T. Hirashima et al. (Eds.) (2011). Proceedings of the 19th International Conference on Computers in Education. Chiang Mai, Thailand: Asia-Pacific Society for Computers in Education

Development of new e-Learning contents using the Augmented Reality Technology

Akinori TOGUCHI[a*], Hitoshi SASAKI[a], Arimitsu SHIKODA[b] and Kazunori MIZUNO[a]
[a]*Faculty of Engineering, Takushoku University, Japan*
[b]*Faculty of Engineering, Tohoku Gakuin University, Japan*
*toguchi@eitl.cs.takushoku-u.ac.jp

Abstract: A learning content used in e-Learning system is prone to one-sided outbound of information. It is difficult to use in laboratory courses require work with the real tools. However, students will easily understand how to operate equipment by watch the real things rather than seeing them illustrated. Therefore, wefocused attention on the augmented reality (AR) technology to solve this issue. By using it, we can make new e-Learning content that can shows instruction on the actual environment through 3D computer graphics models with some instruction information. In this paper, we propose the new e-Learning content using the AR, and report about developed the prototype content with evaluation of students.

Keywords: augmented reality, e-Learning, laboratory course, learning content

Introduction

In the e-Learning, teacher can make learning contents with not only text data but also multimedia data such as videos, sounds and pictures. Primarily, these contents are used in e-Learning as textbook and the exercises for students. On the other hand, it is difficult to uses these contents in laboratory courses require work withreal tools. For example, it is compelled to instruct by indirect illustrations and other media, for description about equipment operation because it is difficult that recognize the student's actual environment through the e-Learning content. However, we think that student can more easily understand how to operate actual equipment watch the real images of them than indirect illustrations. On the other hands, the AR technology has been attracted much attention. By using it, we can make the content that cansuperimpose the instruction on the actual-world environment. Therefore, we have developed a prototype as new e-Learning content for laboratory courses. In this paper, we report about it and report results of evaluation experiments.

1. Current e-Learning content in higher education field

By the recent development of information technology, peoples will be able to use the e-Learning in various places. In addition, the education institutions and corporates are utilizing the e-Learning in Japan.Peoples can further learning at an own pace in various time and places. On the other hand, in general face-to-face courses, student has been learning at same time and places. In these courses, students can throw the questions to teachers, and getting the answersin real time.

Figure 1. An example of our e-Learning contents

"blended-learning" is becoming popular that combines the advantages of e-Learning

courses and conventional courses.In addition, the e-Learning is utilized in the laboratory courses require actual work with the real tools.Moreover, in our universities, e-Learning is utilized inlaboratory courses such as the programming lesson and the electronic experiments. These contents are consisting by the text, some illustrations and pictures for students as shown in Figure 1. However, we should make more effort for students. For example, these contents cannot capture the student's environment.Namely, it is difficult that understand it by seeing the indirect illustrations. We think that students more easily understand how to operate experiment equipment by watch the real things than these illustrations.The laboratory courses have been conducted in the faculty of engineering. In these courses, it is important that actual work with real tools. Particularly, the learning of operation of equipment is important for accomplish the purpose of experiments. Most e-Learning contents are composed by text, sounds, images and videos. These are used in order to present about materials equipment to students. They are working to experiments while seeing it.We think that they will easily understand how to operate experiment equipment by watch the real things rather than watching these illustrated items. Therefore, we have tried to import picture of actual equipment and instructions to e-Learning content for students. However, this approach could not synchronize the movie with the instruction. Therefore, we focused attention on augmented reality to solve this issue. The AR technology is a term for a live direct view of an actual-world environment that is augmented with virtual image generated by computer. It can enhance one's current perception of reality. By using it, we can make a new e-Learning content for learning with real tools.

2. The new e-Learning content using the AR

The Augmented reality technology is a term for a live direct view of an actual-world environment that is augmented with virtual image generated by computer. It can enhance one's current perception of reality.We propose the new e-Learning contentsthat can instruction to actual equipment without using indirect media.

Figure 2. An example of new e-Learning contents

The new e-Learning content can directly instruct to actual equipment through the superimposed instruction images on the actual movie getting from the web-cam. Figure 2 is showing an example of running the content. In this case, content must know a position of equipment in advance for superimpose the instruction images on the image of actual equipment. This position will be known by using the simple black square (marker) to equipment in advance. Actual superimposed position is decided by the position of marker on the equipment. Student can watch the instructions by shooting the marker using the web-cam.We developed the prototype content for laboratory courses in the Tohoku Gakuin University as concrete example. In this chapter, describes the environment of content and reports the prototype contents.In the Tohoku GakuinUniversity, laboratory courses areconducting using the individual booth and web-based instruction manual (Shikoda, et al., 2010).Student does experiment with individual booth while watching a Web page of Web based instruction manual.Our contentsare developed by using the FLARToolKit (Spark Project) and written by the Action Script 3.0. It can embed in a web page of the instruction manual as flash content. Students can further experiments while seeing the direct instructions that superimposed on the image of an actual equipment through a web-cam.We expect that student who did not understand using the illustration, will be able to understand how to operate equipment more easily by using our content.

3. Evaluation experiment

We are sure that our contents will help students who have vague understanding of operation of experiment equipment. Moreover, we should experiment with our contents to use in real classes as next step. Therefore, we conducted the evaluation experiment to six students who are fourth grade studentsin department of electrical engineeringwith a history of this course. After they use our content, we ask them about the following questions.Question 1: "Were you easy to manipulate content?", Question 2: "Do you think that operation of content is easy by you get familiar with it?", Question 3: "Were you easy to see the instruction by AR?", Question 4: "Do you think that our contents are helpful to learn?", Question 5: "Do you think our contents are easy to learn operation of equipment than illustrated instruction?", Question 6: "Would you like to use our contents from now on?". We got the following results from these questions. In the question 1, 67% of students answered strongly positive and 33% of students answered positive. In the question 2, most students answered positive.By these results, it is indicated that most students can manipulate our contents very easily without confusing.However, in the question 3, 50% of the students answered negative. Therefore, teachers need to consider about superimposed objects design and way of fixing camera. In question 4 and 5, the majority of students answered positive. These results are indicating that our contents are helpful for student who cannot understand operation of equipment using illustrated contents.Moreover, in final question, all students answered positive.By this result, we will make further effort to use our contents in real classes.

4. Conclusion

In this paper, we proposed the new e-Learning content using the augmented reality technology. Then we reported the prototype that we are developing as new e-Learning content. In next, we must try evaluation experiments for our university students with this content. We think this content can be used for variety of learning use Internet. Therefore, we will actively try to explore a new possibility.

Acknowledgement

KAKENHI Grant-in-Aid for Scientific Research (C)(23501172) supported this work.

References

[1] A. Shikoda& H. Sasaki (2010). “A Click Stream Visualization Technique for Page Relevance Analysis on a Fully Illustrated. Teaching Material Distribution System”, **INFORMATION AND SYSTEMS IN EDUCATION**, vol.8, No. 1, pp.65 – 71.

[2] Stephen Cawood& Mark Fiala (2007), “Augmented Reality a Practical Guide”, **The Pragmatic Bookshelf.**

[3] A.Toguchi, H. Sasaki, K. Mizuno & A. Shikoda (2011). “Development of Web based instruction manuals through the use of the augmented reality technology”, **International Engineering and Technology Education Conference**, http://www.ietec-conference.com/Conference%20Proceedings/ietec/papers/Posters/Poster%201.pdf, pp. 1.

[4] A.Toguchi, H. Sasaki, K. Mizuno & A. Shikoda (2011). “A Study of e-Learning Contents Development for Student Experiments Courses using the Augmented Reality Technology”, **International Conference on Future Information Engineering**(Accepted)

[5] Philip Lamb, “ARToolKit Home page”, Retrieved October 2, 2011, from http://www.hitl.washington.edu/artoolkit

[6] Spark Project, “Saqoosha/FLARToolKit”, Retrieved October 2,2011, from http://www.libspark.org/wiki/saqoosha/FLARToolKit/en