

HTML5 Web Applications to Support Education in Rural Areas

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Abstract - HTML5 is a brand new core technology markup language of the Internet used for structuring and presenting content for the World Wide Web. HTML5 introduces application-programming interfaces (APIs) for complex web application. HTML5 offers power to develop interactive, cross browser, cross device application seamlessly. This new technology can provide a cost effective solution to implement applications to support education in rural areas by using various devices (e.g. personal computer, tablet, smart phone) without having to build different application for each type of devices. The purpose of this paper is to propose a certain design of HTML5 web applications to support education in rural areas.

Index Terms - HTML5, World Wide Web, APIs, Rural Areas, Education

1. Introduction

Education is one of the key factors for intellectual development of the society. It plays an important role in supporting development of other areas such as economic and social development. However, Indonesia still has several educational problems related to quality and limited access to it. Limited access to education in rural areas is due to lack of educational facilities. Furthermore, uneven distribution and lack of qualified teachers in rural areas led to its poor quality of education in rural areas.

As described in Ref. [2], the Master Plan of Research of Institut Teknologi Bandung 2011-2016 states that one of its programs is the development of digital lesson study. Digital Lesson Study or Digital Learning – Lesson Study (DL-LS) is an enhancement of delivering lesson study activities through the use of information and communication technology (ICT). Lesson Study is one approach in improving teacher quality through collaborative learning activities between teachers in a teacher learning community [3].

In DL-LS, there will be one real classroom and several virtual classrooms that are connected each other through internet network. Real classroom is a class that acts as the center of the learning process, the classroom where the teacher is located and learning process video is captured. Virtual classroom is the classroom that receives the learning process video from the real classroom.

The purpose of this paper is to propose design of HTML5 web applications to support education in rural areas. In order to be an effective solution to support education in rural areas, this application must be easy to use and can be accessed using inexpensive devices.

2. HTML5 Technology

HTML5 is a brand new core technology markup language of the internet used for structuring and presenting content for the World Wide Web. It is the fifth revision and newest version of the HTML standard. HTML5 offers new features that provide not only rich media support (video and audio), but also enhance support for creating web applications.

HTML5 introduces application-programming interfaces (APIs) for complex web application. It also offers power to develop interactive, cross browser, cross device applications seamlessly. This new technology can provide a cost effective solution to implement applications to support various devices (e.g. personal computer, tablet, smart phone) without having to build different applications for each type of devices. Moreover, it presents new technologies for World Wide Web including:

- 1) Semantics: to describe the content more precisely
- 2) Connectivity: to communicate with the server in new and innovative ways
- 3) Offline and Storage: to store data on the client-side locally and operate offline
- 4) Multimedia: to provide support to video and audio content without external plugin
- 5) 2D/3D Graphics and Effects
- 6) Performance and Integration: to provide speed optimization and better usage of computer hardware
- 7) Device Access: to allow usage of various input and output devices
- 8) Styling: to provide more flexible document content

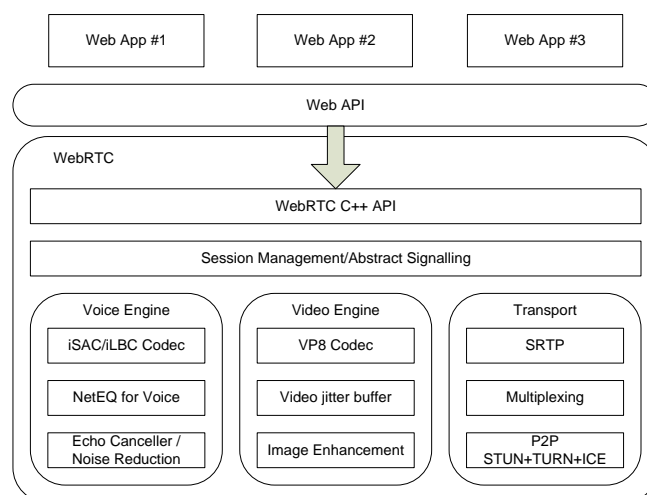


Fig. 1 Architecture of WebRTC API

3. Web Real-Time Communications

Web Real-Time Communications (WebRTC) is a technology that enables audio/video streaming and data sharing between browser clients (peers). As a result, browser with WebRTC support is able to perform teleconferencing peer-to-peer, without external browser plugin. The architecture of WebRTC API can be seen in Fig. 1.

The codecs and protocols used by WebRTC do a huge amount of works to make real-time communication possible, such as:

- 1) Packet loss concealment
- 2) Echo cancellation
- 3) Bandwidth adaptivity
- 4) Dynamic jitter buffering
- 5) Automatic gain control
- 6) Noise reduction and suppression
- 7) Image enhancement

Interactive Connectivity Establishment (ICE) is a framework to allow web browser to connect with peers. Session Traversal Utilities for NAT (STUN) is a protocol to discover the computer public address and determine any restrictions in the router that would prevent a direct connection with a peer. Network Address Translation (NAT) is used to give the computer a public IP address. A router will have a public IP address and every device connected to the router will have a private IP address. Requests will be translated from the device's private IP to the router's public IP with a unique port.

Some routers using NAT employ a restriction called 'Symmetric NAT'. This means the router will only accept connections from peers the computer have previously connected to. Traversal Using Relays around NAT (TURN) is meant to bypass the Symmetric NAT restriction by opening a connection with a TURN server and relaying all information through that server.

4. Previous Works

In previous works, designing and implementing Virtual Class Box (VCB) 3.1 to support distance-learning in rural areas have been done. The main function of VCB 3.1 is to provide video conferencing and, in addition, it has recording and playback, user interaction, presentation, and chat features. The VCB 3.1 applies WebRTC technology as a backbone to support realtime video communication. Therefore, the VCB 3.1 is completed with the ability to adapt to the network and because of that, the system will work on limited network resources [1].

The VCB 3.1 has been used in Open Lesson activity in Cianjur, one of residence in West Java Province, Indonesia. This activity took place between two schools, SDN Ibu Dewi 2 and SDN Karang Tengah Cianjur in May 2014. It has been demonstrated that the VCB 3.1 could run well in both schools. Before 2014, Open Lesson activity was using Skype video conferencing. Note that the VCB 3.1 was developed because video communication quality using Skype is sometimes not acceptable due to fluctuation in bandwidth of the internet networks in both schools.

We also have some research works on designing and implementing Classroom Suite (CRS) to support learning activity in a classroom. CRS is an embedded device in a classroom to provide access to multimedia educational content (presentation and video) that stored in repository server. CRS utilizes an Android smartphone as a remote device to control CRS box.

5. A Proposal of Virtual Classroom Suite

We propose Virtual Classroom Suite, a new integrated application to support education in rural areas. The system utilizes a server to provide various services to different type of devices. It is possible and easier to develop it using HTML5 technology. There are three types of devices:

- 1) Mini PC with video camera, audio system, and display to access video conferencing service and multimedia presentation service
- 2) Embedded devices to access multimedia presentation service
- 3) Tablet devices to provide access to control presentation service

The architecture of Virtual Classroom Suite can be seen in Fig. 2.

The presentation services support PDF file format and Web based presentation format using HTML5 technology. The presentation services also support annotation using tablet device using single touch. Navigation of presentation is controlled using two-finger swipe.

PDF Presentation slide can be uploaded to Virtual Classroom Suite server. Presentation Management System implemented on Classroom Suite Server. Animation in presentation only supported using HTML5 format. Web based presentation editor implemented on the server. In presentation service, to minimize bandwidth requirement, all presentation data will be downloaded to all device when the device joined to conference room and only control signal for presentation navigation will be streamed.

All of the services are provided in the same WebRTC session using unique URL that can be shared with the others. And these services can be accessed from anywhere using various devices through Internet connection.

There are at least two scenarios to use the Virtual Classroom Suite:

- 1) Virtual Classroom Suite is used in single classroom. In this scenario we only use presentation service. The teacher using tablet device to control presentation. Embedded devices connected to LCD projector to display the presentation. Optionally if any students have tablet devices, the tablet can be used to access the presentation.
- 2) Virtual Classroom Suite is used in multiple classrooms in distance learning scenario. The teacher teaches in real classroom using tablet device to control presentation. In every classroom there are Mini PC used to access video conferencing between multiple classrooms. In every classroom there are embedded devices connected to LCD projector to display the presentation.

Tablet device is used to create a conference room and to select presentation file. The tablet device can invite other device to the conference room through email using unique

URL. Or other device can join the conference room using Room ID.

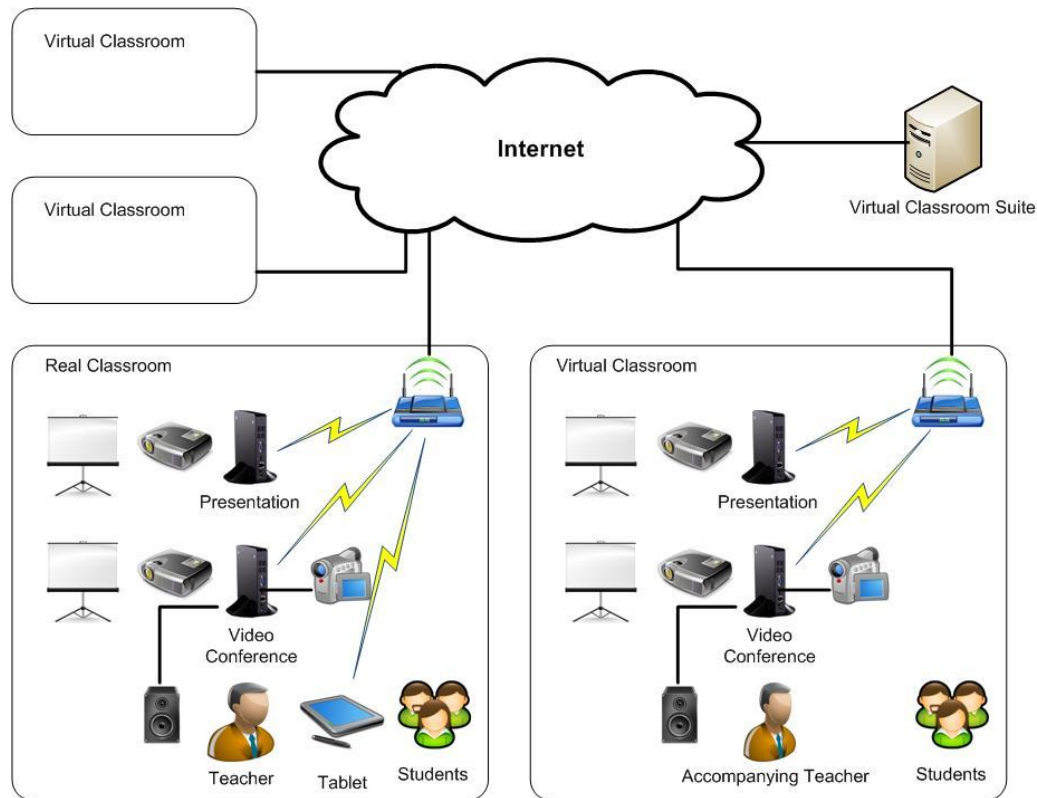


Fig. 2 Architecture of Virtual Classroom Suite

6. Conclusion

HTML5 provide APIs for complex web application. HTML5 can provide a cost effective solution to implement applications to support education in rural areas by using various devices without having to build different application for each type of devices. Tablet support multi-touch and gestures to provide a new exciting user experience to access application.

The use of WebRTC and HTML5 combined with multi-touch device would provide a robust application with great user experience. Tablet will provide a greater penetration to rural areas because there are so many affordable tablets priced in US\$50 to US\$100 price range. It is possible to deliver Virtual Classroom Suite, inexpensive solution to support education in rural areas.

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