Design of Interactive E-Learning Based on Virtual Tour for Higher Education

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Keywords: E-learning, Virtual Tour, Interactive, Immersive, Web

Abstract: E-learning has become a very interesting topic because it offers practical solutions to solve problems in traditional learning or face to face. The e-learning approach utilizes Internet and web technologies to provide adequate learning support. This article proposes the design of an e-learning system based on the virtual tour for higher education in the State University of Malang. The virtual tour presents the real-life visualization of the outside 360-degree moveable dynamic Computer Network components images as the original object. This web-based technology design utilizes HTML5, CSS3, and AJAX scripting to realize a rich interactive and immersive environment. The functionality test results show that the application design is running well in accordance with the defined specifications and no errors found. In the limited testing, the students were very enthusiastic in this approach that enhanced the learning experience and provided positive feedback through the given questionnaire.

1 INTRODUCTION

Information and Communication Technology (ICT) has a dominant role in changing the human lifestyle today. As we know, almost all human activities, both for commercial and non-commercial purposes, rely on the ICT services. There are many fields that are actually utilizing the services of this technology, one of them is education. Various educational strategies, from elementary until higher education level, implement ICT-based systems, for example, electronic learning (or simply called e-learning). In recent years, e-learning has become a very interesting topic because it offers practical solutions to solve problems in traditional learning or face to face. Classical teaching alone in a classroom may not be suitable to fulfil the individual requirements to serve each student's needs which currently leads to the use of modern technology (Banditvilai, 2016). Many researchers agree that the most significant revolution offered by e-learning is the ability to overcome the limits of place and time in learning (Tsai, 2009). According to (Ivleva and Fibikh, 2016), an e-learning approach is also considered appropriate to be one of the valuable solutions to be implemented in education development. E-learning offers many advantages to support education and learning, including being able to save time, costs, and resources.

The interaction between teacher and students in the e-learning context can be implemented either synchronous (real-time) or asynchronous (delayed). Online learning based on ICT features and services are widely applied in education environment because it offers ease and flexibility. However, this exciting potential must be supported with adequate infrastructure, including the availability of meaningful and interesting content. The role of this learning content is very important to facilitate the success of e-learning or digital learning based on ICT. To optimize the quality of electronic learning, it is necessary a rich and interactive learning content. Interactive contents are often used to describe the relationship between two things influencing each other (Prasetya, Wibawa and Hirashima, 2018). Provision of rich content can be realized through multimedia elements, such as text, image, audio, and video. The learning system based on multimedia contents is also able to provide better visual representation and achieve resource sharing among students effectively (Wang, Qi and Cui, 2016). According to the study conducted by (Ni, 2017), the use of multimedia content in learning is able to provide various learning information needed by

students and make language practice in learning more effectively.

One of the potential opportunities to implement multimedia-based e-learning is integrating a virtual tour approach. A virtual tour is an interactive simulation of an existing location on the earth, usually composed of a sequence text, still images, and panoramas. The word panorama denotes an unbroken tour/view because a panorama can be a series of images captured by the photographer or the video footage (Cho and Fesenmaier, 2000). These virtual tours have taken from a series of panoramic photograph known as a vantage point. A virtual tour is a computer-based virtual environment which reconstructs and represents a real place virtually (Yoo *et al.*, 2010). Thus, this technique provides a real sensation to users as if they visit the area in advance. In the 360-degree virtual tour, a panoramic simulation form is provided in full to a 360-degree viewing angle. Virtual environments are being utilized in a wide range of academic and commercial applications.

The study of virtual tour application in entertainment and commercial fields has been done and intended for various purposes. (Zhang, Zhu and Ma, 2017) proposed a special approach for spherical panorama recording by utilizing a head-mounted display equipped with stereo effects on a virtual tour system application. So, in addition to providing realistic photos like virtual tour applications in general, this system offers voice features that make users more impressed. Nevertheless, the implementation of this virtual tour technology in the education area is still not much done. One of the relevant studies related to the use of virtual tours in the field of education was conducted by (Rajapaksha *et al.*, 2017). In his research, Rajapaksha developed E-GEO e-learning application to support Geography subject in Srilanka. The entire design of the application adopts gamification technique to provide a motivational environment for users. This application works in a totally offline environment without the Internet connectivity.

Referring to the related studies we have mentioned, we can highlight the differences works with our proposed research. The objective of this study is the design of interactive e-learning based on virtual tour technology for higher education in the State University of Malang. This system is an extension of the previous system that we have developed before, namely a web-based lightweight interactive multimedia application for distance learning (Prasetya, Wibawa and Ahmar, 2018). Here we add new features to existing systems, a virtual simulation of a tour of computer network hardware

components. We integrate virtual tour features to produce a more interesting and motivating electronic learning environment. Thus, students can have a more realistic representation of objects in learning.

2 METHOD

2.1 System Design

The designed application is an electronic learning application that utilizes multimedia content to support the learning process. The resulting output is a software application product, so the development design also refers to the relevant process model. After the development phase, we conduct a series of tests to ensure that the product is free of errors and meets the appropriateness of use.

The illustration of the system design can be described using the use case diagram as shown in Figure 1. Here are two main users who will interact with the system, they are learners or students and teachers or lecturers. Learners are an entity who has the main role to access the public learning services of the system, such as view materials, virtual tour and take interactive quizzes. In the other side, the teacher entity is a dedicated user who has the main responsibility for managing the content of the learning system. To access the provided content, both learners and teacher must log in first. After successful login, they will be redirected to each page according to their level of the user.
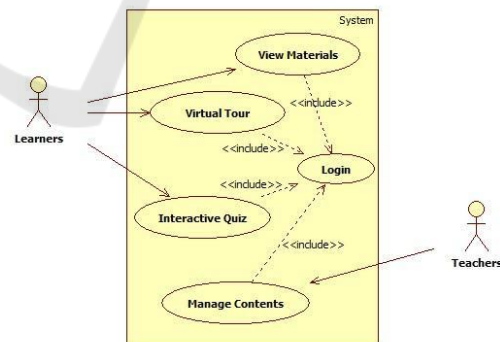

Figure 1: Use case diagram of the system.

The main objective of this application design is to provide an interactive and immersive learning content in order to help improve the quality of education services. To realize the research goal, we choose web technology as the basis of the application platform. The web technology approach is clearly accessible widely and together easily.

2.2 System Testing

There are two types of testing conducted in this study: product testing and user feasibility testing. Product testing is done by testing the main functions contained in e-learning application developed using a black-box method. The main functions of the system represented by five subsystems that have been defined in the use case diagram. To get the objective result, we use the same hardware specifications in both the implementation and test.

The user feasibility test aims to determine the usefulness of the product directly. This test is conducted in a limited way by taking 15 university students in the Informatics Engineering Education study program. In order for the results of testing to be more optimal, the selection of subjects is made through a selection by the class teacher by referring to three categories of student's abilities (advanced, intermediate, basic) with each of 5 people. To complete the testing process, a questionnaire sheet was provided using a 4-point Likert scale

3 RESULT AND DISCUSSION

As we mentioned above, the product in this study is an extension of the features of the products that we have developed previously. Thus, the main interface design also has the same appearance. So, this system is a web-based learning application that takes case studies of Basic Computer Network courses. In the beginning, there are three main menus available, including basic material, simulation exercises, and interactive quizzes. The main interface design is shown in Figure 2.
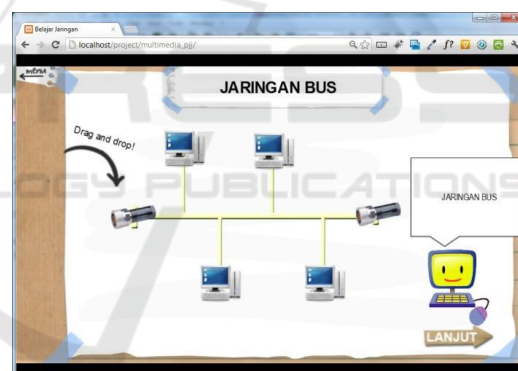
The first part of the material contains an introduction to computer networks that are adjusted to the level of college. This material content is compiled with reference to textbooks and consists of text, images, and videos. The structure of this basic material is similar to that in textbooks, it's just added animated and video content. In the training section, students can try the simulation of composing computer network design based on topology. To try these interactive simulation students use mouse input devices by dragging and dropping to the appropriate node. Display simulation page for composing computer network design is shown in Figure 3. One of the additional features provided in this learning system application is full-screen display. This feature enables the users to focus on the wide view of window application without any interruption by the other window application.

Unlike the previous applications that only finished at the computer network design step, here we added a virtual tour feature. When the computer network is properly arranged, students can click on the components involved to see more details. Display components are designed based on virtual tour technology that can be shifted to the left or right. Thus, students can have a more understanding of the picture of the components as shown in Figure 4.

Figure 2: Main page of learning system.

Figure 3: Network design simulation.

Figure 4: Virtual tour of content material.

The implementation of a virtual tour approach in electronic learning applications looks very appropriate and interesting. However, in the context of computer network material, students need to understand well the components used, including detailed descriptions. Through the virtual tour view, students can see component objects virtually with an angle of 360 degrees freedom. This approach is able to represent objects in real terms as if looking directly. So, students are no longer just to imagining without getting complete information.

The next step after the product development stage is to ensure that the product is in accordance with specifications and there are no errors found. In software development, this step was realized through a series of trials. To support this testing phase we define procedures and test cases first. This phase includes the activities of executing the system in the defined condition and observes the results.

Testing performed by evaluating the main functions of the smallest unit until the whole system. Testing conducted using black-box methods and based on the scenario in each subsystem. There are two scenarios that we involve: normal and alternative scenarios. Alternative scenarios arise when there is branching, for example at the stitching stage, the result might be either successful and failure. As described in the use case diagram, there are five main functions available: view material contents, virtual tour, interactive quiz, login system, and manage content. The complete testing result is shown in Table 1.

The test procedure is to execute the main unit or module of the system application. Furthermore, we give an input and observe the given output as a feedback. For example, in the login system module, the possibility that happens is a successful login (normal scenario) and failure (alternative scenario). If the system gives a suitable output, then it can be said that the module functionality is declared acceptable, otherwise is rejected. If there are still modules that have not well functioned, it will be repaired and retested until the entire of the module is declared accepted. Based on the test results, it can be concluded that the application software is free of syntax errors and well functioned.

In the practical use stage, it starts with a brief explanation and continues by accessing the application through a computer that is connected to the local network. Students are given 20 minutes to carry out learning with the help of products that have been developed. The last stage, students are given 10 minutes to fill in the response assessment instrument on the feasibility of the product.

Table 1: Black-box test result.

No	Sub-system	Scenario	Methods	Results
1	Material contents	Normal	Black-box	Accepted
		Alternative	Black-box	Accepted
2	Virtual tour	Normal	Black-box	Accepted
		Alternative	Black-box	Accepted
3	Interactive quiz	Normal	Black-box	Accepted
		Alternative	Black-box	Accepted
4	Login system	Normal	Black-box	Accepted
		Alternative	Black-box	Accepted
5	Manage content	Normal	Black-box	Accepted
		Alternative	Black-box	Accepted

Based on the results of a limited field test, the average results were 84.00. Referring to the table of validity, it can be concluded that practical use in a limited group got very high criteria. That is, the design of electronic learning applications that were developed received a very good response with a percentage of the appropriateness of 84%.

Based on the field test results, can be analysed the statement items that get the highest point of 91.67% is "The virtual tour approach is able to provide a better and more interesting representation". On the other hand, application performance issues still need to be reviewed again and get the lowest point, which is 78.33%. However, this value can still be tolerated because, as usual, virtual tours usually always involve large or collective image data.
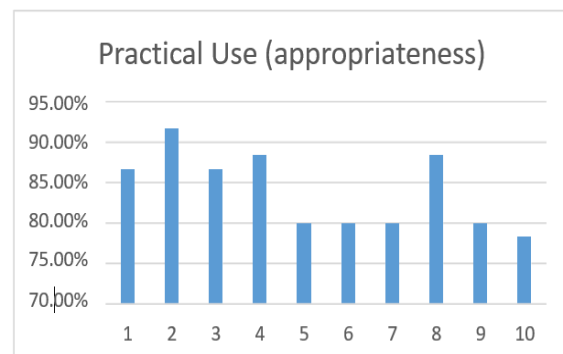

Figure 5: Appropriateness of practical use test.

There are at least 3 added values that contribute to the application design in this article: interactive simulations, virtual tours, and interactive quizzes. Interactive simulation allows students to build network topology designs with drag and drop game models. Integration of virtual tour application in this research is represented by giving outside 360-degree virtual tour feature in electronic learning. This stage is realized by processing a series of images that overlap and form whole objects. Other interactive content provided in the design of this application is multiple choice evaluation. In this feature, the learner can practice and get a result that describes the understanding of the material

4 CONCLUSIONS

This paper has proposed and developed design of interactive e-learning based on virtual tour technology for higher education. The development of this application utilizes web technology that is able to produce lightweight and widely accessible application. To realize the virtual tour feature on material objects, we use a series of overlap images that are processed using scripts and make it moveable through mouse interaction. A web-based virtual tour 360-degree electronic learning application is one of the right strategies to support educational services.

Based on the functionality test results, it can be concluded that the e-learning system is no syntax errors and well functioned. Thus, the development of this application is fulfilled with the defined system requirements. The results of testing in a limited group also show that this product is suitable for use in learning. However, to find a more objective and optimal result, further work is necessary to conduct field testing broadly and involve the learning outcomes.

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