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Functional Design of Virtual Blackboard System

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Abstract: This study describes the functional design of Virtual Blackboard (V-Blackboard), which is a core component of V-Education system. We introduce the development of electronic whiteboard and propose a definition of V-Blackboard, then discuss its main functions and composition, which will play a guiding role to the implementation of the V-Education system.

Key words: V-Education, V-blackboard, function and structure

INTRODUCTION

The development of information technology based on computer and networks will give brand new ideas and methods for the revolution and creation of education. For this basis, we create a "V-Education" (Virtual Education) System, which integrates computer vision, voice recognition, virtual reality, augmented reality and other techniques based on computer into education. By making full use of all kinds of media, the teachers can exhibit the instruction contents more easily in different ways and students can get the knowledge in more ways. This system tries to create an abundant educational resources including virtual blackboard, virtual schoolbag, virtual learning assistant, which will be managed through web, this will give the students learning by internet the same experience with those learning in the classroom and will improve the efficient of traditional classroom education, such as collaborative learning, real time communication, virtual laboratory and construct more real controllable internet teaching environment. In such an educational system, student's geographic position has become indistinct and the educational resources on the internet will also be fruitfully exploited. Thus the education will not be limited in educational entities like schools or classrooms, but become huge learning network, in which teaching and learning can be carried out anywhere and anytime. So the educational resources can benefit wider range of education and will be of great significance of promoting the overall development of the education. This study introduces the function and design of Virtual Blackboard, the core sub-system of Virtual Education System.

DEFINITION OF V-BLACKBOARD

With the great progress of the electronic information technology, newly digital teaching demonstration equipment has emerged, replacing the traditional blackboard and chalk, which is named "Electronic Blackboard", or more generally, called "Electronic Whiteboard". Although based on ordinary whiteboard, Electronic Whiteboard is a collection of microelectronics technology, computer technology, electronic communications technology and other high-tech means, realizing more effective combination of modern multimedia technology and traditional blackboard, which is currently in great promotion.

With the proliferation and application of all kinds of new technology such as 3D projection, virtual reality, augmented reality in the area of electronic blackboard system, the word "electronic" cannot reflect the real development situation of electronic blackboard, moreover, with the "electronic" definition, people likely to produce a certain limitations cognition for the system function and use scope.

In our system, we use "Virtual Blackboard" (V-Blackboard) to rename the current and future electronic blackboard and give it more extensive meaning. So we give such a definition that Virtual Blackboard is a teaching media which makes full use of various information technologies and integrate the function as writing, displaying, interacting, communicating, storing and controlling.

According to the different application in education, Virtual Blackboard system will have two levels (Fig. 1), which are the smart classroom for school education and

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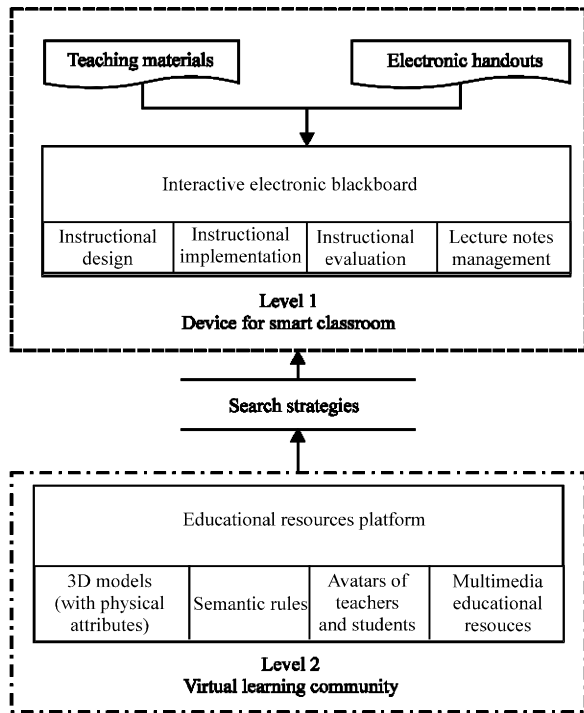
Fig. 1: Hierarchical structure of V-blackboard system

virtual learning environment for the internet (Fig. 2). Shows the simple work flow of the V-Blackboard System.

At the first level, V-Blackboard is a fully-featured teaching media, which cooperates with other elements of smart classroom and realize the functions like instructional design, instruction implementation, instructional evaluation and lecture notes management, mainly including the following:

- An interactive electronic blackboard which can display different teaching contents and realize the reasonable interactive teaching
- Teaching materials, especially the three-dimensional teaching materials which can be well organized
- A set of electronic handouts which are well arranged according to a certain teaching plan

At the second level, V-Blackboard is a virtual learning system based on internet and mobile communication technology, including the following:

- Educational resources platform based on the semantic web
- Virtual learning community and accordingly the teacher and student's avatars mechanism on this basis, to realize real-time interactive virtual learning

DEVELOPMENT OF V-BLACKBOARD

The research on V-Blackboard (previously called electronic blackboard) can be back to the 1960s and 70s (Breedlove and Gessert, 1970), when the electronic blackboard is just a simple hardware electronic product. And media technology core of computer technology was
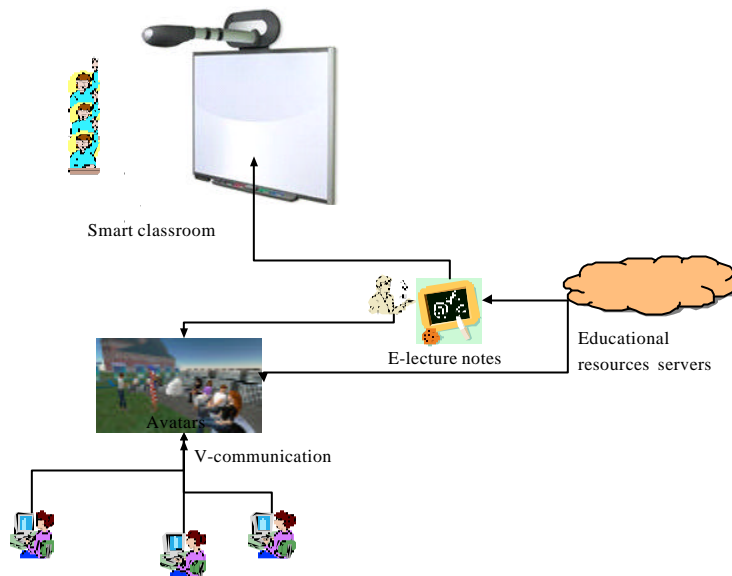

Fig. 2: V-Blackboard sample

not applied to them yet. Until in the early 21st century, rapid progress has made on the research and application in the exact electronic blackboard.

In the early use of electronic blackboard, Walker and Donaldson (1989) compared the traditional teaching and electronic blackboard teaching for the first time. Although the function of electronic blackboard is not as good as that of the current V-Blackboard, the researchers also obtained positive evaluation in the comparison experiments. Rogers (1995) applied electronic blackboard to medical imaging course, showing the medical image data analysis. And prove the flexibility and effectiveness through the comparison with the traditional method. Ahmed and Sowmya (1997) proposed an experiment control method using electronic blackboard and applied it in the AutoLab projects. The results for the project are also acceptable.

Information technology has been unceasingly developing and improving and the electronic blackboard also has unceasingly combining with the latest technology at the same time and so has the more in-depth research. Irfan Ul Haq *et al.* (2009) proposed an electronic blackboard system based on grid and cloud computing and has been used in Service Oriented Computing (SOC) project. Hammami *et al.* (2009) proposed an adaptive E-learning system based on multi-agent electronic blackboard. The agent mechanism of electronic blackboard provided a simple way for communication between learners, thus facilitated the collaborative learning. Almekhlafi (2009) used electronic blackboard to his E-learning remote teaching experiment. The results showed that students obtained higher self-comprehension ability by using electronic blackboard for distance learning. In addition, there was a positive correlation between students' performance and the frequency of making use of electronic blackboard as learning tools. Al-Qirim (2011) researched on the role of interactive electronic board and pointed out the effectiveness of such an application.

As the research on the electronic blackboard projects is concerned, there was an ESRC fund project in England, called "Visualization Helps Me Know Complex Things". The project showed that the visual and verbal ways can play a complementary role in transferring knowledge; The Media Lab of MIT was also developing a visual electronic blackboard system based on RFID, through which, users can get in touch with other personnel. Thus strengthened the cooperation in study and can make equipment management more effectively.

In China, the study about electronic blackboard is not as early as that at abroad and the related research began at the beginning of this century. The research is on

education application, including the following aspects: Constructing the education resource database model related to electronic blackboard application, effectively integrating the information technology and curriculum by using electronic blackboard, application of electronic blackboard in special education areas, etc. (Peng and Xu, 2008).

COMPONENTS OF V-BLACKBOARD

V-Blackboard is not only a simple electronization of traditional blackboard, but also an effective use and scientific integration of various teaching media based on information technology. Regarding the function character, V-Blackboard mainly has the following aspects.

Full-featured instructional media for classroom teaching: V-Blackboard is an auxiliary tool for the class teaching and is an extension and supplement of traditional blackboard. It will turn the teaching elements on traditional blackboard such as board writing, wall map and markers into rich educational media integrating with writing, drawing, storing, audio and video presenting, model displaying and 3D projecting. Based on this, the main functions of V-Blackboard are as follows.

Classification and arrangement of teaching materials: Material classification: to establish the classification system of teaching materials and put forward several different classification method, so as to make the selection of materials more convenient for preparing class.

Material forms: to take rich media format and be design specially for classroom teaching practice, including text, picture, audio, video, animation and other elements, so as to enhance the interaction of teaching and learning.

Material expansion: to provide users methods and tools for uploading the materials of teaching.

Various presentation way of the teaching content: The V-Blackboard should have rich functions and flexible usage. The teaching materials can be effectively organized and presented in various ways. The demonstration patterns of the materials can be adjusted according to the need of instruction, in order to enhance the effect of interaction learning with the students. And in these materials, music, background and virtual scene are created as the good assistant for teaching atmosphere.

Three-dimensional visualized teaching: Making full use of virtual reality and augmented reality technologies, the

V-Blackboard can realize the 3D visualization of teaching contents. Many teaching elements which are difficult to demonstrate in the traditional teaching area, such as the mathematical function graph, chemical reaction and the ancient characters and scene, can be reconstructed through 3D the methods, impressing the student more profoundly and vividly. For those macroscopic and microscopic phenomena, such as molecular structure, the motion of celestial bodies and cell division, 3D visualization can give full play to its advantages, breaking through the restrictions to intuitionistic presentation for such phenomena in traditional teaching ways.

Interactive teaching design: The interactive teaching module mainly includes questions and answers in class, real-time assessment of teaching effect, real-time test and analysis. By using Experience capture technology, teaching process can be automatically recorded and used again as courseware directly.

Management of electronic notes: Electronic notes are sets of V-Blackboard layout, which are the implementation and demonstration of teaching contents. V-Blackboard System provided such related management functions as storage, query, editing sharing and deleting for the electronic notes. Every electronic note file contains the teaching material, specific screen mark, teaching background, etc., which can be produced by teachers before classes or automatically generated by the system during the teaching process. The former is similar to a high-powered demo manuscripts production tool, while the latter is more convenient for the teachers and students to review and memory the course content retrospectively.

The V-Blackboard is a functional extension to traditional blackboard, as mentioned above. While as a real virtual blackboard, its function and intelligence are far more than those of ordinary "blackboard". So V-Blackboard also should have the following characteristics.

Teaching resources based on semantics: Teaching resources is the core of the whole future classroom. Based on the semantic web construction, setting up a teaching resources management platform for teaching materials, teaching equipment educators and educates will provide effective means for the future classroom based on Internet.

The basic idea of semantic Web is to add a layer of metadata description to web resources which will make the information on the semantic Web not only can be read and processed artificially, but also be "understood" by computer in a certain extent, so as to realize the automation, integration and reuse of network information resources and provide a smart learning environment to learners. The V-Blackboard system using the background of semantic Web creates representational and organizational model for teaching resources, as to improve the reusability of these resources, establish the semantic interconnection between heterogeneous data sources and realize the accurate search and dynamic polymerization of teaching resources in dynamic environment. Thus will provide personalized learning services for learners and support collaborative learning for learning groups.

The basic idea for such purpose is to realize the effective organization of unordered heterogeneous resources and reflect the semantic structure learning resources by using the domain ontology knowledge. All resources (web page, PDF document, animation, video, audio, etc) can be identified and located only from URI. And their semantic description information can be obtained through the corresponding learning objects. One or more learning material can link to the same learning object. Knowledge space is actually database based on domain ontology knowledge. Knowledge space is composed by knowledge model and facts library, knowledge model describes domain knowledge (concept, justice, rules, etc.), while the fact library describes the individual facts (individual types, properties and the relationship between individuals). Different role of education (instruction designers, content providers, students, etc.) can access to learning resources through various entrance. So, the resources semantic structure will be clearly defined and separated with resources itself and the system can support semantic interoperability and realize better resources location, query, management and maintenance. The design based on ontology can help developers, teachers and students to organize, release, discover, produce and manage personalized content of courses.

Avatar for teaching and learning: By using intelligent space, virtual reality and augmented reality technology, Avatars of educators and learners are added into V-Blackboard System, which will make the learning experience more like in a real learning environment although the learner are in a virtual one actually, reducing the boring by only simple video and text. The application of Avatar technology has two respects: first, in the network of a community, we can use the Avatar technology to form a collaborative study group, the Avatars represent truth learning partners or classmates and therefore, it seems that the learning environment is fictitious but has no difference with the real one. And so brings the advantages of collaborative learning into full

play; second, in the distance teaching or virtual classroom, an Avatar of teacher designed by the learners using virtual or augmented reality technology will carry on the teaching and interaction. This can help students become more interested and also avoid high-capacity video transmission, thus improve the data transmission efficiency so that the development of teaching can more smoothly.

CONCLUSION

A lot of countries launching educational research projects related to future classroom. This reflects the inevitable trend of combination of education with information technology and in which V-Blackboard was the core status. At present, our laboratory has started the research work. For the semantic web construction, we already has made outstanding achievements in resources platform construction and the data retrieval based on semantic web, this will laid a good foundation for education resources platform; In virtual reality aspect, the laboratory has accumulated a deep research foundation, this will create positive powerful conditions to the construction of virtual learning environment; In system development, our laboratory has done preliminary work in V-Blackboard and developed a practical application electronic blackboard software, which are used in experimental school.

All the experiment shows that, V-Blackboard then is the design of whole V-Education system is feasible. For today's rapid development of the information technology, it is not unreachable for using the most advanced technology to realize the great-leap-forward development of education mode and make education development oriented to modernization, the world and the future.

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