Web Based Multimedia Conference System for Digital Learning in Rural Elementary School

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Abstract. This paper describes the process of designing a web-based multimedia conferencing system that will be used to support digital learning for elementary school in rural areas and implementing them in some network testbeds in Bandung, Subang, and Cianjur. The system must be able to send each of the constituent media, namely video, audio, and other materials (e.g. slide presentations) independently so that the learning process between student and teacher could still be running even if one of the media is absent. In addition, the multimedia conferencing system must also be easily operated independently by an elementary school teacher in rural areas with a minimum computer mastery level. The result is a product that is expected to be useful for improving the quality of primary education especially in rural areas through ICT applications.

Keywords: digital learning, multimedia conference, Product-Service Systems, virtual class, web based program.

1. Introduction

Multimedia conferencing system is a communication technology that allows two or more parties in different locations to interact with the use of document transfer, as well as video and audio in both directions through the internet. The smoothness of video and audio transferred is strongly influenced by the capacity and stability of the network. It is not an easy job to ensure the availability of these two factors on a rural area.

Implementations of video conferencing using VLC and open-lesson activities conducted in Keerom in November reveal new things that should be considered. The technology which previously emphasized in the development of video technology turned out to have an inadequate level of flexibility when faced with limited network capacity and unstable network conditions. If the network has a problem in capacity, transmission of the video will be hampered or even stopped. This is a big problem, considering the learning process would be stopped because the learning materials couldn’t be transferred.

The key factor of learning process is learning material. Meanwhile, the audio and video are tools that simplify the learning process. In addition, the ease of use of the technology still needs to be improved considering the main target of this research are communities that are still not familiar with the newest technology, especially computer. The usage of internet technology should be considered because it provides greater flexibility in making the user interface. In addition, internet does not depend on the operating system used, so it can be accessed by any operating system owned by the user.

Therefore, we need a technology that provides a higher level of flexibility. The technology must be able to transfer learning materials, e.g. presentation slides, as well as video and audio of the teacher who is teaching them in a different place. In addition, these technologies should also be easily used by rural communities.
2. Objectives and Benefits of Research

The purpose of this research is to design a web-based multimedia conferencing system to support digital learning for elementary school in rural areas and implementing them in some network testbeds in Bandung, Subang, and Cianjur. The system must be able to send each of the constituent media, namely video, audio, and other materials (e.g. slide presentations) independently so that the learning process between student and teacher could still be running even if one of the media is absent. In addition, the multimedia conferencing system must also be easily operated independently by an elementary school teacher in rural areas with a minimum computer mastery level.

This multimedia conferencing system designed to provide a higher level of flexibility compared with conventional multimedia conferencing system. The designed system will use a web based program, so it will be platform independent. This kind of program was used because it requires only a web browser to access the system. In addition, the system could transfer learning materials, such as slide presentations or video and audio of the teacher who will be teaching them in from a different place. Thus, even if the video or audio cannot be transferred, e.g. due to network problems, at least the learning material could still be transferred, so the learning process could still be done.

The significance of this research is to produce multimedia conferencing services to support digital learning in rural areas. The product-service is designed so that it will be easily operated by a teacher with a minimum level of computer mastery. The system also comes with instructions for use to help novice users learn how to use the system.

The result of this research is in the form of a product-service system of the multimedia conference and is expected to be useful for improving the quality of primary education especially in rural areas through ICT applications.

3. Research Method

The main priority of this system is to make a virtual class that is easy to build, has low cost, easy to use, and has a satisfactory result in performance overall. Because the main subjects of this system are people with minimum knowledge of computer technology, it is necessary to use a program that is easy to build, easy to use, and still relevant to the subject’s necessity, thus the use of PSS perspective [2]. With a limited fund and resources, it is also necessary to use a program that is low in cost but still has great performance, thus the use of open source software. The software that will be used in this research is a type of web based audio/video conference software. Using PSS perspective, the open source software will be configured necessarily so that it becomes a program that will satisfy all of the criteria above.

PSS defines the final product of virtual class using such web based audio/video conference software through some phases. Each of these phases could be grouped in two scope, problems, and solutions. The phase that could be counted as problems are market analysis, use case analysis, and testing. The phase that could be counted as solutions are value proposition, definition of the product/service structure, prototype architecture, and final definition [2] [3]. Both scopes related one way to another in a relatively simple manner.

First, it is necessary to determine the value proposition of the service. After that, it is best to consider the market analysis for the product. Both of those will be the base to define the product and the service. After both the product and the service have been defined, it is necessary to deepen the system by mapping its usage. This phase is also known as use case analysis. Both of the base definition and use case analysis will be used to build the prototype of the system. Then, the prototype service will be tested and the result shall be used as a correction for the prototype to define the final product, that is both simple and satisfying virtual class using a web based audio/video conference software.
4 Results and Analysis

Below are the research activities that have been conducted and the results obtained during the research period from February to November 2010. Obstacles faced when conducting research activities were also presented in this section. The result will be presented phase-by-phase of the PSS perspective.

4.1 Value Proposition

Value proposition describes the definition of the needs to be fulfilled by the PSS. The value proposition of this system is as follows.

A system that supports the community of rural primary schools in the digital learning process by providing the ability to transmit video, audio, and/or materials (e.g. slide presentations) learning through the Internet and can be operated by elementary school teachers with a high school level of computer mastery.

4.2 Market Analysis

Market analysis describes the definition of target users and use patterns, analysis of similar and related services. Judging by the result of some interviews with the local teachers, it can be defined that the target user of this system is elementary school teacher with a high school level of computer mastery.

To analyze similar services, first it is necessary to know what is needed for the system. The system needs an open source program that has the ability to transmit audio, video, and other materials through internet connection with simple interfaces. Below is a table that compares three qualified web-based multimedia conference programs.

<table>
<thead>
<tr>
<th>Features</th>
<th>Dimdim</th>
<th>OpenMeetings</th>
<th>VMukti</th>
</tr>
</thead>
<tbody>
<tr>
<td>public/private chat</td>
<td>yes/y</td>
<td>yes/no</td>
<td>yes/y</td>
</tr>
<tr>
<td>video signals from all</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>user status indication</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>upload &amp; store content pdf, swf</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>whiteboard &amp; annotat.</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>math editor</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>learners as presenters</td>
<td>yes</td>
<td>yes, no</td>
<td>yes</td>
</tr>
<tr>
<td>session recording</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>session scheduling</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>polls</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>localization (languages)</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>paid teaching service</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>desktop sharing</td>
<td>built in</td>
<td>add, inst</td>
<td>add, inst.</td>
</tr>
<tr>
<td>collaboration</td>
<td>yes</td>
<td>4 as max</td>
<td>yes</td>
</tr>
<tr>
<td>learners need not log in</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>
After continuous research and tryouts, it is concluded that the best program for this system is OpenMeetings, an open source, web based, flash based multimedia conference program.

### 4.3 Product/Service Definition
The definition of OpenMeetings feature and ability is as follows [4].
- Video/audio
- Desktop sharing
- Recording (Complete Session and Interview styled)
- Whiteboard with drawing, write & edit, drag & Drop, Resizing, Images (Drag & Drop from Library), Symbol(s)
- Import documents (.tga, .xcf, .wpg, .txt, .ico, .ttf, .pdd, .pcds, .ps, .psd, .tiff, bmp, .svg, .dpx, .exr, .jpg, .jpeg, .gif, .png, .ppt, .odp, .odt, .swx, .wpd, .doc, .rtf, .txt, .ods, .sxc, .xls, .sxi, .pdf)
- Multi-language (Currently: Arabic, Chinese (Simplified), Chinese (Traditional), Czech, German, English, French, Galician, Hungarian, Indonesian, Italian, Japanese, Korean, Persian, Portuguese, Russian, Spanish, Swedish, Thai, Turkish, Ukrainian, Galician, Finnish) and customizable
- Integration API and ready modules
- Send invitation and direct links into a conference room
- LDAP-connector
- Remote SOAP-Gateway for Single Sign On, integration and remote administration
- Moderating system, User-/Organization-/Moderating- System
- Backup and Language Module
- Private and Public (Organization only) conference rooms

### 4.4 Use Case Analysis
This phase describes analysis of several conditions of use on the basis of the available research and information. It can also be described by making a diagram. The use-case diagram for OpenMeetings can be seen in figure 2 below.

![Figure 2. OpenMeetings use case diagram](image-url)
4.5 Prototype Architecture
The prototype that will be formed is a two-way multimedia conferencing system, so it takes at least two computers, one computer as a server and at least one computer as a client.

The server is used as a service provider of the multimedia conferencing system. This computer will receive requests from each client and send information required by the client to run the conference. In addition, the server also performs synchronization between clients to minimize the occurrence of lagging data in the form of text, voice, or video.

Client computer is used as a service user of the multimedia conferencing system that has been provided by the server. The number of computers that are used as a client depends on the number of user who wants to use the service.

To build the connection between server and client, the first step to do is to install a router that has a DHCP server built in. The server will be connected to a switch or router to allow it to get an IP address. All client computers are connected with the nearest switch, so that client computers will also get IP addresses through a connection between the router and the switch. After all computers are connected, the server and the client will be connected in one network. As the final step, the client computer will access the server via internet browser on the client computer, and enter the IP address of the server computer.

4.6 Test
The testing of the product will be conducted at the laboratory of Digital Signal Processing, Achmad Bakrie building 4th floor, Institut Teknologi Bandung, and at two primary schools located in Subang.

The test located at the laboratory was conducted by connecting the server to multiple clients while monitoring each of the computer’s usage statistics to find the use of bandwidth, memory, and product durability. In terms of bandwidth usage, the system does not require large bandwidth. In idle condition, the send/receive network packet graph shows value ranging from about 400 to 600 Bytes per second (Bps) if the number of clients connected to the server is less than 7 users. The graph shows value about 1.3 kBps if the number of clients connected to the server is greater than or equal to seven users. When there is activity on the system, the graph shows value of 30 to 120 kBps.

In terms of server workloads, the processor has a usage of 40% peak for connections that are not related to documents manipulation and reached 100% when there is a connection associated with document manipulation. The computer that was used as a server has Intel® Atom™ D410 (single-core, 1.66 GHz, 512 KB L2 cache) as its processor.

The test located in Subang was conducted at two elementary schools, SDN Cinta Mekar and Madrasah Ibtida’iyah Al-Huda 1, which is located in Desa Cinta Mekar, Kecamatan Serang Panjang, Kabupaten Subang. The test was conducted to obtain feedback from sample users, whether if they are new to technology or even experienced, to obtain data on the performance of the prototype of this multimedia conferencing system.

The test was carried out by using one server computer and four client computer. The server and two client computers are placed in MI Al-Huda1, and two other client computers are placed in SDN CintaMekar. The network scheme of this testbed can be seen in the picture below.
Experiments carried out with four clients enter the same conference room, and doing some simple tests, such as:
1. Audio and video quality test
2. Program interface test
3. Synchronization test

After the test has been completed, each tester is given a questionnaire that includes an assessment of the multimedia conferencing system. The assessment was measured with a scale of 1-5 where 1 means very bad or very hard and 5 means excellent or very easy. The results from the questionnaire could be seen on the table below.
Table 2 Multimedia conferencing system questionnaire result

<table>
<thead>
<tr>
<th>Terms</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio/Video quality</td>
<td>3.750</td>
</tr>
<tr>
<td>Audio quality</td>
<td>3.625</td>
</tr>
<tr>
<td>Difficulty of hearing</td>
<td>3.500</td>
</tr>
<tr>
<td>Video quality</td>
<td>3.500</td>
</tr>
<tr>
<td>Difficulty of seeing</td>
<td>3.375</td>
</tr>
<tr>
<td>Tools quality</td>
<td>3.625</td>
</tr>
<tr>
<td>Difficulty of material learning</td>
<td>3.500</td>
</tr>
<tr>
<td>Interface simplicity</td>
<td>2.857</td>
</tr>
<tr>
<td>Difficulty of interface learning</td>
<td>3.143</td>
</tr>
<tr>
<td>Difficulty of operation</td>
<td>2.857</td>
</tr>
<tr>
<td>User manual quality</td>
<td>3.714</td>
</tr>
<tr>
<td>Difficulty of user manual learning</td>
<td>3.286</td>
</tr>
</tbody>
</table>

From the results of the questionnaire, it can be seen that the multimedia conferencing system has a fairly good quality in terms of the performance of audio, video or interface. On the contrary, this system is still not good in terms of simplicity of the interface and ease of operation. In addition, there is some input from tester that one of the reason the system has an average score in simplicity is due to the use of the English language on the system’s interface.

4.7 Final Definition

From the research, along with the early definition of the product, this research has got some additional information about the multimedia conferencing system that has been built. Overall, the system has already satisfied the main target of this research, both in terms of audio, video, and interface. However, this system still has some problems.

One of the problems is that the interface of the system is still too complicated for users who are still inexperienced in using computer without any assistance from the experienced users. Moreover, this system still uses English language for its interface. This is also a problem for some users, especially for those who are still not fluent in speaking English.

Technical problems are also found at both the test at the laboratory as well as at Subang. The problems include high processor usage on some tasks, complicated interface, and many other small problems. Given the program used as the main multimedia conference program, OpenMeetings, is still in development stage, those problems are expected to be corrected in the next OpenMeetings version.

5. Conclusions

- The multimedia conferencing system built was capable of functioning in accordance with the main objective of this research.
- The main program of this system, OpenMeetings, is able to meet almost all of the demands for a web-based conferencing system.
- The multimedia conferencing system has been quite successful in offering ease of use, but for some users, especially those that is still inexperienced in handling multimedia conference technology, still have difficulty in using the system.

6. Acknowledgement

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7. References


