

INFORMATION SYSTEM FOR REMOTE CARRYING OUT LABORATORY WORKS ON THE BASIS OF INTERNET-TECHNOLOGIES

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Abstract

The report is dedicated to the distributed information system developed at the Computer Engineering Department of TPU. The system supports remote access in multi-user mode, automated carrying out studies, controlling a current progress, interaction and information maintenance of students and instructors. The technologies of remote (virtual) laboratory works are considered.

Keywords: distant learning, information system, remote access

1. Introduction

By the present, in the Russian educational community there is no information about successfully solving the problem of integrating new information technologies in the sphere of distant learning. It is mainly connected to the complexity of integrating quite different technologies within the framework of a uniform learning system. All developers of distant learning systems inevitably pass through stages of creating separate electronic textbooks, electronic learning systems etc. State-of-the-art software packages are usually used to facilitate this process. Computer Engineering Department of Tomsk Polytechnic University also has passed through the creation of separate systems using various technologies [1].

However, our experience proves that any department involved in distant learning should have means of complex supporting the educational process with the use of Internet. In other words, various software and technologies must be integrated into an information system of distant learning.

The information system developed at our department has united some servers of the department and appropriate systems software and applied software. In this connection, main Internet-technologies were used: e-mail and mailing lists, WWW, FTP, remote program execution (telnet, ssh), on-line teleconferences.

The information system provides remote access in multi-user mode, automated carrying out studies, controlling a current progress, interaction and information maintenance of students and instructors [2].

When developing the information system core, we designed and implemented the following parts: the database, the subsystem of progress registration and student knowledge control, and the subsystem of visualization and statistical analysis of educational process data.

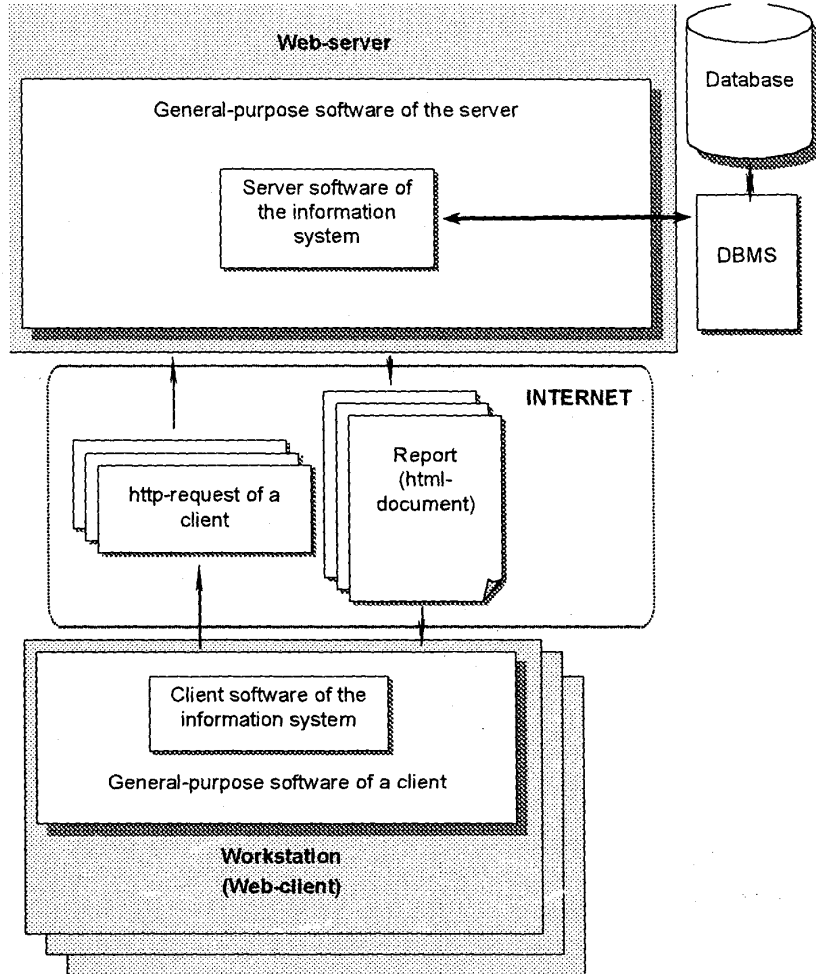


Figure 1. Information system structure

Services of the department server are made available for the four user groups: *visitors*, *students*, *instructors* and *administrators*. The server gives different services and resources to members of each group. Access to some resources of the department server implies authenticating and registering a user. When registering, a login name and password is given to the user. Login names are unique for all users registered. Such organization of accessing server resources allows storing confidential information on the server, having provided a good level of data protection from unauthorized access.

2. Information System Structure

Considering simplified, the information system consists of the server part and multiple client parts. The server part incorporates a database, a database server including a database management system (DBMS) and a web-server. The database server and the web-server can physically be located on

either the same or separate computers. The client part consists of hardware (user computer) and software part (a standard web-browser and the client software of the information system). Interaction between the client and server parts is carried out via means of HTML and CGI (common gateway interface).

The presence of two independent web-servers at the department allowed solving the problems put using two independent program platforms. In the first case it is the operating system Linux, web-server Apache, DBMS MySQL (Fig. 1), and in the second — operating system Windows NT, web-server IIS, DBMS Oracle (Fig. 2).

The subsystem of administering database performs functions of separating user access to the database and functions of modifying the database structure. It has a web-interface.

The subsystem of query processing accepts user queries (input information stream) and forms reports (on the basis of database contents), which are then transmitted to the user (output information stream). Examples of queries: “Show the curriculum”, “Show student progress” etc.

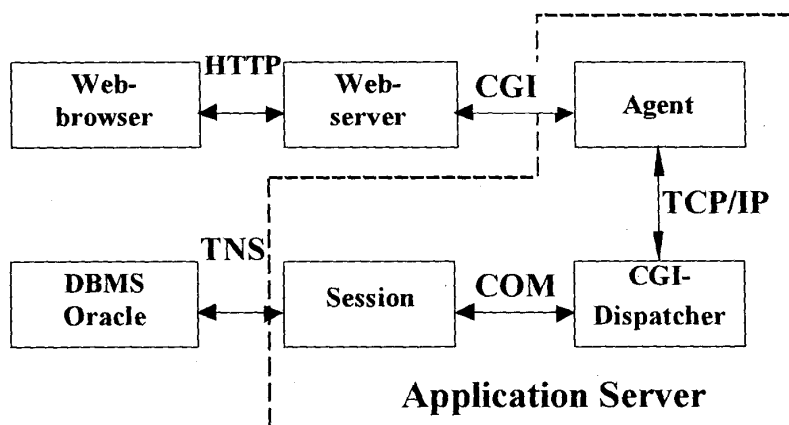


Figure 2. Structure of user interaction with the application server

The subsystem of progress registration is intended for both students and instructors but with different access rights. After user authentication an appropriate interface is provided. An instructor can perform necessary operations above logbooks of current progress: creating, editing and reviewing. A student is allowed to view them only. The web-server gives students syllabuses; technological schemes of learning disciplines; lecture abstracts; guidance of self-studying educational materials and doing practical/laboratory works and term papers; logbooks of current progress. Remote execution of laboratory works is also organized via the web-server.

3. Supporting Remote Laboratory Works

To carry out laboratory works with remote access implies installing a complex of tutorial software on various subjects on the department server. This complex is intended to providing distant learning without involving an instructor in this process. In view of such an approach, the demand of obligatory presence of students at classes is no longer relevant. In that case one can do a laboratory work at any time without leaving home. An Internet-connected computer is the only need. The stage of studying the tutorial software may not be obligatory and may be omitted by the student having sufficient

knowledge. Nevertheless, it is strictly recommended to study it in order to prevent possible errors while doing a laboratory work.

Before working begins, a student has to be registered using the login and the password given to him/her earlier (Fig. 3). While the student is doing the work, all his/her essential operations are being recorded and can be viewed besides the work results (Fig. 4).

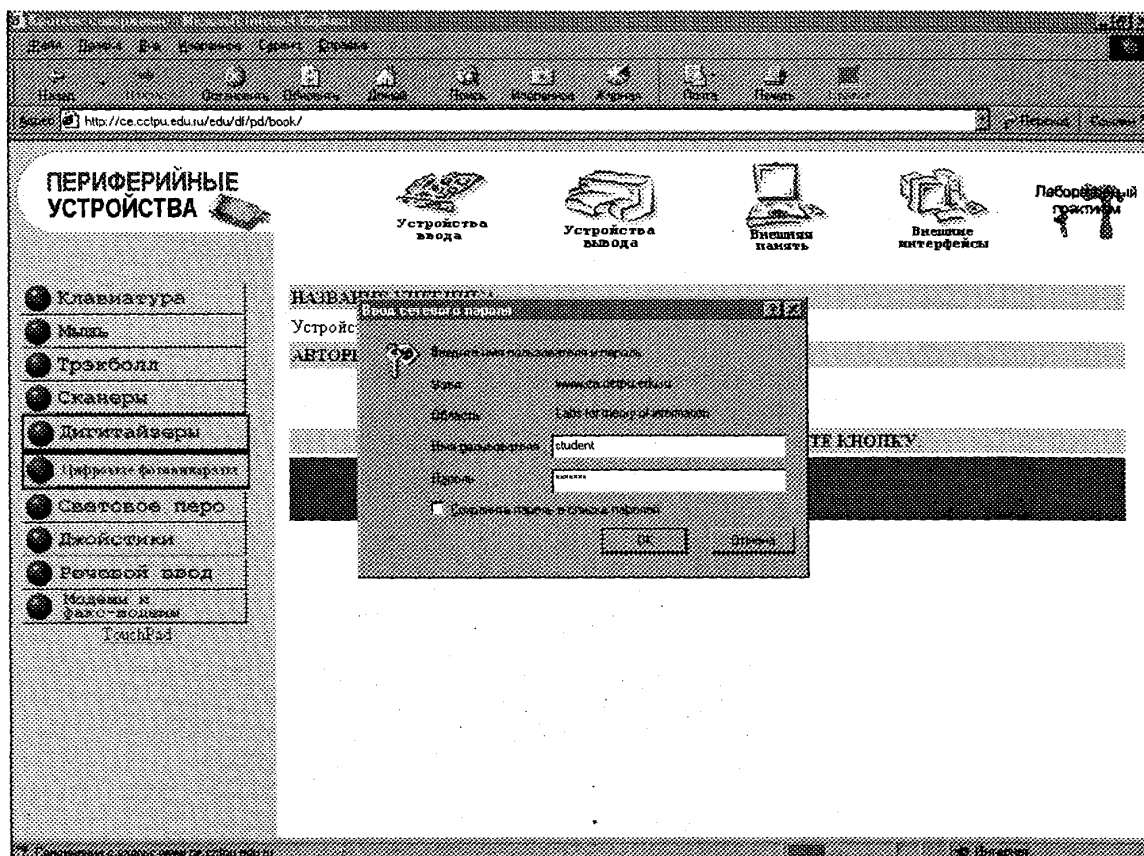


Figure 3. Student registration

The technologies of remote carrying out laboratory works are classified into four classes [3]. The 1st class technologies allow the student to do simple laboratory works requiring minimal software. When doing them, a student obtains only methodical instructions and assignments from the web-server. Work results are sent by the student to the teacher by e-mail or another way. An example is the work on the subject "Programming languages and programming". The student has to send the program listing to the instructor as the result of the work.

The 2nd class technologies imply that a student obtains the methodical instructions and assignments and can obtain additional maintenance if necessary while working. An example is the work on the subject "Applied mathematics". Transferring results can be carried out similarly.

The 3rd class technologies include laboratory works, which imply program simulation of special laboratory devices (i.e. using virtual devices) on the student's computer. The methodical instructions, assignments and basic software are sent to the student for each work. After studying the theoretical

material and passing a knowledge control, the student obtains additional software to model the device. An example is the work on the subject "Information theory".

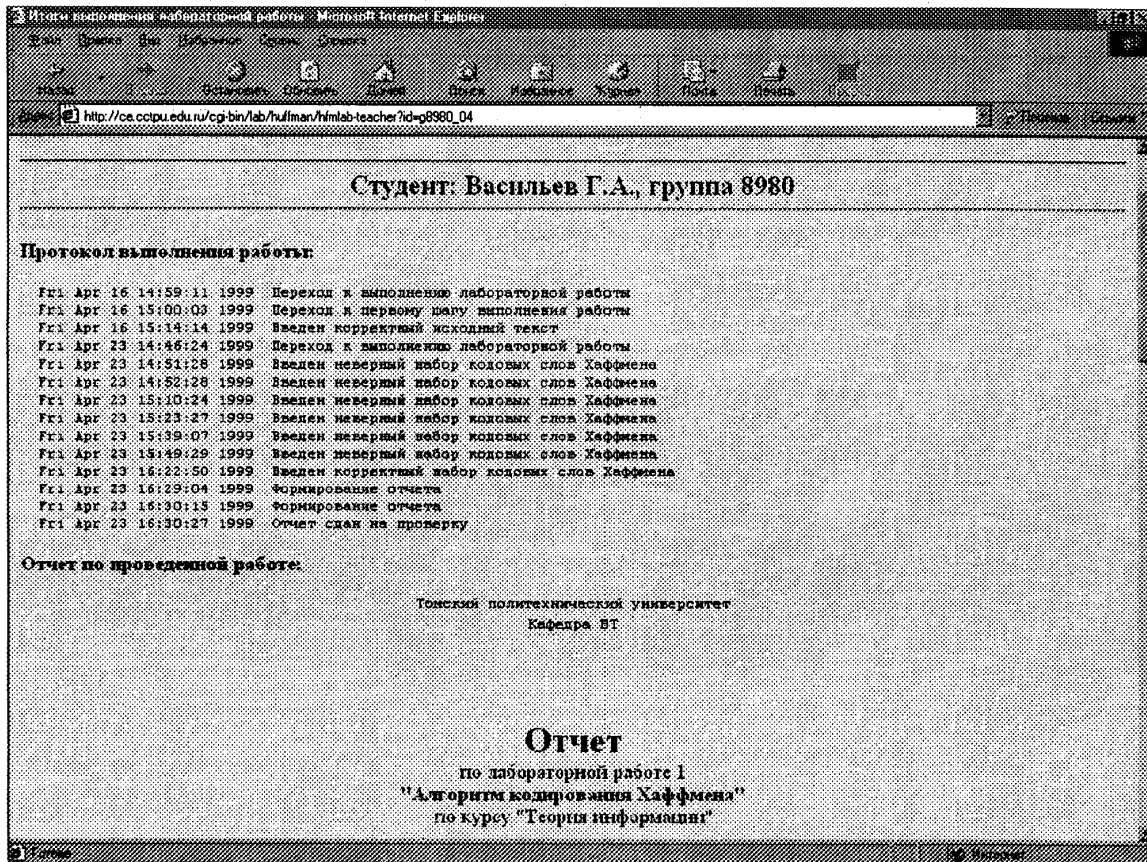


Figure 4. Log of student operations during the work

The second and third classes allow adjusting the educational process in a more flexible way. If necessary, a laboratory work can be divided into stages (doses). Working with the subsequent stage is possible only after successfully passing the previous. At any time the teacher can view results of student operations on each stage and, if necessary, forces the student to do this or that stage once more. Thus, the teacher always knows how the student does laboratory works and can give necessary support.

The 4th class covers technologies of visually doing laboratory works, i.e. the technologies based on a principle of remote access to unique laboratory devices, expensive programs, or complex information systems located at the department labs only. A number of such technologies has been implemented by means of the system "LabView". An example is the work on the subject "Networks and telecommunications".

Intensively using virtual laboratory works makes it possible to increase the quality of student knowledge on a subject being studied, develop student independence in learning educational material, and use unique expensive equipment more effectively.

4. Conclusion

The concept of designing the distributed information system to collect, store, process and visualize information about the educational process has been considered in the paper. Connecting the technologies of Internet, databases and virtual laboratory works allows automating the process of distant learning and rationally using the time of instructors and students.

The experience of using the information system makes it possible to conclude that the approach offered is perspective.

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