

## **PORTABLE SYSTEM CONTROL OF THE EDUCATIONAL ROBOTIC COMPLEX**

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Remote control has the broad audience of application - from systems of video observation and systems «clever house» before control and monitoring of complex technical objects and complexes. The purpose of the given operation was system engineering of the remote control educational robotic (URTC) complex (fig. 1).

The control system should realize following functionality:

- Installation of connection between the client and a server;
- Transmission of commands on start of movement on the certain coordinate and in the certain direction;
- Transmission of commands on a stop of movement on the certain coordinate;
- Transmission of coordinates from a server to the client.

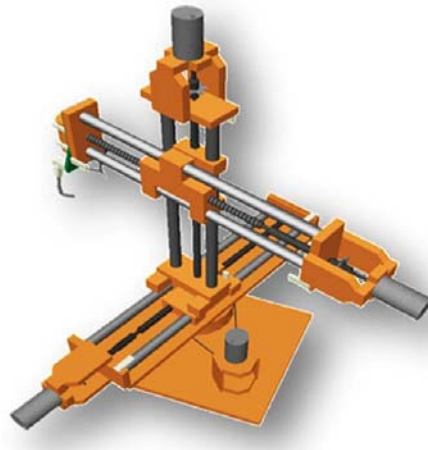


Figure 1. Educational robotic complex

The system of the remote control consists of 2 parts: server and client.

Both client and server parts of system are written in programming language Java, a client part - on platform Java 2 MicroEdition, and server on Java 2 Standard Edition. The choice of language Java has been caused by his following characteristics [1]:

- Object technology;
- A multithreading;
- Cross platform structure;
- A client and server part are written in one programming language that facilitates development.

The server part – is installed on a personal computer from any operating system (Windows, Linux) with installed Java Virtual Machine. Through LPT the port is connected to a computer URTC. Network connect the Internet is necessary.

The client part is installed on a mobile phone. The Mobile phone should have the color display, it is desirable with the permission not less than 176 on 132 pixels, to have network connect the Internet (it is used GPRS more often).

The interface of a server part is represented in a figure 2. The server part allows to control from a local computer or to be connected to her far off. For a choice of an operating mode switches «Control from the PC» and «Remote control» In the right part of a window of the program. Ten buttons are intended for control from a local computer. «S» (Stop) character on the button means, that at present movement on the given coordinate in the given direction is stopped. «R» (Run) character means, that at present movement on the given coordinate in the given direction is started. Also on the screen current values of parameters are displayed.

For the remote control it is necessary will switch in a mode «Remote control», to enter number of port which will be listened by the program and to press button «Listen» then the program passes in a waiting mode of connection of the client to the specified port. The

information on connection of the client, commands of start and a stop of the movement, required coordinates will be displayed on the panel «Dialogue the Client-server». Simultaneous control from a local computer and far off it is impossible.

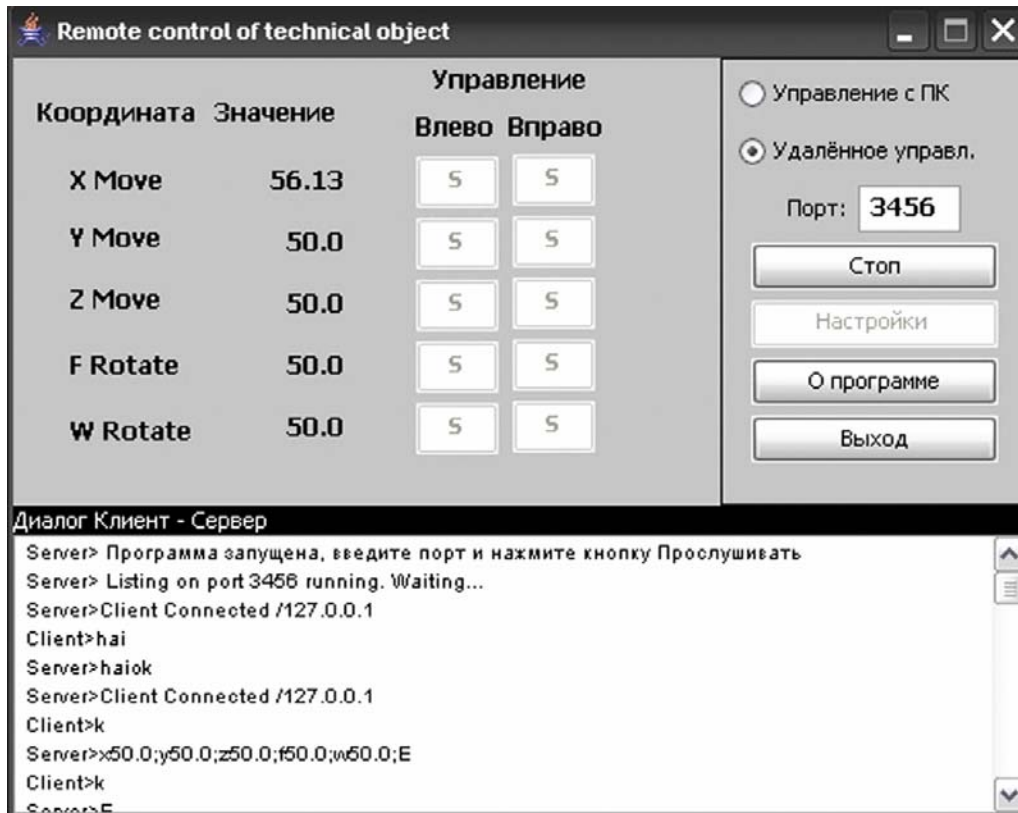


Figure 2. The User interface of a server part

The client part is installed on a mobile phone. The user interface of a client part is represented in a figure 3. Before connection to a server it is necessary to specify in a window of «Customization» IP the address and port of a server. Data transfer between the client and a server is carried out on TCP/IP protocol. At transition in a window of control (figure 3) there is a connection to a server.

Thus the client creates two connections to a server. One for transmission of commands and obtaining of confirmations about their execution, the second connection is used for inquiry of coordinates.

For control ten pushbuttons are. Moving between buttons occurs pressing the keys «2», «4», «6» and «8» or by means of the joystick of a mobile phone. Pressing of a screen key is carried out by means of a key «5» or pressing the joystick. Transition in the previous window is carried out by pressing the key «0».

After pressing to what or a pushbutton the command on start or a stop of movement on the given coordinate in the given direction is transmitted a server. At start of movement color of the button varies on red.

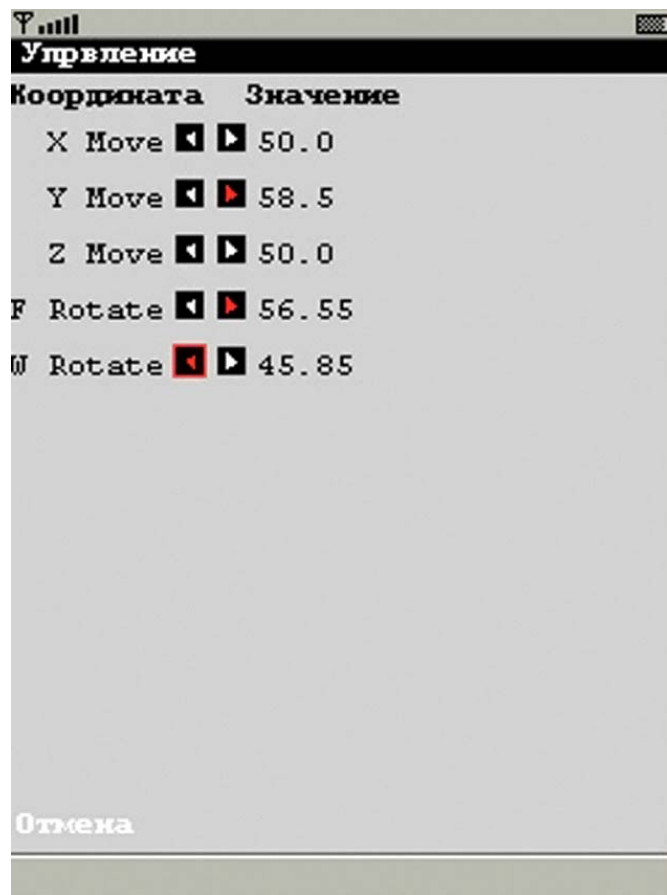


Figure 3. The user interface of a client part

Messaging between the client and a server is regulated by the protocol of an application layer which will determine syntax and semantics of commands. Commands can be divided into three groups:

1. The Message of a greeting. It is transmitted at connection of the client to a server, and informs that the server is ready to the further operation with the client.
2. Messages on start or a stop of movement. These are transmitted by pressing one of pushbuttons and have a following format. The first character determines operation - to start or stop ('r' or 's'), the second character determines coordinate ('x', 'y', 'z', 'f' or 'w') and the third character determines a direction of movement ('r' or 'l'). For example, rxl command informs a server on necessity of start of movement on coordinate x, to the left. The direction to the right is routed on increase in coordinate, the direction to the left is routed on decrease of coordinate. In case of successful execution of servers of the command the server answers with the message:

*[The executable command] ok*

In case of an error at execution of the command the error message «error» is transmitted».

3. «k» Command of the client is inquiry of current values of coordinates. In the answer the server sends string of the certain format in which to contain coordinates, their values and flags of operation of end sensors. For example, in string:

*x50.23; y56.24; z50.0; wmax100; fmin0;*

Values of all coordinates are transmitted, and also flags *max* and *min* mean, that have worked end sensors on coordinates *w* and *f*. Coordinates are requested 2 times a second. Values of those coordinates which have varied from the moment of the previous inquiry of coordinates are transmitted only.

The developed system of the remote control meets to all put requirements: installation of connection between the client and a server, transmission of commands, obtaining by the client of coordinates from a server. The control system is easily updated for control of other objects. One of advantages of the given system is that the client part is installed on a usual mobile phone that allows to have access to control of the object from any point of the world being in a zone of service of the transportable operator. Remote control probably and from the remote computer at presence of the installed emulator from program product Sun Java Wireless Toolkit.

#### **Literature**

1. Nouton S., Shildt G. Java 2 (In Russian) “BHV-Petersburg”, Sankt Petersburg (2006) 486 p.