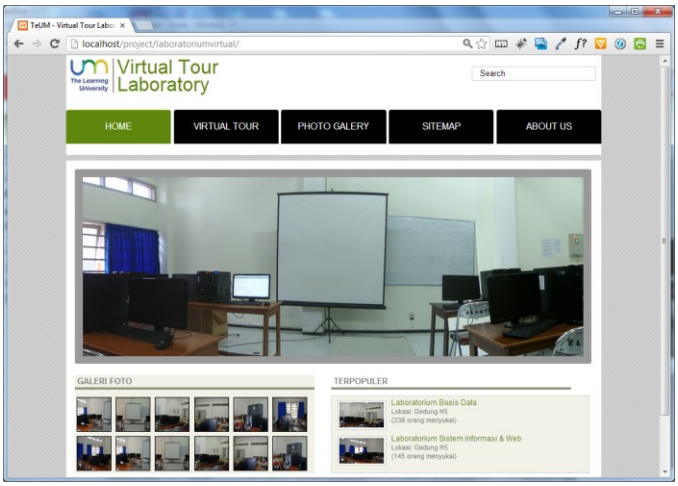

Fig. 3. Main Page of Application Design

The panorama page represents the laboratory environment in the Department of Electrical Engineering which is packaged interestingly. The main page design refers to the responsive web model so it can be accessed through various user devices. This page displays the main image of a laboratory panorama with a description of the laboratory.

On the main page, there is a menu link to go to the detail panorama page. One of the panoramic page views in the computer laboratory is shown in Figure 4.

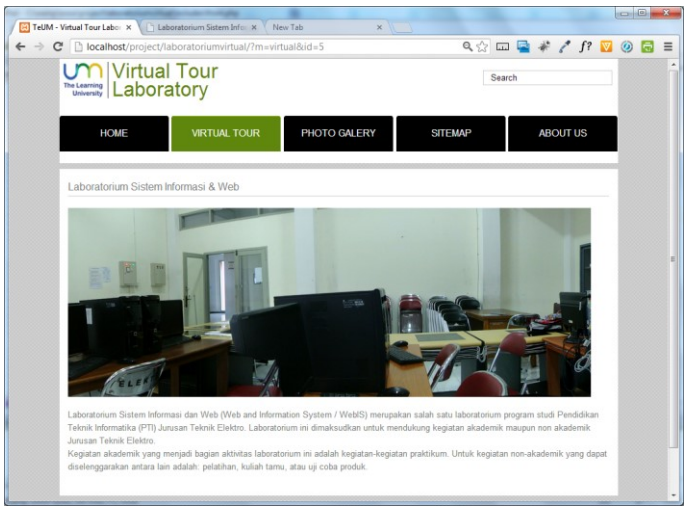

Fig. 4. Computer Laboratory Panorama Page

The panoramic page will instantly display a laboratory panorama with a dynamic 360º angle. There is a play/pause button to control panorama movement using the mouse. User can also use the scroll mouse to shift panoramic images to the left or right.

In addition to displaying panoramic images, also provided a laboratory photo gallery page with a user-friendly design. Presentation of photo galleries grouped by type of laboratory making it easier for users to browse photos. Various laboratory activities that have an educational value are displayed to provide useful information to visitors.

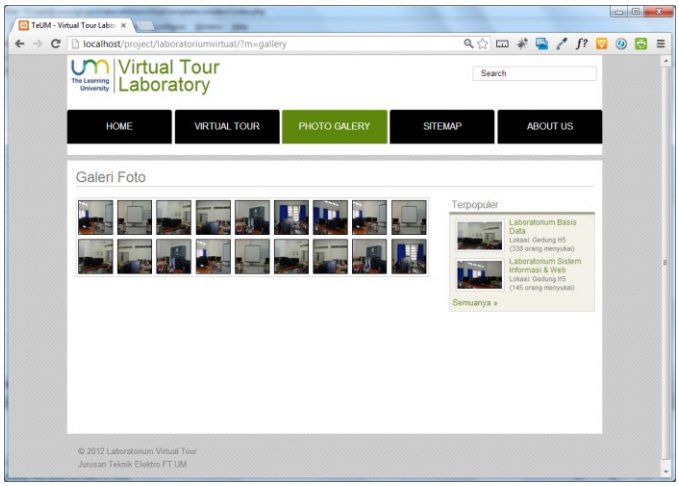

Fig. 5. Panorama Photo Gallery

Details about the laboratory photo gallery display the main image from close range. In this view, the user can see around the laboratory with more focus. Some important information can also be added to this close-up view, such as the name of the lab and the activities that have been done.

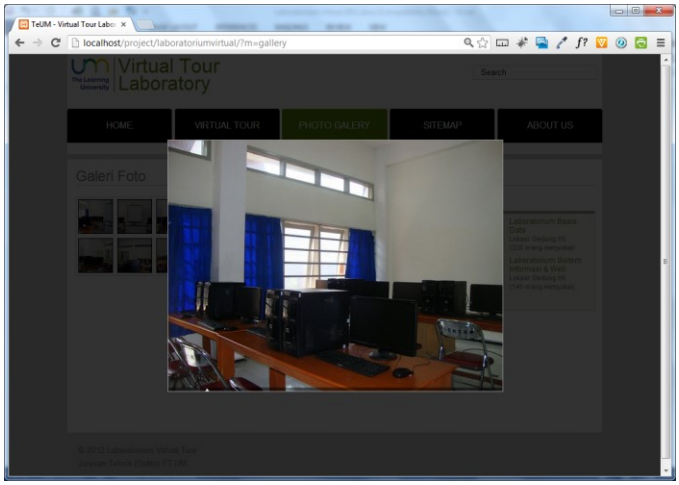

Fig. 6. Detail of Laboratory Panorama Image

The virtual tour is widely used to describe a wide variety of photography-based media. In this implementation of this design, virtual tour is combined with other media, such as text, audio, and animation.

IV. Discussion

Utilization of ICT technologies has great potential in supporting and improving education services. Solutions that rely on this Internet network allow applications to be distributed and available for access by users from various places. Design web applications that apply the concept of responsive web design makes the application ready to access through various types of devices, both desktop and mobile. This characteristic is best suited for publishing information.

The virtual tour approach is widely used to describe a variety of photography-based media. In the implementation of this design development, the virtual tour is combined with other media, such as text, audio, and graphics. Compared to the use of video, a 360º virtual tour has several advantages, among which is lighter because in principle only in the form of images. In addition, the virtual tour also allows for better interaction supported navigation and user control, such as scroll, zoom in / out, and integration with other interactive menus. In addition to allowing widespread access to the rest of the world, the display provided is also more interesting and interactive.

The representation of the virtual tour laboratory is visible on a panoramic image that can be moved horizontally at 360º angle. Through the mouse control, users can see the corner of the laboratory from the inside. This allows users to view the contents of the laboratory space as if in it directly. A publication approach with such a concept will involve the user directly so as to motivate attraction. Based on the test results by the black-box method through a defined test case, it can be concluded that the design of the software application is free of syntax errors, and functionally release the results as expected. Similarly, on the administrator side, once the admin has successfully authenticated, it will be redirected to the administration page. On this page, the administrator can add or modify laboratory panorama content. Thus, the virtual lab tour application design can be utilized to improve education services.

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REFERENCES

[1] Reips, U.-D. The Web experiment method: Advantages, disadvantages, and solutions. In M. H. Birnbaum (Ed.), Psychological experiments on the Internet (pp. 89–117). San Diego, CA: Academic Press. 2000.

[2] Hart C, Mulhall P, Berry A, Loughran J, Gunstone R. "What is the purpose of this experiment? Or can students learn something from doing experiments?" J Res Sci Teach, 37:655–675, 2000.

[3] Hovstein. "The Role of the Laboratory in Science Teaching: Neglected Aspects of Research". Review of Educational Research Vol: 52 issue: 2, page(s): 201-217, 2016.

[4] Wang J.M, Qiu N.W, Liu K, Chen C. "Research on the pollution prevention and safety management of university chemistry laboratory". LABORATORY RESEARCH AND EXPLORATION; 2015-03

[5] Alessandri, S. & Alessandri, T. Corp Reputation Rev 7: 252. https://doi.org/10.1057/palgrave.crr.1540224, 2004.

[6] Heradio R. "Virtual and remote labs in education: A bibliometric analysis". Computers & Education Volume 98, July 2016, Pages 14-38, 2016

[7] Ferrero. "A simulation tool for virtual laboratory experiments in a WWW environment". Instrumentation and Measurement Technology Conference, 1998. IMTC/98. Conference Proceedings. IEEE

[8] Cho, Y. & D. R. Fesenmaier. "A conceptual framework for evaluating the effects of a virtual tour". In Fesenmaier, D. R., Klein, S. & D. Buhalis (Eds.), Information and Communication Technologies in Tourism 2000, pp. 314-323. Wien: Springer Verlag.

[9] Steuer, J. "Defining virtual reality: Dimensions determining telepresence". In F. Biocca & M.R. Levy (Eds), Communication in the age of virtual reality (pp. 33–56). Hillsdale, NJ, USA: Laurence Erlbaum Associates. 1995.

[10] Koyuncu, "Virtual Campus," INTERNATIONAL JOURNAL OF COMPUTERS, vol. Volume 1, no. Issue 4, 2007

[11] Prasetya, D.D. "Aplikasi Virtual Tour Berbasis Web Sebagai Media Promosi Pariwisata". Seminar on electrical, informatics, and Education. 2011

[12] Jacobson I, M. Christerson, P. Jonsson and G. Overgaard, "Object-Oriented Software Engineering: A use Case Driven Approach". Addison Wesley, 1992.

[13] Birnbaum, M. H. (in press). "Decision making in the lab and on the Web". In M. H. Birnbaum (Ed.), Psychology experiments on the Internet. San Diego, CA: Academic Press.

[14] Yin, R.K., Case study research – design and methods, applied social research methods series, 5, 2nd Ed., CA: Sage Publications 1994

[15] Prasetya, D.D. Design reflowable digital book template. Green Construction and Engineering Education for Sustainable Future AIP Conf. Proc. Published by AIP Publishing. 2017.