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SOFTWARE PACKAGE FOR STUDYING MEASURING INSTRUMENTS

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Annotation: Distance forms of education are becoming more influential in the modern world. The author proposes a variant of virtual learning tools in the field of using measuring instruments. A comparison is made with known software products and the need for work in this direction is justified.

Keywords: virtual devices, distance learning, device emulation, virtual laboratory, VS C#.

Introduction. There are a large number of virtual laboratories on the modern software market. The vast majority of these software tools are designed to work with physical measuring instruments and are essentially SCADA. To use such tools in the educational process, it is necessary to have both a software component and devices connected to a computer. With distance learning, the problem of using the hardware part remains. The interfaces of such programs are focused on presenting information and are not related to the real appearance of the devices. Universal programs mostly have a high-quality mathematical apparatus for emulation, but do not give an idea of real devices. For example, LabVIEW. A software tool with enormous capabilities. Allows you to receive information from external sources through popular interfaces, generate signals and control devices, simulate the operation of technical systems. But from the point of view of distance learning, this program does not give an idea of a real device or a set of devices. When teaching students, there is a need to give an accurate idea of both individual devices and the stand used in the laboratory workshop. One option is to use video content from a real laboratory and virtual emulators. The author proposes a solution to this issue using emulator programs that

are visually as close as possible to real laboratory equipment.

Methodology. The popular Visual Studio C# environment on the .NET platform was used for software development. The proposed variant uses the basic principles of object-oriented programming. Programs are independent units and can be executed separately. To execute on the client's computer, the .NET environment must be installed.

Individual parts of the program are made in the form of libraries. They contain components that can be modified in the future. Structurally, the program can be divided into three parts - the interface, the mathematical apparatus, and the reference system.

The user interface is a graphic image (photo) of a real stand or individual devices. This allows you to learn the principles of performing operations with the stand and also identify real devices in future activities. The controls have a visual appearance similar to real devices. The necessary adaptation of the interface is built on the basis of virtual controls placed on top or nearby - buttons that are responsible for switching or rotating using the mouse manipulator.

The mathematical apparatus is the basis of the emulator. Depending on the sensors and measuring instruments, appropriate mathematical models are used. They describe physical processes or functional dependencies between the input and output signals of the instruments. It is also provided for introducing errors at all stages of the signal passage. This is a necessary condition for the emulation to approach real operating conditions. Since the errors must be random, it is necessary to use a random variable generator. Unfortunately, the generation tools built into the environment are of insufficient quality. Therefore, the proposed emulation program uses a software random number generator that has a Gaussian distribution of the obtained values. On its basis, if necessary, other distribution functions can be obtained that will be most acceptable for emulating the operation of the stand.

The help system is an obligatory part of any software tool. In the proposed emulator, the help contains information about each component of the laboratory stand with a brief description. There is also a section on the procedure for performing

laboratory work. Such a comprehensive approach allows you to fully absorb information without having to interrupt yourself to search in third-party sources. The description also contains information that may be specific to a specific method of using the device or the features of the stand's operation.

The results. The software complex consists of separate programs that function independently. The use of separate libraries that describe the reaction of devices to external influences allows you to make modifications independently of the general program code. The advantages also include the ability to replace graphic and text material with a change in the hardware part of the stand.

The basic version is built on relatively simple mathematical dependencies, but if necessary, it can be modified to meet other requirements. To do this, it is enough to create the code in the form of a separate library and replace it with the one located in the program folder.

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