MSL_AR TOOLKIT: AR WITH INTERACTIVE FEATURE FOR NEXT GENERATION EDUCATION

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Keywords: Augmented Reality, Interaction, Authoring tool.

Abstract: We describe an authoring tool for Augmented Reality (AR) contents. In recent years there have been a number of frameworks proposed for developing Augmented Reality (AR) applications. This paper describes an authoring tool for Augmented Reality (AR) application with interactive features. We developed the AR authoring tool which provides Interactive features that we can perform the education service project and participate it actively for the participating education service. This paper provides learning and teaching models for next generation digital textbook which Augmented Reality interactions between teacher and learner. The proposed method of this paper is applied to educational contents and we found positive effect which is supported by statistical experiments.

1 INTRODUCTION

The digital textbook project which embarked by the Ministry of Education, Science and Technology has focused on experiments and practices from the school designated by the government in Korea.

However the previous research about digital textbook provides static interaction models and teaching-learning models analogous to web-based learning based PC even the framework of the digital textbook is based of Augmented Reality.

This paper provides learning and teaching models for next generation digital textbook which encourages interactions between teacher and students. The proposed method is applied to educational contents and we found positive effect which is supported by statistical experiments. The results of this study about the future development of digital textbooks will be effective development plan.

The study results from the demonstration digital textbook project sponsored by the Ministry of Education showed that the form of the digital textbook contents made the insertion of supplementary study materials difficult. This difficulty resulted in a failure to arouse continued interest and as a learning obstruction factor. In particular, because the simple presentation-type, web- and multimedia-based passive contents currently used in schools and the composition of digital textbook contents are similar and thus provide only a limited degree of freedom with respect to learning, such contents revealed limitations in terms of inducing interest and flow.

Since virtual information difficult to observe in the real world can be attained with the use of augmented reality technology, it is possible to utilize additional information and receive guidelines or additional information appropriate for the user's situation through situated cognition. As it allows tangible testing using markers, it can be effective for inducing interest in learning.

In this paper, we aim to design and create a future digital textbook content scenario by using augmented reality technology. Accordingly, for augmented reality-based digital textbook development and application, we drew up and applied a development and teaching-learning method design for "interactive chemical formula teaching contents" to explain structures of atoms and molecules in a chemistry course. Through the results obtained, we seek to increase the student's interest in

Shim J., Seo J. and Han T..
MSL_AR TOOLKIT: AR WITH INTERACTIVE FEATURE FOR NEXT GENERATION EDUCATION.
DOI: 10.5220/0003476404570461
In *Proceedings of the 3rd International Conference on Computer Supported Education* (ATTeL-2011), pages 457-461
ISBN: 978-989-8425-50-8

learning together with learning flow and inquiry ability.

2 BACKGROUND

2.1 Augmented Reality

Augment Reality means a converged environment of the real-world and a virtual reality. The time that the research related to augment reality begins is since the Boeing Company has coined a term 'Augmented Reality'.

Also, since augmented reality technology as a learning tool is provided to have the students directly experience the contents regarding study materials that are not abstract symbols, it induces motivation by enhancing the interactivity and increasing the flow. In addition, by serving as a guide that enables the students to become interested and to inquire about the learning assignment on their own, it aids the students to engage in active, self-driven learning. (Jeeheon Ryu., et al., 2006).

2.2 Augmented Reality Authoring Tool

Current situation of AR Authoring Tools have too short history and lack of common application compare with 3ds MAX, MAYA. AR Authoring tool has a major ripple effect on technically yet. (e.g. (Yuan Wang, et al., 2009))

Table 1: Types of Authoring tools.

	Programmers	Non-programmers
Low level	ARToolKit arTag	DART ComposAR
High level	Studierstube osgART	AMIRE MARS

2.3 Flow

As an outcome of continuous responses hastened by interactivity, flow is accompanied by loss of self-awareness and is characterized by voluntary enhancement. Hoffman and Novak (1997), through their research on flow in the web environment, asserted that flow is the continuity of ceaseless responses hastened through the interaction between machine and human in the process of sailing the network.

In this paper, based on the concept of the flow, we tried to look at the effect of student's flow related to a digital study contents based on an augmented reality.

2.4 Interest

Since existing digital textbooks have repetitions of unnecessary animations or sounds and are mostly filled with pictures and videos for simply presenting the content of the text, they can degenerate into simple presentation types that reduce the level of concentration or interest.

In this study, however, augmented reality technology is applied as the future digital textbook technology, enabling the students to understand given principles by directly experiencing and manipulating on their own the contents of the textbook. We are going to see the change of before and after the interest by planning the study activity so that the class becomes possible to focus on the students.

3 MSL_AR TOOLKIT

In this section we describe the prototype of a MSL_AR toolkit process. Our goal is to develop a low-level tool that will allow programmers to build AR contents with interactive features. The users can modify configure file that needs for interaction on AR content through GUI.

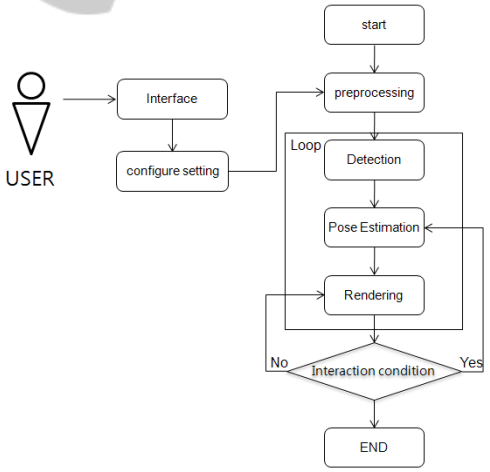

Figure 1: MSL_AR toolkit authoring tool process.

Fig 1 is a diagram of a MSL_AR toolkit authoring tool overall process. The first step is to input the information to create a simple AR content through User GUI. After that it creates AR content about entered information through main frame of MSL_AR toolkit.

The AR content that came out as the result of MSL_AR toolkit works with interactive feature

which specified by the user

3.1 MSL_AR Toolkit Process

MSL_AR toolkit authoring tool requires coding and scripting skills with programming knowledge. This authoring tool provides main function of engine and DLL library basically. Configure file determines markers` ID and the interaction methods, etc. Authoring tool that has been developed provides interaction that uses marker occlusion and marker merge methods. Fig 2 shows a flowchart of MSL_AR toolkit authoring tool.

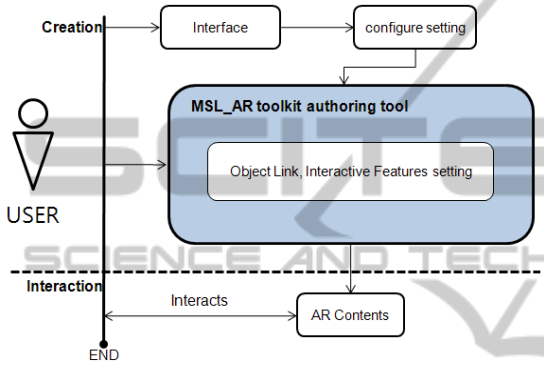

Figure 2: MSL_AR toolkit flowchart.

User sets the configure file through interface. And then, user implements the MSL_AR toolkit, it creates the AR content by applying the configure file in the stage of preprocessor. When the process activates, it will find marker in the inputted video from camera and augments the object above the marker. It interacts by interactive feature with the information that user input.

3.2 Augmented Reality Content Design for Education

In this research, we developed the contents instructing 'Atoms and Molecule' in Chemistry. An each marker indicates the unit of the atoms or molecule like Figure 3.

When these individual atoms or molecules are brought near to each other, the molecular (Figure 4) and application models (Figure 5) (Figure 6) that can be generated from the combination of atoms or molecules are generated through the interaction function of the designed markers.

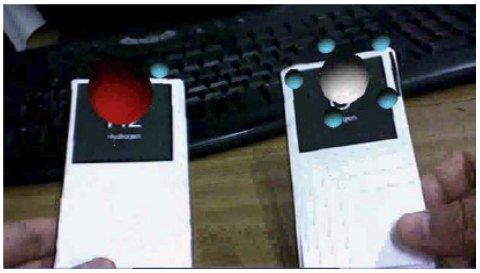

Figure 3: Basic atomic model.

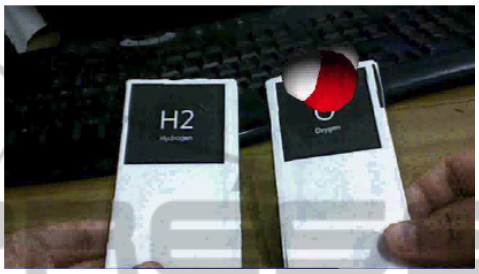

Figure 4: Molecular model by Interaction.

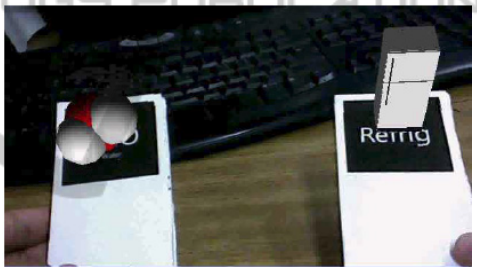

Figure 5: Refrigerator Marker.

Figure 6: Change of state.

A teaching-learning guidance plan was designed based on the '4-1. Three Forms of Matter' unit for the 7th grade level in Korea by using the augmented reality contents related to molecular arrangement, as shown in Figure 3. A teaching-learning course, in which the learning contents of the augmented reality-based molecular arrangement were applied, was created as a problem-solving learning model where the student directly makes the physical model

of each molecule and explores its strengths and weaknesses and understands and resolves the molecular arrangement resulting from the condition of the substance by utilizing the augmented reality contents. The learning format consists of group learning activity followed by individual learning stage.

4 ANALYSIS

4.1 Applying Object

To apply the guideline of teacher who is dealing with Augmented Reality contents, we guide the people who are mostly students.

The study subjects comprised 30 fifth grade students from a primary school located in Incheon, Korea. The developed contents were used in class lessons for one month.

4.2 Applying Result and Analysis

As the teaching-learning design that utilized the augmented reality proposed in this study was being applied to the students, in order to find out whether there are significant changes in the three dependent variables of learning flow, interest, and inquiry ability with respect to the students before and after its application, the results were analyzed through paired samples t-test.

The collected materials are analyzed by SPSS12.0 which is a statistic program and we set the significant level as $p < 0.5$.

4.3 The Influence of Future Contents Application that will Affect the Someone`s Flow of Study

In order to determine whether there is a significant difference in terms of the students' learning flow when the augmented reality-based contents were applied in the digital textbook, the learning flow test tool translated by Eun-ju Lee (2001) was modified and used. The examination tool is total 28 questions and we measured 5 point as Likert standard.

Table 2: flow before-after Test of experimental group.

	average	Standard deviation	t	p
before	2.80	.39	-6.761	.00
after	3.20	.46		

p<.05

4.4 The Influence of Future Contents Application that Will Affect the Someone`s Interesting of Study

In order to determine whether there is a significant difference in terms of the students' learning interest when the augmented reality-based contents were applied in the digital textbook, the learning flow test tool created by Eun-ju Lee (2001) was used. The test tool consisted of 10 questions with a mixture of 5-level Likert scale and short-answer types. (T.P.Novak., et al., 1996)

The pre- and post-test results of the test group students' learning interest showed that the average value improved by 3.2 points after the program application. This is a significant difference since the significance property value is less than .05. Therefore, the future contents are shown to be effective in terms of learning interest when applied to digital textbooks.

Table 3: Interesting before-after Test of experimental group.

	average	Standard deviation	t	p
before	56.17	6.98	-6.033	.00
after	59.37	7.69		

p<.05

5 CONCLUSIONS

The existing limitation of Augmented Reality authoring tool is fixed and provided restricted contents. Thus, there is no more additional information. The function of Augmented Reality based offers additional virtual information; that is actually difficult to observe, recognizes the situation and provides guideline about experimental procedure or order, etc. Also through interaction technology, MSL_AR toolkit increases the educational effectiveness and can be performed effectual, tangible experiments using marker.

In this study, as an alternative for the social demand for learning contents and system supplementation that can be applied to future digital textbooks, we applied to education augmented reality-based contents that provide a learning environment allowing students on their own to immerse in studying as well as improve learning interest and learning flow effect by hastening the sense of realness and flow. From this study, the following conclusions were obtained.

First, augmented reality contents can be widely applied in school lessons under the future digital textbook environment because work that would have been impossible to do or learning elements that could not have been experienced due to spatial and physical limitations can be easily simulated in the augmented reality environment where the real world and virtual reality converge.

Second, the results from the application of augmented reality-based contents showed that it can provide high level of interest and learning effectiveness of learning flow; and as such, it can be applied as the next-generation learning model.

Third, through this technological progress, the augmented reality-based learning, as a revolutionary learning method by which the students can become immersed on their own and gain understanding and generate new knowledge using the method of exploratory learning, is expected to become further developed by fusing with future learning technologies such as personal customized learning, ubiquitous learning, multi-game type learning and intelligent learning.

In follow-up research, we intend to develop a prototype of a digital textbook augmented reality writing tool that will allow teachers to easily utilize in the classrooms the development of augmented reality-based contents. Moreover, we seek to develop a more advance forms of educational contents and verify them in the classrooms.

ACKNOWLEDGEMENTS

This work (2010-0027654) was supported by Mid-career Researcher Program through NRF grant funded by the MEST.

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