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Paper

PAPER

USE OF DIGITAL TECHNOLOGIES IN THE PROCESS OF DISTANCE EDUCATION

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Abstract

The article discusses distance learning and distance learning laboratories, which are an effective form of education using digital technologies.

Key words: Aurdino laboratory, interactive dialogue distance system, distance education, distance education laboratories.

INTRODUCTION

The advent of digital technologies has changed situations that have remained unchanged for several centuries. This was reflected in the exchange of regular correspondence with e-mail, and libraries with websites. Now, instead of traditional forms of education, elements of distance education have entered the educational system. The introduction of modern information and communication technologies into the educational process has led to the creation of a new form of education - distance education, in addition to traditional teaching methods.

In distance education, the student and the teacher are spatially separated and communicate with each other with the help of specially created training courses, control forms, electronic communication and other technologies of the Internet. Distance learning based on the use of digital technology provides access to the global information and education network, performs a series of important new functions with the principle of integration and interaction. Distance learning provides an opportunity for continuous improvement of skills for all those who want to learn. In the course of such training, the student learns independent teaching and methodical materials in an interactive mode, passes control, performs control work under the direct guidance of the teacher, and communicates with other students of the ”vertical learning group”in the group.

Distance education is a convenient form of education for people who, for certain reasons, do not have the opportunity to study in full-time departments of educational institutions, for example, those who do not require health, who intend to change their specialty, or who are old and intend to improve their skills.

Distance education uses various information and communication technologies, that is, each technology depends on the purpose and nature of the issue. For example, traditional print-based teaching tools (study guide, textbooks) are based on introducing students to new material, while interactive audio and video conferences are designed to communicate over a certain period of time, to establish direct and reverse e-mail communication, that is, to send and receive messages. Pre-taped video lectures allow students to listen to and watch lectures, and fast exchange of faxes, messages, assignments over the network allows students to learn through mutual feedback.

ANALYSIS OF LITERATURE ON THE SUBJECT

U.N. on problems such as improving the training of technology teachers, their development in a digital educational environment, the role of digital technologies in improving the quality of education. Nishonaliev, A.R. Khodjabaev, N.Sh. Shodiev, N.A. Muslimov, Kh.I. Ibragimov, E.I. Roziev, O.Q. Tolipov, N. Saidahmedov, D. Ergashev, Sh.S. Sharipov, O. Abduquddusov, E.T. Research works were carried out by Choriev, O. Torakulov, J. Hamidov, A. Joraev, U. Jumanazarov, O. Koysynovlar and many other scientists of our country.

RESEARCH METHODOLOGY

The methodology of the article, starting from the analysis of scientific and increasingly popular sources, analyzes the

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professional activity of future technology teachers, technological potential, the importance and role of using digital technologies - distance education in training future teachers.

To improve the quality of technology classes, the methods of analyzing the content of digital technologies, working programs and manuals for improving the quality of education, scientific generalization on the use of modern web tools, and the methods of interviews with future technology teachers on this research problem were also used.

ANALYSIS AND RESULTS

The implementation of remote work in remote mode is ensured by the remote control system of the pedagogical experiment through general telecommunication networks (the Internet, the university's local network).

Special software has been developed to access laboratory work, with the help of which the user connects to the server via the Internet or a local network, performs experimental setup from the studied circuit and installation of measuring instruments in the designated area, setting signal parameters, forming requests, measuring results, processing and presenting them [1].

Remote laboratories must be developed and used taking into account certain requirements:

1. The remote laboratory work must be available in a multi-user mode, i.e., the same setup can be used by several students according to a specific schedule.

2. Remote equipment and laboratory stands must have the technological ability to connect to other laboratories, i.e., the same locally installed devices can be available in various remote works and laboratories.

3. Remote laboratory stands must be in 24/7 mode, i.e., a student can perform educational tasks at a convenient time.

The Interactive Dialogue Remote System (INDUS) was developed at the university for remote control of distant objects via the Internet. It focuses on local developments in devices connecting the experimental setup with a computer (SAP-ASP boards) and previously widely used international standards (e.g., CAMAC). The system does not require expensive licensed software environments such as LabVIEW to support it and uses the HTTP protocol to contact the client with the remote control.

At the same time, there are data transfer function separation, setting different operating modes between the web server and the client computer, and processing the results, which minimizes the data transmitted over the network and performs tasks faster. Due to formalized principles, creating software and hardware complexes connected to the Internet is much cheaper than purchasing expensive imported equipment with an attached software environment.

In the INDUS system, software tools used to connect computers and various system components running under DOS and Windows are written in Pascal, Delphi, Java, HTML and can be easily adapted to existing local equipment to increase ease of use and minimize the cost of network automation of experimental setup. Special software libraries for converting files into various graphic formats and visualizing measurement results, and standard tools of existing software environments can be used [2]. Applied software includes a number of subsystems that provide functional services to various components of the workshop.

Remote laboratory workshops are used in the educational process and in foreign technical universities. For example, there is a remote laboratory at the National University of Singapore, with the help of which students study various measuring instruments (functional generators, oscilloscopes, multimeters, etc.) and the transient and frequency characteristics of radio circuits and devices. The remote system is developed based on GRIB elements connected to a personal computer supplemented with a data acquisition controller.

Access to the capabilities of the remote laboratory is provided by a server machine that is a web server. Visual control of the processes being studied is carried out by a video camera installed in the system. Data transfer between the remote user and the system server during the learning experience is carried out using the TCP protocol and the CGI application. The interface for student interaction with laboratory equipment is implemented in an internet browser via the HTTP protocol. The implementation of the CGI program on the server was carried out in the LabVIEW software environment.

The Automatic Control Engineering Laboratory operates at the Faculty of Electronics of the National Institute in Nis, Serbia. The automated teaching system is based on the client-server protocol. This TCP/IP protocol provides data transfer between remote users and the system server and is necessary for remote control of the equipment. Two research complexes were implemented in the laboratory - the study of magnetic fields and high-speed servomechanisms.

Remote laboratory work is also carried out in radio electronics sciences. At the Mysore Engineering College (India), a laboratory device designed for remote control of bioreactor processes has been developed [209]. The application interface, implemented using the LabVIEW software system, allows you to display process characteristics, set control signals, and analyze measurement results. The interaction of the web server with the bioreactor elements is carried out using the ELVIS measuring station and the PCI6251 input/output controller developed by National Instruments. The user interface with virtual tools monitors the characteristics of the process, and the webcam allows you to monitor the processes in real time.

A remote laboratory device has been introduced at the Chirchik State Pedagogical University to study the capabilities of microcontrollers to control peripheral devices. With the help of this setup, students master microcontroller programming technologies for exchanging digital and analog signals between the Arduino UNO controller and input/output devices. Monitoring the operation of the devices is carried out using a webcam.

The task solved with the help of the laboratory stand is the remote study of ATmega328 microcontrollers, namely: remote study of the basics of microcontroller programming; remote control of input/output devices located on the laboratory stand; remote visual observation of microcontroller programming results.

For this, information LEDs of keys are additionally introduced into the laboratory stand, which includes an electronic board with digital and analog data input/output elements; a variable resistance controlled by a servo motor; a webcam for remote monitoring of the laboratory stand; two Arduino UNO controllers connected to a personal computer and providing a remote control panel, remote control of the laboratory stand.

With the help of a laboratory stand in remote mode, students can perform the following laboratory work on programming and controlling a microcontroller [3] :

- digital output of data (control of LED and microelectric motor);
- digital input of information (determining the state of the key);
- analog output of data, digital-to-analog conversion (changing the brightness of LEDs and the rotation speed of a microelectric motor);
- analog input of information, analog-to-digital conversion (determining the position of the potentiometer shaft);
- controlling a seven-segment indicator.

The algorithm and procedure for working in a remote laboratory have their own specific features. To access the Arduino LAB remote laboratory, the remote laboratory website is required: (https://sites.google.com/site/arduinolaboratoria/)

1. You need to open a Google account - https://accounts.google.com

2. Install the Google Chrome browser on your home computer https://www.google.ru/chrome/browser/desktop/index.html.

3. Install the Chrome Remote Desktop application; to do this, in the Google Chrome browser, through the Chrome App Store (https://chrome.google.com/webstore/category/apps), you need to find and install the application - Chrome Remote Desktop (https://support.google.com/chrome/answer/1649523?hl=ru).

4. To receive access and instructions for working with the remote Arduino LAB, you must subscribe and then write a message to the group on the page: remote Arduino laboratory - https://vk.com/DArLab, full name, the name of the educational institution and the field of study, group number, Google account (email address in Gmail).

Over time, the algorithm and procedure for the Arduino LAB remote laboratory may change and improve. All changes for working with remote laboratory work are located on the laboratory website (URL) - https://sites.google.com/site/arduinolaboratoria). The block diagram of the remote laboratory workshop is shown in Figure 1.

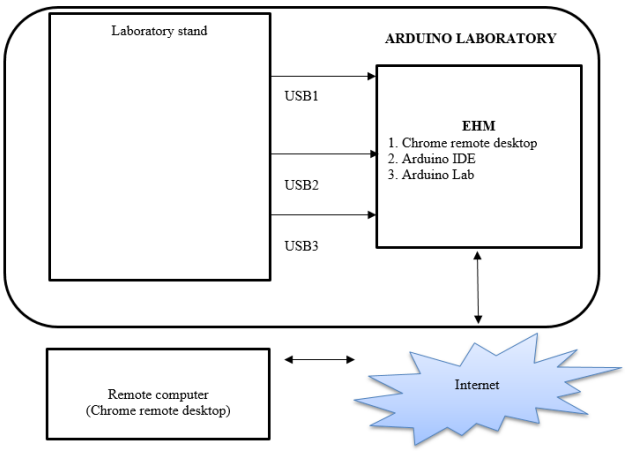

Figure 1. Block diagram of remote lab workshop

Thus, a laboratory stand for remote study of microcontrollers allows remote mastering of microcontroller programming technologies and analysis of the operation of control devices and indicators. This form of organizing students' independent work ensures an increase in the effectiveness of the educational process and significantly reduces the time for mastering the basics of microcontroller programming.

When studying digital technologies, students are very interested in working with digital control machines. Such machines can be used especially effectively in project activities. Remote interactive laboratory work technologies also allow remote control of machines with digital control.

A remote laboratory setup consists of a milling machine, a server to which the machine is connected (specialized computer), software installed on the server to control the machine, and a webcam connected to the server to monitor the operation of the machine (Figure 2). To work on the machine remotely, it is enough for the student to have a personal computer connected to the Internet. The computer remote control program must be installed on the laboratory setup server and on the student's personal computer.

As a machine for the remote laboratory, we used a milling machine manufactured by a student during the course work. An engraving machine is used as the main driver of the cutting tool. The machine control system allows you to programmatically turn the machine on and off, move the cutting tool in three planes.

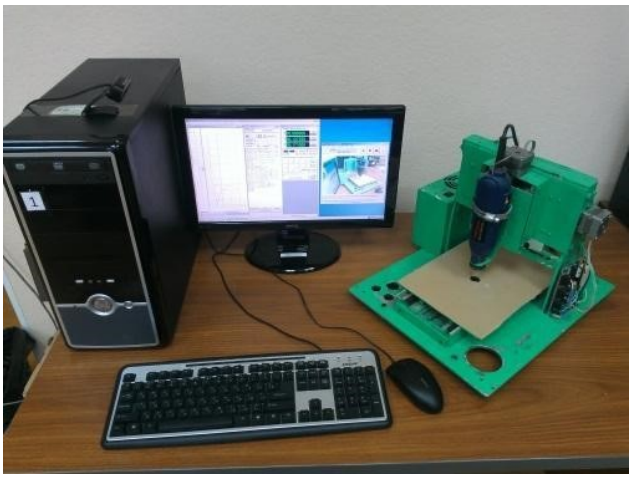

Figure 2. Remove lab setup overview

The Kcam program is used to control the machine. A special feature of this program is that it can be configured for any control unit connected via the computer's LPT interface. With this program, you can control the machine in various modes:

- manual control via the keyboard or on-screen buttons;
- manually writing G-code commands in the program control window;
- using a command file in a format that matches the commands supported by the program;
- using files created in computer-aided design systems (CAD applications).

A wide range of options allows you to perform functions that are usually characteristic of more expensive software packages. Typical tasks for Kcam are 2D and 3D milling, engraving, equalization milling, drilling, and plasma cutting.

A webcam is connected to the computer to monitor the operation of the machine. Having a camera that broadcasts the operation of a fully computer-controlled machine, we can organize remote laboratory work. It only remains to provide remote access to the control computer.

Several technologies are used for remote control of equipment. The first method is the "remote desktop". In this technology, everything that is displayed on the remote computer screen is reflected on the monitor of the student's personal computer, and at the same time, the student can control the laboratory computer in real-time. With this control, keyboard and mouse commands are transmitted from the student's computer over the network, and the image is transmitted from the remote computer. At high connection speeds, it is almost impossible to determine that the student is controlling a remote computer, not their own.

The second method is to exchange files between multiple computers. In this case, when connecting to a remote computer, you can see a list of files and folders that can be edited and copied. Remote control of the laboratory computer is carried out based on working with files.

The third method is to control the peripheral devices of a remote laboratory that have the status of network devices. Typically, such devices are printers, scanners, webcams, but there may be other devices and settings. Such devices are accessed via a web interface.

In our case, organizing remote laboratory work is most suitable for the first method - remote control of the computer. For this, you need to install the appropriate program on the student's server

Таблица 1. Software products remote computer control

Name of products	Developer	Distribution size	Distribution way
Radmin (Remote Administrator)	Famatech, www.radmin.ru	9.1 Mb	shareware (bepul dastur)
UltraVNC	UltraVNC Team, www.uvnc.com	2.0 Mb	freeware (bepul)
TeamViewer	TeamViewer GmbH, www.teamviewer.com	4.7 Mb	shareware (bepul dastur)
Remote Manipulator System	TektonIT, www.rmansys.ru	11.5 Mb	shareware (bepul dastur)
Anyplace Control	Anyplace Control Software, www.anyplacecontrol.com/ru/	4.8 Mb	shareware (bepul dastur)
Ammyy Admin	Ammyy, www.ammyy.com	0.7 Mb	shareware (bepul dastur)

and personal computer. There is a very wide variety of software products for remote control, some of which are listed in Table 1.

We have tested several software products. They have their pros and cons. For our purposes, the most convenient and simple solution was Ammyy Admin. This simple and compact program allows secure and fast remote access to your personal computer via the Internet. It allows you to remotely control the remote server in real-time, share folders and files, and communicate with voice in a chat. To work with the Ammyy Admin program, you do not need to install it, you just need to copy the program to personal computers and run it.

For a student to connect, it is necessary to confirm a special identification code transmitted via e-mail and, on the laboratory computer, the student's right to control the laboratory setup. You can individually configure access for individual students, which allows you to personalize connections and tasks.

Before students perform remote laboratory work, a preparatory part is carried out in the laboratory, which includes setting up and connecting the equipment. The tasks of the laboratory assistant are:

- visually inspect the electronic and mechanical parts of the machine to identify defects and prevent malfunctions;
- select and fasten the cutting tool and workpiece;
- turn on the control computer and the machine;
- launch the Ammyy Admin software package on the control computer - to obtain an identification number and password for remote access;
- transfer the connection data to the student via e-mail or Skype authorization settings. The student must contact the teacher or laboratory assistant in advance to receive methodological assistance in connecting and performing the work. To work with the laboratory, the student needs:
- a personal computer with Internet access (channel bandwidth of at least 512 kbit/s);
- a program installed on the computer to connect to the server desktop (Ammyy Admin);
- after receiving the access data, connect and run the video broadcasting and machine control programs;
- load a pre-prepared control program into the Kcam program module;
- remotely turn on the machine and start the execution of the control program.

After establishing a connection with the laboratory server, the screen of the student's personal computer will look like this (Figure 3)

Of course, the student must: confidently own a personal computer; navigate the Internet; know the special Ammyy Admin program; be able to use the Kcam control program.

CONCLUSION

The use of such virtual technologies in the educational process and the use of distance learning provide qualitatively new opportunities for students' independent work, which allows not only to demonstrate unique interactive technologies, but also to actually control modern technological equipment.

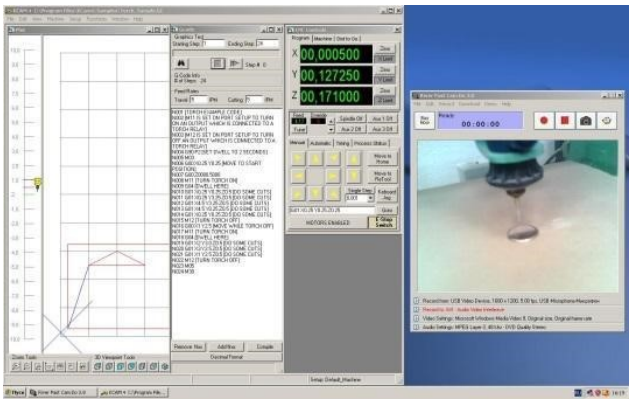

Figure 3. The screenshot of the student's personal computer screen

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