

# Chapter 4.18

## Project Smart

### Remote Classroom: Providing Novel Real-Time Interactive Distance Learning Technologies

**Yuanchun Shi**

*Tsinghua University, China*

**Weikai Xie**

*Tsinghua University, China*

**Guangyou Xu**

*Tsinghua University, China*

**Peifeng Xiang**

*Tsinghua University, China*

**Baopeng Zhang**

*Tsinghua University, China*

#### **ABSTRACT**

Real-time interactive virtual classrooms play an important role in distance learning. However currently available systems are insufficient in supporting large-scale user access, and they cannot efficiently support accessing with heterogeneous devices and networks. Furthermore, these systems are usually desktop-based, until the result that the teacher's experience is completely different from teaching in a real physical classroom. This

chapter discusses the Smart Remote Classroom project that deals with these difficulties using the following novel technologies: (1) A hybrid transport layer multicast protocol called TORM and an adaptive content delivery scheme called AMTM, which work together to enable large-scale users to access a virtual classroom with different devices and networks synchronously. (2) A dedicated software called SameView, which takes use of the proposed TORM and AMTM technology, and provides a rich set of functions for teachers and students to efficiently carry out the real-time

interactive tele-education. (3) The Classroom augmented by Smart Space technology called Smart Classroom where the user interfaces of the SameView are incorporated in the classroom space. Thus the teacher can instruct the remote students just like teaching face to face in a conventional classroom. All these technologies have been successfully integrated and demonstrated in the prototype system at Tsinghua University.

## **INTRODUCTION**

### **Motivation**

In recent years, distance learning has increasingly become one of the most important applications on the internet and is being discussed and studied by various universities, institutes and companies. The Web/Internet provides relatively easy ways to publish hyper-linked multimedia content for more audiences. Yet, we find that most of the courseware are simply shifted from textbook to HTML files. However, in most cases the teacher's live instruction is very important for catching the attention and interest of the students. That's why Real-Time Interactive Virtual Classroom (RTIVC) always plays an indispensable role in distance learning, where teachers and students located in different places can take part in the class synchronously through certain multimedia communication systems and obtain real-time and media-rich interactions. However, to provide this type of distance learning in large scale, there still remain some barriers:

1. Lack of adequate technologies to cope with large-scale access. Most tele-education schools simply adopted commercial videoconference products (usually they are H.32X-based systems) as the operating platform for RTIVC, where all clients should connect to a centered MCU (Multi-Point Controlling Unit) and data initiated from one

client is replicated (sometime maybe mixed) and forwarded to all other clients by MCU. However these systems are not scalable, since the maximum user number (usually 10 or more) is rigidly limited by the capacity of the MCU. Moreover, the cost of communication service is very expensive or there is no guarantee for the quality of service. Thereby nowadays most tele-education schools can only operate RTIVC classes including a small number of students. A possible approach to address this scalability issue is leveraged by the IP Multicast technology, where no central data-replicating node like MCU is required. However, the current state of the IP Multicast technology is not full-fledged yet. First, the IP Multicast service provided by the network layer is a best-effort service. This is not tolerable for applications like RTIVC that are sensitive to the loss of messages. For example, the dropping of a single packet at one client will make the state of the whiteboard in a RTIVC system at this client lose consistency with others. Secondly, IP Multicast is not fully supported by many currently deployed routers of the Internet. Today's Internet can be viewed as many Multicast islands that fully support IP Multicast being separated by the Unicast zones which are not capable of IP Multicast. As a result, we can see many applications which directly rely on the network layer. IP Multicast cannot be successfully deployed on current Internet infrastructure.

2. Lack of adequate technologies to accommodate students with different network connecting and terminal device conditions in one session. Most current RTIVC systems have rigid requirements for the network and device settings of the clients. Clients with inferior device capability or network bandwidth could not join the session and get smooth service quality. On the other hand, clients with superior conditions could not

14 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: [www.igi-global.com/chapter/project-smart-remote-classroom-providing/27526](http://www.igi-global.com/chapter/project-smart-remote-classroom-providing/27526)

## Related Content

---

### Online Assessment of Foreign Language Proficiency: Meeting Development, Design and Delivery Challenges

Paula M. Winke (2008). *Online and Distance Learning: Concepts, Methodologies, Tools, and Applications* (pp. 2224-2233).

[www.irma-international.org/chapter/online-assessment-foreign-language-proficiency/27545](http://www.irma-international.org/chapter/online-assessment-foreign-language-proficiency/27545)

### User Interface Design Pedagogy: A Constructionist Approach

Benjamin K.S. Khoo (2010). *International Journal of Information and Communication Technology Education* (pp. 96-105).

[www.irma-international.org/article/user-interface-design-pedagogy/38987](http://www.irma-international.org/article/user-interface-design-pedagogy/38987)

### Late Departures from Paper-Based to Supported Networked Learning in South Africa: Lessons Learned

Illasha Kok, Petra Besterand Hennie Esterhuizen (2018). *International Journal of Distance Education Technologies* (pp. 56-75).

[www.irma-international.org/article/late-departures-from-paper-based-to-supported-networked-learning-in-south-africa/192073](http://www.irma-international.org/article/late-departures-from-paper-based-to-supported-networked-learning-in-south-africa/192073)

### The Effectiveness of Scaffolding in a Web-Based, Adaptive Learning System

Mei-Yu Chang, Wernhuar Tarngand Fu-Yu Shin (2011). *Dynamic Advancements in Teaching and Learning Based Technologies: New Concepts* (pp. 1-15).

[www.irma-international.org/chapter/effectiveness-scaffolding-web-based-adaptive/49294](http://www.irma-international.org/chapter/effectiveness-scaffolding-web-based-adaptive/49294)

### Mobile Learning Technologies as a Means of Maintaining Education Delivery In Crisis Situations

Hoda Baytiyeh (2019). *International Journal of Information and Communication Technology Education* (pp. 1-10).

[www.irma-international.org/article/mobile-learning-technologies-as-a-means-of-maintaining-education-delivery-in-crisis-situations/229014](http://www.irma-international.org/article/mobile-learning-technologies-as-a-means-of-maintaining-education-delivery-in-crisis-situations/229014)