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Web-Based Teacher-Student Interaction in a Traditional Course *

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Abstract: - Platform independent Java application to support interaction between an instructor, teaching assistants and students in a traditional on-campus course is developed. The TSI (teacher-student interaction) application includes a specialized Web server, an ordinary Web server, a mailer and a simple database. The HTTP protocol is used for all communications. Both teachers and students employ Web browsers to access the TSI server. Students have possibilities to check their personal data (scores and comments), to download educational materials, to upload files and to communicate to the instructor or teaching assistants. The instructor and teaching assistants can upload Excel table containing student personal records, send personal e-mail messages to students, upload educational materials etc. Two-year use of the TSI system demonstrates that it is a helpful tool for improving communication between students and teachers in a traditional course.

Keywords: - Web technologies, classroom teaching, teacher-student interaction, Java, Web browser, server.

1 Introduction

Web technologies are widely used in education. However main efforts of researchers in educational applications are directed to the development of approaches and software for Web distance education [1-4]. While Web distance education has large potential, at present the majority of university courses are delivered on campus in a traditional way. In traditional courses, students attend classes, faculty members deliver lectures and provide educational materials, teaching assistants (TAs) help to the instructor during exercises, check student tasks etc. Both the Web and e-mail are usually used in traditional courses. Encouraging results for the Web interactive learning in class are reported in [5] and [6]. Active employment of the e-mail in the learning process is discussed in papers [7] and [8]. In our opinion, the Web and other computer technologies should play bigger role in traditional courses. In this paper, we focus attention on efficient use of Web technologies for communication between instructor, TAs and students in a traditional on-campus course.

The process of learning is characterized by constant exchange of information. The instructor with a help of teaching assistants delivers lectures and or-

ganizes exercises. Besides verbal and visual information during classes, the instructor delivers lecture notes, exercise tasks and other written and graphical information. The students submit solved exercise problems, projects etc. The instructor and the teaching assistants check student exercises and other student work and distribute scores among students. While information exchange can be performed on paper, it is reasonable to use computers for this purpose. Many possibilities are available for information communication using computers.

A simple way to publish course materials is to put them on the Web. However, to add new material it is necessary to modify a Web page on the Web server. For informing students about their performance during semester, it is possible to place student scores on the course Web page. However, in this case personal information is available to anyone, which is considered inappropriate in most institutions. E-mail provides big opportunities in delivering information to students and in getting their replies. Using e-mail it is easy to send same message to all students subscribed to the course, but it is difficult to mail messages containing individual information for each receiver. With CGI scripts that are executed on the Web server, it is theoretically possible to perform various interac-

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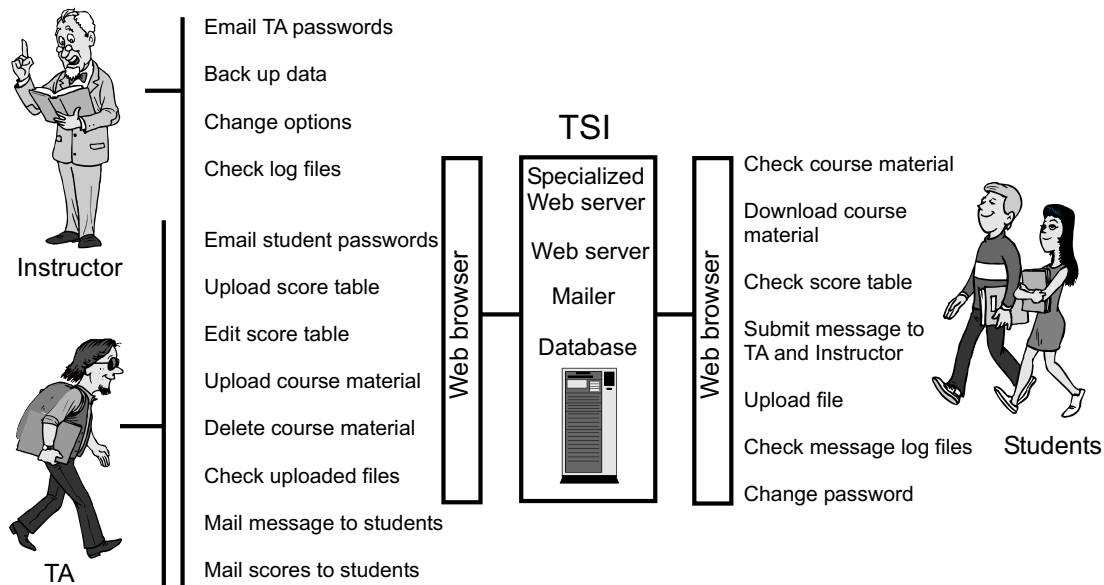


Figure 1: Instructor, teaching assistant and student interfaces to the TSI system.

tive actions. However, development of CGI scripts is a complicated task for professors, and the university regulations may forbid CGI scripts on personal Web pages. For active interaction with the students, the instructor should probably use all three techniques: Web pages, e-mail and CGI scripts. Such approach can be time-consuming in development and inefficient in use.

After analyzing typical communications between students, TAs and an instructor in a traditional on-campus course, we came to creating a Web-based application, which can help to organize such communications in a simple way. In this paper, we present a TSI (teacher-student interaction) Java application, which contains a specialized Web server, an ordinary Web server and a specialized mail client. The HTTP protocol is used for all communications between users and the TSI server. Because of this all participants can employ standard Web browsers on different computers. Since the TSI server is written in Java, it can be run on any platform.

2 Interaction Interfaces

In a traditional course at the University of Aizu an instructor and 1-2 TAs interact with 80-90 students. The course usually includes lectures, exercises, a term project and an examination. Exercises are graded on a weekly basis. After investigating needs of the in-

structor, teaching assistants and students, the interfaces shown in Fig. 1 have been created for Web-based teacher-student interaction. The TSI system can be accessed from any computer. Since the Web is the chosen environment for the TSI system, it follows that the Web browser is used for communication.

2.1 Student View

For a student, a typical scenario of using the TSI is as follows. First, the student receives an e-mail message from the instructor containing some explanations about the TSI system, an URL of the login page and a personal password. Using the Web browser at any computer, the student logs in to the TSI and changes his original password since it was generated automatically and consists of an inconvenient character sequence. Then he can look at the course Web page supported by the TSI, which can work as a usual Web server. Next possible student move is to check the existence of educational materials. If materials exist the student can download them. Another typical action of the student is to check his personal records consisting of scores for exercises, instructor comments, etc. The student also can submit a message to the instructor and TAs. A log file, which contains all sent and received messages, is available. It is possible for the student to upload any file (for example, solved exercise problems). A student interface to the TSI is shown in Fig. 1.

2.2 Instructor and TA View

For the instructor and teaching assistants, the main advantage of using the TSI system is the possibility to jointly keep, modify and distribute a table with personal student information (the score table). The score table may be created using Microsoft Excel or any other spreadsheet program. As a minimum, it contains student names and ID numbers. Student ID numbers are used as login names. It is supposed that student ID numbers are prefixes of student e-mail addresses. The score table is uploaded to the TSI using the Web browser. Student passwords are generated automatically after table uploading. If later the uploaded table contains new students, these students are added to the database and passwords for them are generated. The passwords with a brief explanations about the TSI system are mailed to all students and the process of interaction between students and the instructor begins. The score table can be later modified using Excel and can be uploaded to the TSI in one piece. The other possibility is to edit the score table inside the TSI using the Web browser.

Among other opportunities, the instructor and teaching assistants are able (see Fig. 1):

- to upload course materials (usually as PDF or PS files);
- to modify course materials files (delete or replace);
- to check and to download files submitted by the students;
- to mail messages to all or selected students;
- to mail scores or other individual information from the table to students;
- to check student log files.

In addition to TA privileges, the instructor has the possibilities:

- to add teaching assistant accounts;
- to back up TSI files;
- to change options for the course;
- to look through all log files (TA log files, error log files, etc).

3 Implementation

3.1 Choice of Programming Language

The TSI system for teacher-student interaction has been implemented in Java language. Our choice of Java as a programming language is related to such Java features as multiplatform support, multithreading and reliability.

We can expect multiple clients to work with the TSI server at the same time. Because of this we need to create multithreaded application. Java includes built-in support of multithreading on the language level.

Since TSI is a real-time application with multiple clients it is desirable that it would continue to run even when some error occurs. Java exceptions help a lot in creating reliable real-time application. In many important cases Java forces a programmer to use `try-catch` structures in order to catch an exception.

Java from the beginning was developed as a language suitable for the Web. Because of that Java is inherently safer than most other programming languages. Through proper authentication and authorization Java allows to create reasonably secure Web applications.

3.2 TSI Architecture

In order to have the application a lightweight one with easy installation and use it was decided to develop it as a stand-alone application with the use of Java standard APIs. An architecture of the TSI system is presented in Fig. 2. The Java application consists of three main parts: a specialized Web server, an ordinary Web server and a mailer. The specialized Web server and the mailer have access to a simple data base where score table, course materials, log files and some other information are stored.

The function of the specialized Web server is to accept user requests and to provide replies to users using HTTP protocol. The user employs a Web browser and first goes to the log page of the TSI system. After logging in he arrives at the page with main menu. Selecting items of the main menu and other menus the user can perform various actions.

The mailer is used for sending e-mail messages from students to the instructor and teaching assistants and from the instructor or TA to the students. The TSI mailer provides some unusual possibilities for the instructor and TAs such as sending personal messages to all or selected students.

The ordinary Web server is included in the TSI system because it is convenient to have all materials related to the course in one place. For the instructor it may be natural to put course Web pages in the TSI inner directory instead of uploading them to the University or Department Web server.

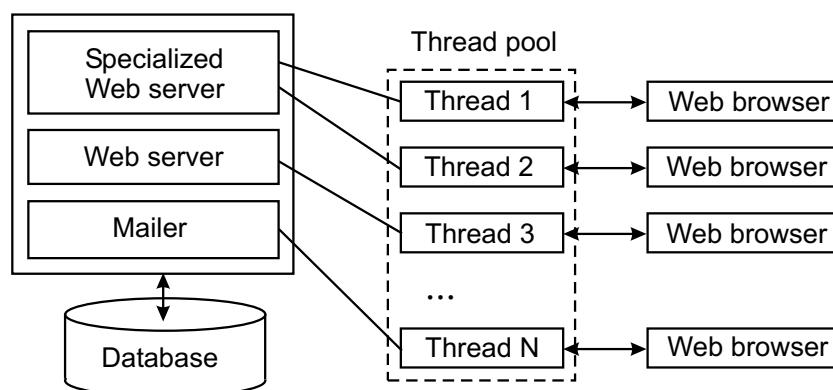


Figure 2: Architecture of the TSI system.

Each user action is executed by the TSI with the use of a separate thread. Threads are allocated from a thread pool and are returned to the thread pool after finishing the user action.

4 Working with the TSI

The TSI system does not require installation. The TSI application is placed on any networked computer with Java Virtual Machine 1.3 or later. After starting, the TSI manager shows a window with possibilities to setup the TSI and to start/stop its server.

If the user chooses to setup the TSI, it is necessary to specify port number, which is used for communication, common part of IP address for computers that are allowed to connect to TSI and domain name of the University. Specification of common part of allowed IP address (several such numbers can be specified) is used for security reasons. The TSI server replies only to computers with allowed IP addresses. If no IP is defined during setup then any computer can communicate to the TSI server.

The TSI can handle any number of courses. A special wizard helps the instructor to initialize new course. Initial information for a course includes: a course name, an instructor name, an instructor logging ID, a directory where course files are placed, an e-mail server name and an instructor e-mail address.

4.1 Instructor Menu

The main TSI menu for the instructor is shown in Fig. 3. The left menu column contains possibilities to get information from the TSI. The instructor can access: the score table, files uploaded by students, stu-

dent and TA passwords and various log files including files containing messages send by all participants of communications through the TSI system. The right column of the main instructor menu contains items, which allow the instructor to perform various actions: to e-mail personal or common messages, to upload and edit the score table, to upload course materials, to backup data, to alter options for the course and to change password.

4.2 Working with the Score Table

The score table is logically a central point of the TSI. To initialize the course score table it is natural to submit a student list, which contains student IDs and student names. The student list can be prepared using Microsoft Excel or any other appropriate spreadsheet application. The student list Excel table is saved as a text file with fields separated by tabs. The table is uploaded to the TSI using menu item "Upload score table" and the subsequent dialog. Later the student table can be modified by adding student scores, instructor comments or any other personal information. The instructor or the teaching assistant can work with the score table using Excel. After modification, the table can be uploaded to the TSI as a whole.

Another possibility for the score table maintenance is to edit it employing the Web interface. The score table can be edited using Web browser with table environment. The Web editor possibilities include: adding or deleting columns or rows of the table and editing contents of a row or a column. If the score table is modified with the Web editor, a master copy of the table is kept by the TSI. For safety, the backup of the score table should be regularly done.

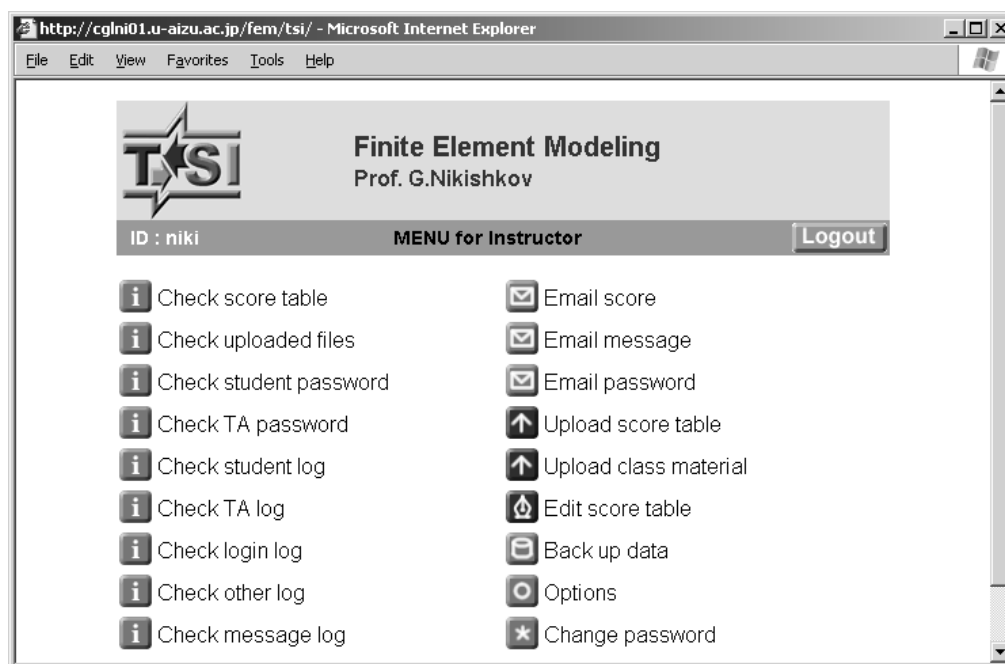


Figure 3: The main menu for the instructor.

4.3 Personal E-mails

Information stored in the score table is used to send personal e-mail messages to students. After selecting menu item "Email score" a dialog page is displayed. It is possible to specify columns (information content) and students (list of recipients). The TSI suggests default body of the message, which can be edited. Since fields of the score table have no size restrictions then any personal information can be delivered to the students. For example, one column can contain a score for an exercise and another column can include instructor comments. A possibility to e-mail personal information by one mouse click considerably increase efficiency of instructor communication with his students.

4.4 Student Menu

The main TSI menu for students is presented in Fig. 4. It contains six items and allows the student: to access personal information from the score table, to look through messages related to him, to download learning materials, to send message to the instructor and/or teaching assistants, to upload files, and to change his password. While the number of items in the student menu is less than in the menus of the instructor or the TA, the student has various possibilities of communi-

cation, which are sufficient for the traditional course.

4.5 Experience with TSI

Several professors have been using the TSI system for two years at the University of Aizu. The TSI was employed for communication between professors, teaching assistants and students in different courses ranging from Programming and Numerical Analysis to English Language courses. Opinions of both students and teachers are positive. Students consider the TSI valuable because they can easily check their performance any time and because they can find all course materials in one place. Instructors feel that the TSI helps them to organize all information about a course and student performance easier than in the case of using other software of several different types. A possibility to edit the score table jointly with teaching assistants is also considered valuable. Based on the experience, some modifications in the TSI have been made. For example, accessible log files for instructor and student messages have been introduced.

5 Conclusion

We developed a Web-based Teacher-Student Interaction (TSI) system, which facilitates communication between the instructor, teaching assistants and stu-

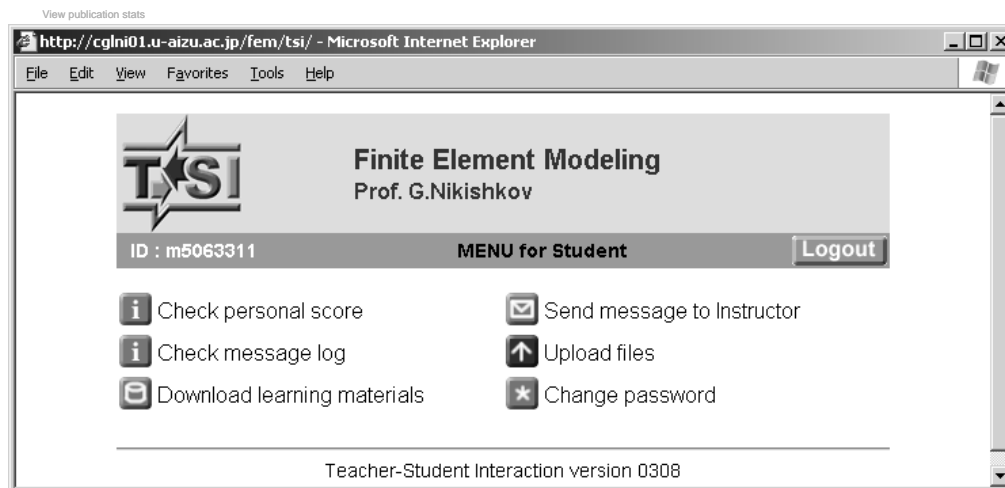


Figure 4: Main menu for a student.

dents in a traditional course. The TSI consists of the specialized Web server, the ordinary Web server and the specialized mailer. One application programmed in Java can provide all main possibilities for teacher-student communication. The center of the TSI system is the score table containing personal student records. Excel table (saved as text with tab separators) can be uploaded to initialize or update the score table. The TSI system also allows the instructor and teaching assistants to edit the score table using Web browser. This helps to organize collaborative work of the instructor and teaching assistants. In addition, the TSI offers other simple and important possibilities for communication, such as: e-mailing messages with personal data, delivering learning materials etc.

Registered students have Web access to their personal data. They can also download course materials, upload files and submit messages to the instructor and teaching assistants.

Several professors have been using the TSI for two years at the University of Aizu. It is found that the TSI is a useful addition to other instruments for teaching a traditional course. The TSI Java application can be downloaded from the following URL: <http://www.u-aizu.ac.jp/~niki/tsi>.

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