Virtual Learning 3D Environment on Cloud Service Platform

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Abstract. Virtual reality applications of education increase quickly. Massive 3D models of learning have been produced, organized, managed and shared. It has been an important questions on how to use these models in education. This article aims on researching the methods of how the 3D virtual reality learning resources is designed, built, managed and service issues. We proposed a framework using of cloud services platform to share learning resources and services of the massive 3D models. Key technologies of 3D model learning resource design, 3D models retrieval, 3D scene quickly building, and 3D model sharing are discussed. Massive cloud 3D resources management technologies are used to make better 3D learning resources services. The future of virtual reality and cloud computing technologies are discussed in summary.

Keywords: Virtual Learning, 3D Model, Cloud Computing.

Introduction

In these decades, ICT (Information Communication Technology) often play a key role in modern education and instruction. More and more innovation technologies have been employed in education. Some of them have already changed the formal education. It is generally considered that the development of remote learning has gone through three stages: D-Learning, E-Learning, and M-Learning.

Recently, cloud computing technology and virtual reality technology have been cutting-edge fields of information technology. Since they have great advantages and characteristics, the application of Virtual Reality and Cloud Computing technologies is a new attempt to support teachers work. we engaged to visualize knowledge with Virtual Reality technology and share the massive learning resources by means of cloud computing technology.

Based on modern learning theories, we proposed a new learning form named as virtual learning which employing cloud computing technology and virtual reality technology in the field of education. Virtual learning refers to use virtual reality technology and visualization technology in the teaching and learning process in order to improve the learning efficiency. It usually builds an innovation learning environment which combining the real world and virtual world to support learner-centered learning.

Related Works

Virtual Reality Education Application. Virtual Reality technology has been used in education for several years. The first time of virtual reality used for learning is in 1994. The University of

Washington and the American Westinghouse Science Foundation launched a mobile teaching program to attempt teaching with 3D animation technology. Another project named "Round Earth Plan"[1] is funded by Natural Science Foundation to explore how to teach high school students in abstract concepts learning by means of VR.

In Italy, Cognitive Psychology Laboratory of Catholic University opened experiment classes of machine tools using virtual reality technology [2]. UK Newcastle-Upon-Type Secondary school explored the use of 3D VR software package in foreign language and industrial safety training. The Nottingham university developed VIRATR project. Singapore also set up a project named "virtual learning in the virtual world" [3] that showing how to use the virtual teacher in a virtual learning environment. Virtual Reality technology and distance learning research plan are established in Taiwan [4]. UNESCO carried out a promoting program in Africa using virtual reality technology to enhance the native education [5].

It is considered that VR technology will exhibit extensive influence in the field of education. Many universities have established virtual campuses and virtual laboratories. In sense of three characters of VR (immersion, interaction and imagination), it is still very limited in education applications.

Cloud Computing in Education. Google put forward the concept of cloud computing officially in 2007. With the wide application of cloud computing technology, the importance of ICT in education is paid more research attention [6]. There are new experimental study of educational philosophy teaching changes from cloud computing, but also from the perspective of the application interface research to explore multi-modal user interaction method, as well as constructed from a service platform to explore aspects of research and technology integration platform to showcase aspects of [7], are also made from the perspective of the algorithm. Research to improve the system performance analysis with regard, and so on. Meanwhile, with the cloud computing technology in education , a number of new teaching concept is also being constantly raised , such as Elia proposed "i-learning" the future of education trends [8], Liang et proposed virtual personal learning environments (VPLE) [9].

Several education applications based on cloud computing have been already carried out. Microsoft, Google, and IBM Corporation engaged in the researching. Currently, the researchers have start working on how to realize 3D Virtual Reality applications in the cloud computing environment. There are already a few studies [10] [11], but still in a preliminary stage.

Virtual Learning Cloud Platform Design

Framework Design of Virtual Learning Cloud System. We researched the technology for providing adequate resources to meet the educational use of 3D virtual educational resources. To build a cloud platform for virtual learning system (VLCS), we need to consider two things. One is how to build a general services logical and physical structure using cloud services for 3D system and resources. Another is how to meet the education needs of teaching and learning with the 3D virtual reality resources.

Cloud computing infrastructure architecture usually contains three layers, which includes: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) application. Cloud services platform and services framework must be discussed before Virtual Reality learning resource should be migrated. VLCS platform for virtual learning mainly includes following aspects. What is involved is shown in Fig.1.
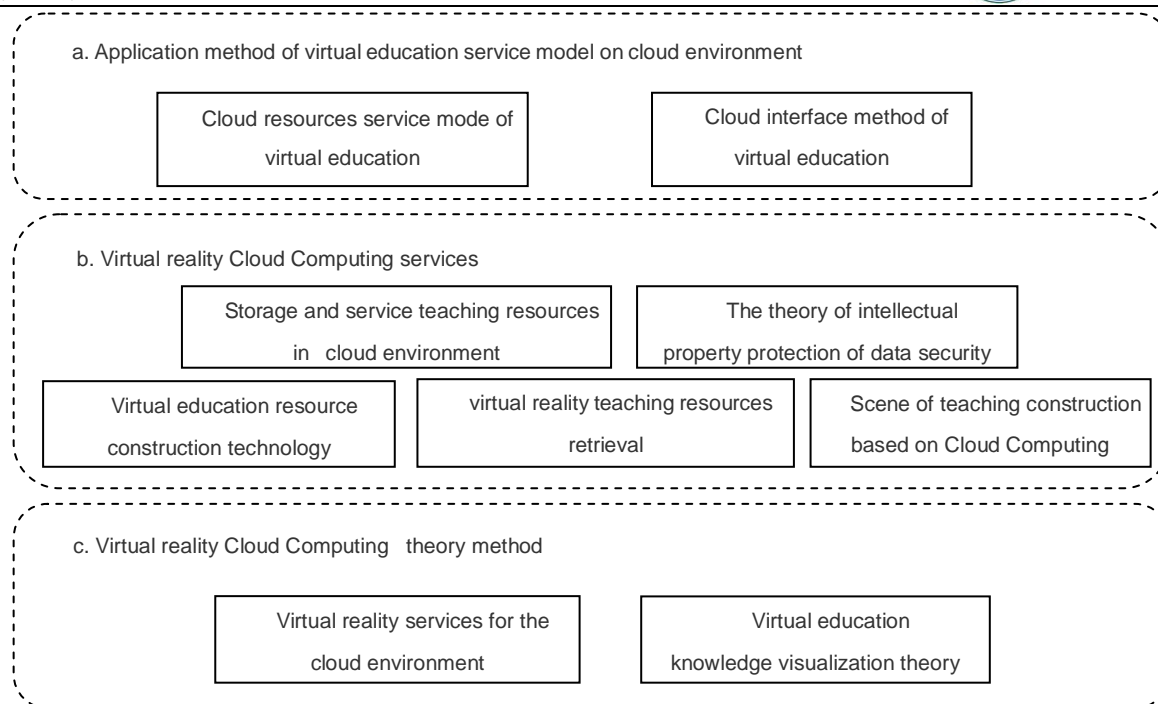
Fig.1: Architect of VLCS.

Education Applications of Virtual Reality Cloud Services. (a) Cloud-based virtual reality service model

To build a virtual cloud service system for education, a full analysis of the traditional large-scale 3D model of distributed VR environment is very necessary. Suitable data storage and management models must be designed to match the education cloud platform architecture.

(b) Cloud-based virtual education scene quickly building

Situational teaching is a new teaching method for primary and secondary schools education. Under the new situation, teachers purposefully introduced or create a certain mood colors image or scene to vivid the specific subject in order to help students understand the materials and to get the students' psychological functioning.

(c) Cloud based virtual education service interface

Based on large-scale 3D model of teaching scene, we can provide a useful support for education. In order to full use of existing technology and infrastructure of cloud computing, the storage and management need to be designed and implemented for supporting multi-modal scene display, 3D interactive courseware, and so on. For online teaching, Education cloud services contains user resources submission interface, teaching scenario quickly building interface.

Key Technology of Virtual Learning Cloud Services

Semantic of Virtual Learning Resources. The main features of the 3D virtual learning resources include two aspects: (a) virtual reality models and learning properties. They contain the information required for various operations in the education applications of virtual reality systems. (b) Geometric features and physical properties of the model geometry. Geometric features of virtual reality model can be generated quickly and create a model for education.

3D model of educational applications of virtual reality resources usually include a combination of context entities scene semantics and description of space. The basic semantic of education applications of virtual reality can be obtained from multi-source. Entities require to be assigned

related rules of combination and reasoning for the descriptions and definitions. Physical properties of the core concepts of semantic representation method generally includes a description of space semantic, scene semantic, contextual semantic and perspective semantic.

Each object has learning ontology (Content Ontology). It includes the types of resources in the form of classification hierarchy, sequence dependent relationship between the front and rear resources. Also it may include using objectives for learning objects, prerequisite knowledge required, and so on. Considering 3D models' features and VR characters, Ontology are described with RDF/RDFS and OWL language of Semantic Web. The relations of combination semantic representation can be achieved.

Quickly generation of virtual learning resource model. Virtual learning resource is the foundation of Virtual learning and its platform. Resource designers need to generate 3D models through various means and upload to the cloud platform for storage and applications. The main sources of 3D teaching resources are produced by using of 3D modeling tools, using parametric method to automatically generate, and integrating the existing 3D model resources.

For existing model resources library, you can obtain them by buying or download. After normalization and format conversion, additional labels and instructions tags are needed to form a 3D model library matching the teaching requirement. After a classification, model library can quickly expand relevant teaching resources. A typical 3D model includes various types of 3D topography field, 3D molecular structure, etc.

Model Storage and High Dimensional Index. Before using the resources, we need design a framework for data management and storage using Hadoop based distributed platform in Linux cluster technology. Distributed Map/Reduce computing technology is also used for fast data processing and indexing.

The 3D models library contains a few of types data, which including the model files, thumbnail files and texture files JPG, OBJ files, the texture, contours and other characteristic data, related data processing algorithms, models and other documents of structured data file information. They are commonly stored in a distributed database management system. Use Hadoop Distributed File System HDFS. We can build a high-dimensional indexing tree to manage the models and related data. Additionally, education information of knowledge are represented, structured and organized. The 3D model library and its visual models are complemented with the teaching knowledge, methods and strategies. The platform manages the details of the different data sets of virtual 3D model of education.

Content-based Virtual Learning Resource Retrieval. Usually, content and teaching resources are retrieved mainly by text related to the 3D objects. Since the 3D object library in large scale, it has been a difficult job to get a target resource material from virtual learning resource library. Semantic and content based virtual education model retrieval methods are very necessary for education apply.

To achieve a fast retrieval, multiple features (Such as geometric features, topological features, and semantic features) of 3D model are employed. These features are extracted from the geometric models and stored in the cloud -based platform. The application can achieve real-time search results on internet environment. Methods includes: content-based retrieval services, two-dimensional sketch based retrieval services, and scene semantic based retrieval services.

Summary

Information technology for education and digital learning has been very vital even in the formal education. Cloud computing technology and virtual reality technology is currently developing cutting-edge fields. They have great advantages and characteristics. Virtual reality cloud computing environment can be implemented by virtual reality and cloud computing and other emerging information technology. Learning theory is combined to build a virtual learning cloud services platform, to form a new concept of virtual learning. Virtual education cloud services platform will help to change the insufficient and uneven status of social education resources in the world.

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