ATLANTIS PRESS

Advances in Social Science, Education and Humanities Research, volume 298

2nd International Conference on Education Science and Social Development (ESSD 2019)

How a Multilingual Remote Teaching System Can Take into Account the Specifics of National Education

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***Abstract*-The paper presents the architecture and functionality of a learning system, as well as the main approaches to manage the distance education process. Our learning system provides an effective and natural human-computer interaction based on modern information-communication technologies and interfaces. This platform has been successfully used to teach a programming course, showing a number of advantages and benefits in comparison to the traditional teaching methods. Our system belongs to the important class of teaching tools, where a variety of modern methods of human-system interactions, such as speech recognition, are utilized. The paper also describes features of the Norwegian education system; the features include an adaptive method to teach students who speak different national languages. The aim of our work is to integrate effective training courses with a remote teaching system. We must take into account the peculiarities of training multilingual students.**

Keywords-E-Learning platform, E-Education, learning process effectiveness, interactive mode of teaching, speech recognition interface

I. INTRODUCTION

Our E-learning software platform consists of a number of modules: a class-conducting module, a course management module, and an authorization module, an event bus, a web socket service and a database.

The class-conducting module is the most important; it provides the following functions: group interaction of users (chat), interactive board, video transmission, etc.

A particularly important functionality is our graphical system and our class-conducting interactive mode. Our approach, utilizing a speech recognition system, improves how new material is memorized by students and allows an instructor to teach more effectively, i.e. the system does not interfere, but helps to make learning process more effective.

Our training software can make it possible to "rewind lessons" and index the content, i.e. to find the necessary fragments for full-text search. Re-viewing the lesson can generate statistics about which parts of the lesson are more interesting and which ones are less.

In our training system, students and instructors have additional sources readily available. It is also possible to send video messages with synchronous control from the instructor to all students connected to the chat.

In future, we plan to add information about the user's status (technical parameters of the terminal, statistics of answers to questions, whether the user writes a chat message, etc.). There are hotkeys in the program that help us to work with the application elements (for example, with the context menu), as well as notifications that indicate if a certain important event occurred (a new message arrived in the chat, and the interactive whiteboard is opened, etc.).

Note the remaining components of our training software. There is an authorization module that allows users to organize a different hierarchy of access to resources. A course management module allows users to search for interesting courses (and to register to them), create and edit courses. A user's personal page is the entry point to the application.

It is difficult to debug such a training system; many labor-intensive tasks, taking into account the real-time factor, have to be solved. The variety and complexity of the requirements and constraints imposed on such systems are increasing; the most critical of these constraints are the limitations associated with a man and the system naturally interact.

The proposed platform analyzes the capabilities of internet-based laboratories for online teaching and learning systems.

II. THE MAIN PERFORMANCE CRITERIA OF E-LEARNING SYSTEMS

A good E-learning system should be able to:

- provide high quality and stable service for a certain period of time;

- assimilate educational materials using modern information technologies;

- optimize and organize remote education and manage teaching processes;

- conduct real-time laboratory experiments: an Internet-based Teleoperation Laboratory system allows students to perform practical exercises on real laboratory equipment remotely from home.

A. *Some Basic Criteria to Choose a Platform for E-Learning*

In addition to the above listed performance criteria, there are some basic criteria to choose an e-learning platform:

- Functionality: chats, forums, course management, student activity analysis, etc.
- Stability, i.e. how stable the system works under different modes of operation and load, depending on how active user are.
- How convenient it is to use the system: One of the most important parameters to affect the quality of the educational process. How convenient and easy it is to administer and update the content.
- Cost: How much it costs to buy and support the platform.
- Scalability: The system must be flexible and able to expand both as the number of students increases and as new programs and courses are added.
- Multimedia: Systems should be able to use not only text and graphic files as training tools, but also video, audio, 3D graphics, etc.
- The system must have a good technical support.

III. ARCHITECTURE OF REMOTE TEACHING SYSTEM AND MAIN REQUIREMENTS

The existing remote teaching systems are given in [1-5].

We are building an analogue of Big Blue Button. Our System Requirements:

- Text chat,
- Interactive teaching board (with video broadcasting),
- Recognition of unstructured speech,
- Interactive class and course planning,
- Reference multimedia material,
- Tests to verify student progress,
- Internet connection monitoring and statistics gathering.

A. *The Main Functions of Our Remote Teaching Software Platform*

Our system allows us to

- draw on an interactive board,
- send pictures,
- share files,
- play video synchronously,
- carry out surveys,
- conduct tests,
- control student activity,
- visualize student's mood,
- rate messages,
- conduct a lesson by more than one teacher,
- include assistants and moderators to the process,
- manage schedules,
- provide a private user page,
- organize communication outside the classroom,
- schedule free time of the student,
- plan lessons,
- plan courses and group of courses,
- deliver notifications,
- repeat playback,
- provide a voice interface with speech recognition.

Our remote teaching software platform can be integrated with an automatic recognition system for different languages. Thus we tailor the system for a foreign student to serve along side his/her national educational system.

B. *Architecture of Our Remote Teaching System*

An architecture of our remote teaching system is shown in Figure 1.

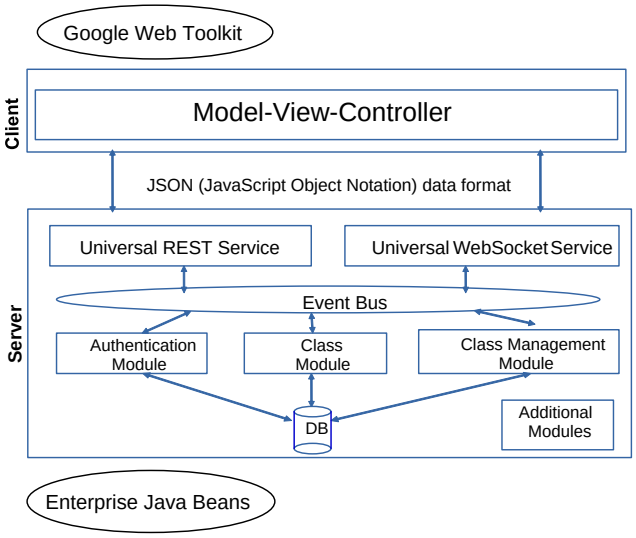

Figure 1. Architecture of our remote teaching system

Three-tier client-server architecture.

Our system utilizes a three-tier client-server architecture. Considerable amount of video/audio processing and routing to serve a large number of clients leave us no choice but to have both a “thick” client and a “thick” server.

Client-side. Our client follows the Model-View-Controller architecture. This client architecture allows us to clearly separate internal representation of information from the ways information is presented to and accepted from the user.

We used GWT technology to build the client. This technology allows programmers with basic knowledge of java to contribute to the code base of our system.

Server-side. Our server-side uses the Event Bus architecture. The server-side consists of 7 big blocks: the Event Bus itself, Universal Rest Service, Universal Web Socket Service, Authentication module, Class module, Class management module, Database.

The Class module is designed to manage the class activity of a single student. The Class management module coordinates the activities of all the students taking the class.

Such server architecture allows us to transfer large amount of data, scale the system horizontally, call the methods as micro services, allocate modules to different data bases, and easily add additional modules.

The server itself is built on the EJB technology. This technology provides good performance, scalability, and upgradability for enterprise Java applications.

Client-Server communication. Our clients and server communicate with each other by means of our Universal REST service (via HTTP protocol and JSON data format) and Universal WebSocket Service (via WebSocket protocol and a proprietary data format). Our communication-intensive real-time video/audio streams and files are transferred via the WebSocket service.

C. Application of Communication and Media Technologies.

Our software platform is built using various information and multimedia technologies.

Graphic capabilities: The newest teaching approaches use graphic capabilities to a large extent to quickly assimilate new teaching material to the target audience. Among the graphic capabilities of our teaching system is an interactive teaching board, an effective teaching tool (Figure 2).

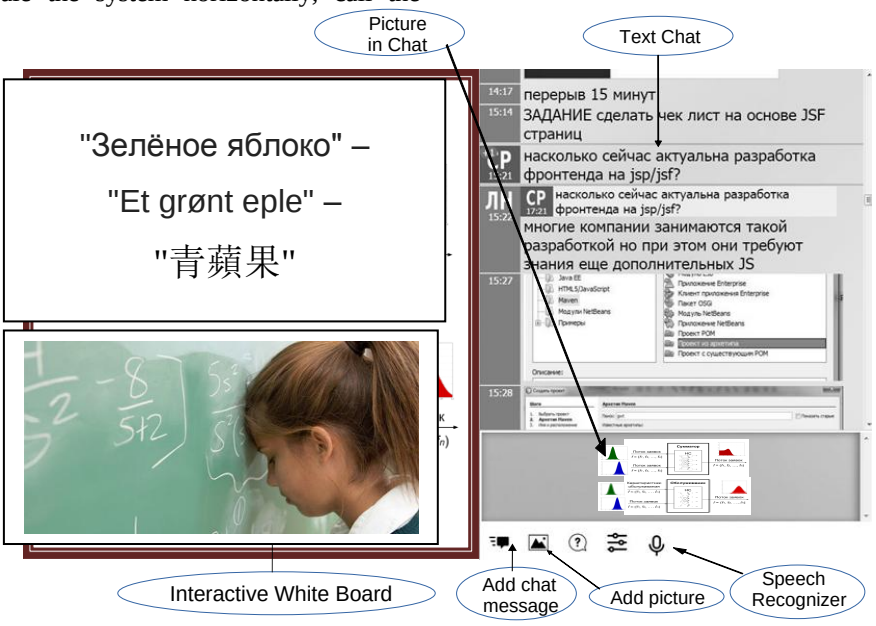

Figure 2. User interface of the remote teaching system

There are a whiteboard on the left and a specialized chat on the right side of the figure. The chat controls are on the bottom right.

The whiteboard allows the instructor to draw images, post pictures and formulas from a database and send them to the class chat. Specialized chat among the students and among the students and the instructor allows them to exchange text messages, formulas, and pictures. The main elements of the session also include video broadcast, which allows the instructor to stream a video from his webcam or his monitor screen to all students in the class.

The developed training system can provide a way to "rewind lessons" and perform indexing, i.e. to find necessary fragments for full-text search. A re-view of a lesson can generate statistics about which parts of the lesson are more interesting and which are less. It should be noted that the

fragments that are viewed in the accelerated mode are less interesting, and the repeated reproduction of the recorded lesson can include interactive tasks and repeated tests.

Speech user interface: The modern teaching approach is to use speech recognition techniques. Therefore, an extremely important element of our software package is the speech recognition module. The use of speech allows a person to interact with a computer system more efficiently and naturally. It should be emphasized that to create a speech interface is a complex process that requires the software developer to be competent in a wide variety of areas such as the properties of the recognizers, the nature of speech, the basics of linguistics, the features of human behavior in various situations, and the inherent limitations of how concepts and speech are perceived [6, 7].

As a speech recognition system designer, you can use various ready-made implementations (for example, speech recognition based on the Google technology). These systems can provide acceptable recognition quality of common phrases, however, the accuracy of recognizing specific and rare terms may not be too high. It is more effective in modern remote education systems to use systems that analyze unstructured speech information [8]; some of them can process unstructured speech data in Russian.

When we designed such a system, it was possible to find the most acceptable way to use a speech recognition software that helps in the class. With this system, you can solve a number of tasks, for example, quickly dictate questions and answers.

Our training system was successfully used to teach a programming course and showed a number of advantages in comparison to the traditional methods [9]. At the same time, we created an educational tool, which incorporated not only a speech recognition software, but also a sophisticated graphic tool.

From the debugging point of view, such training systems require a lot of effort. The requirements for such systems are diverse and complex, so the constraints imposed on such systems are increasing. The most critical of the constrains are the limitations associated with the natural human-computer interactions.

IV. SOME ADDITIONAL FEATURES OF OUR SYSTEM

A. Interactive Plan of the Course and Classes.

An interactive plan, both of the whole course and the classes, is an important part of the teaching process. It should be noted that in private practice such a plan is often not available. On the other hand, modern teaching systems, as a rule, should provide a detailed plan for the session and the entire course at any time as the student or the teacher request the plan.

In full-time education, the teacher must remember a lot of information that he must keep in mind during the lecture; when distracted with questions from the class, it can be difficult for him to return to the interrupted place. At this point, the mark of the place in the class plan, where the instructor is now, is an important auxiliary factor. At the same time, it would be convenient for the instructor to keep track of the lesson plan with a time frame to understand how much time it is left to explain a particular topic. This helps to make a decision whether to give an additional material or to follow strictly the plan of the lesson.

If courses start at different times, teaching without an activity plan is extremely difficult, because the instructor has to switch between courses with different intensity. With the class plans at hand, the instructor can conduct several courses in parallel.

B. Student Progress Assessment and Surveys.

It is especially necessary to note the problems associated with student progress assessment and homework grading. With this point of view, the training system contains a wide range of possibilities, for example, with tests containing questions with multiple choice options.

Student progress assessment is usually conducted at the end of the course, which can lead the students to shift their active learning to the last week of the course. Our training system effectively allows the instructor to conduct surveys at every class; he can even use gaming methods to better motivate the students to take a test.

Let's give an example of several types of questions:

- a single choice question;

- a multiple choice question;

- a question where one option can be chosen from the list, but there is no clearly defined correct answer (opinion polling);

- a question where you can choose several options, but there are no right or wrong (polls with multiple answers);

- a question with an opportunity to chose an answer and an opportunity to enter an answer.

Thus, pools (tasks) from several dozens of grouped questions can be formed. Such tasks can be at the end of the course or before the laboratory work. It should be noted that an effective solution is to use one question at the end of a small topic for 10 minutes; this question will help to track which of the students are active and how quickly they respond.

Special software helps the instructor to remotely check if student homework is correct. It should be emphasized that homework can be checked by the instructor in person, and also the students can check each other.

V. THE SPECIFICS OF THE NORWEGIAN EDUCATION SYSTEM.

A. *Features of Learning Multilingual Students.*

Multilingual students in the early stage of fluency in Norwegian are placed in classes in ordinary schools, where all subjects (except foreign languages) are taught in Norwegian. However, students whose native tongue is not Norwegian or non-Sami can attend a special class in Norwegian until they are good enough in the language to study the school subjects well enough. In addition to the special training in the Norwegian language, these students, if necessary, can either study their native language, or to bilingually study school subjects, or can attend both types of education at the same time.

B. *The Principle of Adapted Education*

Under any circumstance, the Norwegian school system is organized in such a way that both native Norwegian students and multilingual (or foreign language) students must feel that they belong to their group, their class, and be integrated. This implies that students with different abilities and needs study in the same class. In order for such a system to be feasible, the principle of adapted learning ("tilpasset opplæring") operates. The principle means that all teaching must be adapted to students, built on their needs, and stimulate the individual abilities of each student. At the same time, trends in the school education methodology show that pupils more and more fulfill learning tasks that require an ever greater degree of independent work. For example, group tasks, when a teacher gives a topic to develop on a certain subject, and the students themselves must answer questions and, for example, make a presentation. For example, a presentation about the water cycle in nature. That is, students learn to work together in groups, to solve the problems and tasks set for them, to look for information and to think critically to select only the information that is necessary to describe this topic. The pupils not only form the answers to the assigned tasks, but also choose independently from the previously acquired skills (which the school gives them) the methods to search and arrange information, various forms of cooperation between classmates, and so on. In this situation, pupils, who are not sufficiently fluent in Norwegian, fall out of the team and need, first of all, not subject help, but language help. They need to train their Norwegian language. But such school classes lose their meaning for them, because falling out of context, they not only don't improve their language and communication skills and do not acquire subject knowledge, but generally lose their motivation to go to school, drop out of the team, remain misunderstood by their classmates.

This is why language programs, trainings, and technological type supports are needed. A math teacher is not always a linguist and understands the specifics of teaching Norwegian as a foreign language.

C. *How Our System Can be Applied in the Norwegian Flexible Teaching*

Lets see how our Remote Teaching System can be applied for the Norwegian system. Here, on the left side there are what Norwegian teachers and students do, on the right side there are how our system can help.

What Norwegian teachers and students do	**How our system can help**
Each teacher has their own individual class schedule; the classes take place online in real-time mode as part of the school day of students. For each lesson, for each level, a specific topic is highlighted, for example, equations with two unknowns, or the structure of human respiratory organs.	Our course management module is a good tool for this job. When distracted with a question from the class, the instructor marks the place in the class plan, where he is now; the instructor returns to the place when he answered the question. At the same time, the instructor keeps track of the lesson plan with a time frame to understand how much time it is left to explain a particular topic.
Students, with headphones and a video camera, connect to the virtual class of their online teacher. They see and hear their teacher, who explains the topic to them. Teachers use a graphic tablet as a board; the tablet is connected to the teacher's computer and is visible to students through Adobe Connect. The teacher himself either shows himself to the students, or the content of his board, when he needs it. Students (via Adobe Connect) can "raise a hand" if they have a question and ask it orally, so that all other participants in the virtual class can also hear the question and answer, the student can also write a message and ask the teacher a written question and get an answer to it . There is practically no communication between students during classes. The lesson is intensive, without joint work in groups between students.	Our class-conducting module addresses these functionalities. The whiteboard module allows the instructor to draw images, post pictures and formulas from a database and send them to the class chat. Mature students can chat with each other and their instructor. The main elements of the session also include video broadcast, which allows the instructor to stream a video from his webcam or his monitor screen to all students in the class. Also, our speech recognition module allows the students to dictate questions, if the student attends the class remotely from home. Finally, our system generates statistics about which parts of the lesson are more interesting and which are less.
In addition to online lessons, the Flexible Learning Internet Platform consists of assignments and videos; the videos explain topics that are publicly available to project participants, both for teachers and for students. Students can watch an explanation of the topic, for example, photosynthesis, in their own language. The Norwegian terms, for the particular topic, are also provided.	Our system offers a variaty of progress accessment options. There are multiple choise questions, polls, etc. Also, our whiteboard is well suited to show pictures and videos with subtitles on different languages.

D. Principle of Flexible Learning.

In Faculty of teacher education and international studies of National center of multicultural education of Oslo Metropolitan University there is a project “Flexible teaching” - “Fleksibel opplæring” [10]. These are bilingual education, student support in online mathematics and natural history with a bilingual teacher, and a set of interactive bilingual tasks and examples (videos, exercises, tests). So bilingual students, who do not speak Norwegian very well, can get online advice on topics in mathematics and environmental studies from bilingual teachers. Thus, they understand more about what is happening in the classroom, and learn new words and terms in Norwegian. There are bilingual assistants in local schools, who help students in the classroom.

VI. SUMMARY

We developed a software platform for remote teaching; the platform is based on modern information and multimedia technologies. The aim of our work is to organize and conduct highly effective courses on various subjects and disciplines. We analyzed the specifics of training in classes, where students are not fluent in the language in which the teaching is conducted. Therefore, an attempt was made to apply the principle of adapted learning.

Our E-learning software platform consists of a class-conducting module, a course management module and an authorization module, an event bus itself, a web socket service and a database. The class-conducting module allows users to interact in groups, use interactive board, video transmission, etc.

The new technologies gradually changes the education system – it is easier to get knowledge. Personalized training allows the instructor to approach each student individually to helps the student learn the material quicker and enthusiastically. We demonstrated how flexible our system is by how it can be adapted to the Norwegian school teaching system.

In the following studies, we will consider how to build a new generation remote teaching systems, integrate the systems with new approaches, methods and courses for effective training and quality education.

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