

E-LEARNING TOOL “DILECO” FOR LOW INTERNET BANDWIDTH AND ITS APPLICATION

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Abstract: *The following paper offers an overview on the advancement of features of the e-learning tool “Dileco”. The main features of this tool aim to support operations, using unstable and limited Internet connection, utilizing novel solutions outlined in this paper. This system would be one of the best tools applicable for e-learning in countries with poor Internet. The paper pursues the objectives of showing some of the innovative features of the system and demonstrates the progress of the system starting from 2002. This paper aims to express technological aspects on building this system. The paper offers a snapshot of application areas of the system. The paper offers a snapshot of application areas of the system. It also addresses the research activities on virtual organizations, currently carrying out at the University of Amsterdam, which could provide impact on usage of the tool. The paper provides suggestions for future expansion of application areas covering Europe, the USA.*

Keywords: *e-learning, video/audio transmission, preset, video/audio e-mail, virtual organizations*

1. Introduction

Moving forward on the journey into the 21st century, it's impossible to know with any certainty how this era will be characterized by those generations who will come after this one. But let's suggest that one feature of what is already being called the Information Age that surely will influence that human beings will become in the decades ahead, is people's relationship to technology. One of the fastest growing and most demanding areas in Information Technology field for the 21st century for all over the world is e-learning, which is a type of distance learning. E-learning is becoming increasingly important in today's technology era. It moves the learning experience out of the traditional classroom and into people's world. It's learning anytime, anywhere without geographical or scheduling barriers. It's learning that relies on the Internet for accessing studying materials and interacting with experts and fellow learners [11].

2. General Description

Armenia also had been successful in its first steps towards increase of e-learning awareness and implementation of it [1], [6], [8]. In Armenia also there were attempts of different initiatives regarding e-learning, like learning via e-mail, on-line messengers, and special tools for e-learning. Some of the attempts have been successful, others not. Although Armenia is and had been considered the IT center of Caucasus and Ex-Soviet Union, still there are different barriers to implement e-learning in Armenia. Some of the barriers are:

- Internet bandwidth limitation, which may significantly decrease the throughput of the connection
- Unstable Internet connection
- Absence of software called especially for poor Internet bandwidth

Correspondingly, appropriate tools had been elaborated according to the development of Information Technology and the users' needs. One of such tools, called Dileco [1], is created and developed by the first author of this article, which provides several solutions for poor Internet bandwidth. The tool is universal and can be applicable using reasonable Internet connection too.

The aim of the tool is to allow video and audio conferencing type e-learning within two points at different geographical location using the existing telecommunication system. The software enables educational institutions, SMEs (Small and Medium Enterprises), governmental agencies and international organizations of a country establish virtual links between its departments and other organizations across a country and elsewhere, facilitate communication and contribute to the advancement of IT infrastructure in the country. The tool aims to help individuals, students and trainers in their study process eliminating the geographical barriers and cost implication. The software is specifically important for the developing countries.

The creation and development of the tool Dileco has a history starting from 2002. Different articles about the tool are published in professional journals and conference folders (see [1], [2], [3], [4], [5]) and different aspects of the tool and its implementation had been presented in several conferences, workshops and scientific discussions. Besides successes of the Dileco tool and strong interest from different specialists, the tool is continuously being developed and becoming more and more advanced. After 2003 all the components are revised, better developed, and recreated by new and advanced programming means, in particular Java (JBuilder9 Enterprise), Java Media Framework (JMF), JavaMail API (Application Programming Interface), javax.comm. serial communication package, MS Project PRO 2005, TogetherJ6.0, design and architectural patterns.

The paper emphasizes some of the important features of the tool, which are considered as the solutions for the poor Internet bandwidth, the progression and advancement of the tool and some practical expertise and testing as detailed further in this article.

3. Advancement and Offered Solutions

1. Step by Step Control

Figure 1 illustrates the structure of the video conferencing component of the system [1], [2]. The motor camera is connected to the server-computer situated in the classroom. The professor located at a distance can connect to the classroom via Internet just typing the appropriate URL on agreed time. The professor can control the camera using Remote Control interface through Internet. Here the professor has 2 options for remote control (“Continuous” and “Step by Step”) dependent on the Internet bandwidth. If the Internet is not adequate for good quality of delivering vide/audio transmission and the professor does not have any idea about the correct latency, then he/she can choose “Step by Step” control option and click as many times to a certain direction (right, left, up, down) as he/she can consider the camera will move to the desired position. In this case, each click corresponds to 3 degrees, which gives an orientation to the professor. So, “Step by Step” Control is considered as one of the solutions for poor Internet bandwidth. For audio transmission the modified JMStudio’s audio transmission is applied. JMStudio is a stand-alone Java application that uses the JMF 2.0 API to play, capture, transcode, and write media data. JMStudio also uses the JMF RTP (Real Time Protocol) APIs to receive and transmit media streams across the network. JMF supports audio sample rates from 8KHz to 48KHz. As for video transmission, it is adapted and programmed JMStudio’s visual component under H.263/RTP standard video compression for unstable and limited Internet connection ([1], [2]).

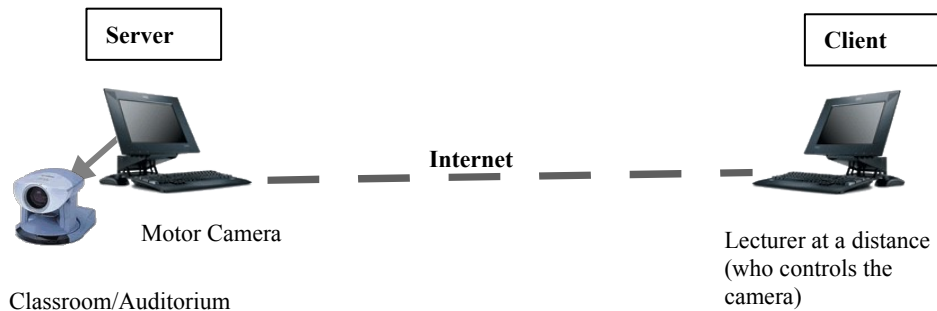


Figure 1: Client/Server (Professor/Classroom) Model

2. Presets

Another solution, while using non-reasonable Internet connection, is **presets** functionality. Preset is defined as a preliminary set position in the classroom programmed in the camera. This feature consists of two sections. One is a section, which provides 7 preliminary set positions – presets, located from the left to the right in the range of 100 degrees. Here the professor can control the camera moving it towards any of these 7 positions of the classroom. By clicking to any of the position, the camera moves and stops in the preliminary programmed position.

Second option for the presets is an option quite interesting and imaginative, called dynamic presets. This allows the professor (Client) to set the positions himself/herself making the list of presets dynamic. The professor can move the camera to the desired position and then save the position giving a name. For example, he/she can move the camera to the place of one of the students and save the position by the name of this student thus creating a list of set positions. For the next times he/she can choose any name of a student from this list and the camera will immediately go to the place of the chosen student. In this case, it is considered that each student has his/her own sit in the auditorium/classroom. Any time the professor can see any of the student’s position regardless the quality of the Internet connection.

3. Frame Rate Control

When the Internet bandwidth is low, and the Client side (the professor) cannot obtain video stream of high quality([12], [13]); from the Server side (classroom) “Frame Rate control” feature is recommended to use. This feature lets the user from the Server side to choose the frame rate (1, 3, 5, 10, 15 and 20 ms) depending on Internet bandwidth and sending to the other side. This means that the system captures images from a video stream, for e.g. each 10 millisecond (when the user chooses 10 from the list), makes from this image JPEG compression and sends to the other side (the professor) through HTTP protocol. The professor will see the changes of movement each 10 millisecond but he/she cannot see a fluent movement. This is one of algorithms of image processing related to video compression, which is proposed to use. This compression engine is better in case of applying in this application, because it is small, fast and effective in processing serial of images captured from device in real time and gives out small enough data to be sent on low-bandwidth connection. The system is tested; it has a good quality under low-bandwidth and unstable connection; e.g. dialup line below 48kbps.

4. Video E-Mail

Other newly created and elaborated part of Dileco tool is video e-mail component [4] (architecture illustrated in Figure 2), which provides all the features of a traditional e-mail client and additionally it provides a functionality of automatic view of video/audio message, in case the sender recorded such a message and sent it to the recipient.

This component works in the following way: the sender can record a video/audio message and the system automatically saves it in appropriate format and then the sender can dispatch the message to the recipient either with or without text message. When the recipient opens the message and if the message includes a video/audio message, the recorded message automatically plays. The recipient can play the same message as many times as he/she wants. This component also contains innovative elements and can be useful in e-learning for short and important speeches, presentations or assignments. This is foreseen as a solution in case, the Internet connection cannot be adequate to support video/audio information transmission. An individuality of the tool is the video e-mail embedded system, described above. The Video E-Mail Client Part is designed and developed using two different Java libraries – JavaMail API and JMF(Java Media Framework). These two libraries - JavaMail and JMF are adjusted into a single application, which is another peculiarity of the tool Dileco, comparing with traditional e-mail clients.

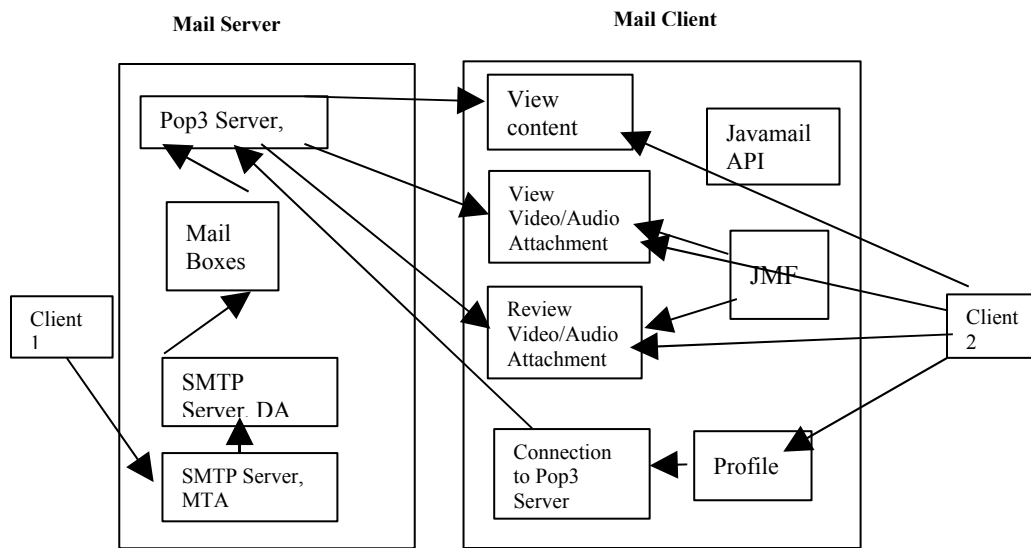


Figure 2: Video E-Mail System Architecture

4. Application Areas and Future Plans

Research and development of the tool Dileco were achieved starting from 2002, serving as a tool under open source development, a Master Project at the American University of Armenia - AUA (branch of UCLA, the USA), CIS Dept, and then as a PhD thesis at the Institute of Informatics and Automation Problems at the National Academy of Sciences of Armenia. The tool Dileco had been tested and used for e-learning purposes starting from 2003. A successful e-learning pilot project had been conducted in 2003 in the framework of Armenian Development Gateway (E-Armenia Foundation, funded by World Bank and Development Gateway Foundation, the USA) executed in several universities in Armenia. The tool had been used in the European Regional Academy of Caucasus of Information and Communication Technologies (ERIICTA) in implementation of distance learning, distance workshops and seminars in summer 2003. Dileco is tested at the American University of Armenia (branch of UCLA, the USA) used for distance learning purposes. After advancing the system, in the near future it is planned to continue e-learning program in the European Regional Academy of Caucasus using Dileco system. It is also planned to put the tool into practice in several other educational institutions situated in the different geographical locations ([7], [8]).

Currently, in the University of Amsterdam, The Netherlands, in the scope of ECOLEAD project ([14]), funded and supported by the European Commission, a research is being conducted on the incentives of the members of the virtual breeding environments and virtual organizations. Investigation found out that one of the important incentives could be the usage of common tool by all the participants in virtual breeding environment and virtual organizations. The future steps of the research would be also discovering the tools appropriate for the consensus usage. One of the candidates of those tools is Dileco, which requires further analysis for this specific purpose. For the future expansion of application areas, it is planned to involve diverse countries covering Europe and the USA. For that purpose detailed implementation plan would be designed.

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