USE OF COMPUTING PLATFORMS AND BASES OF APPLIED SOFTWARE

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Annotation
The article describes the possibilities of using hardware tools for implementation of a logical control task, security control, input and output of volumetric data, device interaction, as well as the possibility of using available real-time operational systems.

Keywords: logic control, computing platform, IT-technology, programmable logic controller, industrial automation, intelligent hardware device, high-speed communication protocol, wireless access, operational system.

The use of software-implemented logic controller to implement a logic control problem. Most of the world leaders in the field of logic controllers have software-implemented logic controllers in the list of automation tools. This trend is directly related to the use of general-purpose computing platforms as a hardware base. To implement the principle of "controller based on a computer" it is necessary to have a hardware calculator and software. In this case, the logic controller software at the system level implements the controller's cycle. Among the world leaders in the field of industrial automation, which have software-implemented controllers, one can distinguish: Siemens, with the S7-1500 Software Controller, Bosch-Rexroth, with the Soft Control product, Rockwell, with the SoftLogix controller, etc.

Use of specialized hardware tools to implement security controls. Modern automatic control systems must be equipped with emergency protection tools (EPT). The specified type of systems must be implemented in accordance with GOST R IEC 61508-1-2007 (international standard IEC 61508-1: 1998, Functional safety of electrical, electronic, programmable electronic safety-related systems) [1]. EPTD systems imply yellow marking of hardware, the presence of devices for direct opening of electrical circuits (for example, emergency fungus), duplication and redundancy of critical processes and security processes, the implementation of algorithms for verifying critical calculations, the use of a specialized industrial data transfer protocol, which assumes guaranteed packet delivery over a specified period of time (e.g. Safety over EtherCAT protocol). In contrast to Russia, European and American legislation imposes rigorous requirements to the developers of control systems regarding the use of emergency protection systems, and therefore the "Safety" systems of Western manufacturers differ in wider functionality.

Use of intelligent hardware input/output devices. In modern conditions of technology development, there is a constant increase for data received from the control object, which is a reflection of the Industry 4.0 concept, one of the fundamental features of which is working with Big Data. This approach involves processing information at all stages of working with it, including directly at the control facility. Until recently, in logic control systems, pre-filtering and signal processing were performed only for analog input types. In modern control systems, it became possible to use hardware inputs/outputs, which have additional functions that significantly expand the intellectual capabilities of information processing directly at the control object. The capabilities of intelligent input/output devices include the following: filtering input signals and eliminating contact bounce effects, support for specialized communication protocols with sensors (for example, EnDat), the ability to combine various types of inputs/outputs into single groups for preliminary processing of incoming information, etc.

Use of high-speed communication protocols based on Ethernet technology. At present, passive devices for organizing inputs/outputs are available on the market, which support data exchange using one of the standard high-speed communication protocols using Ethernet technology, which at the physical level of industrial systems has become the de facto standard. These devices are an order of magnitude cheaper than standard PLCs because they do not contain intelligent modules capable of organizing the processing of equipment control algorithms. If the logical controller, based on the control system is implemented, supports a standard high-speed communication protocol, then a number of passive hardware input/output modules, including those located at a considerable distance from the main elements of the control system, can be connected to it, and thus organize a full-fledged logical control system. The world leading manufacturers of control systems support one of the most common high-speed industrial communication protocols.

Distributed principle of building logical control systems. Distributed Control System is a solution in the design of control systems that appeared at the end of the last century due to: an increase in the number of parameters (sensors) controlled by a control object, an increase in the territory on which individual elements of a control object are located, as well as complication of control algorithms. Modern distributed control systems, in addition to basic functions, allow implementing:

- One or more high-speed communication protocols for connecting remote hardware input/output O modules.
- Multi-rank industrial networks on the “master-slave” principle, which allows controlling heterogeneous technological equipment within a single system with the ability to distribute control functions between nodes within the specified network.

• Work in local and global computer networks. The controller, which provides support for Ethernet technology and implements the TP/IP protocol, is capable of operating within the corporate computer network. In this case, support is provided for working with standard network hardware devices (switches, routers, gateways, etc.), which allows implementing, including, a multi-rank network.

• Support for wireless access. At present, a useful option for the hardware platform of controllers is support for wireless access (for example, Wi-Fi). This allows, using mobile terminals, access to auxiliary functions of logic control systems, such as configuration, setting, setting of constant values, etc. In this case, the operator, having one mobile terminal, can perform preventive maintenance of automation units one by one.

• Possibility of remote loading and debugging of logic control programs, which allows implementing a single terminal from which a logic control program is debugged for a group of systems, usually located within the same workshop.

Use of real-time operating systems. There are a number of real-time operating systems available in the system software market today that are installed on general-purpose computing platforms. As a result, a full-fledged logic controller is obtained, which is used as a node of automation systems for solving a wide range of tasks. As such operating systems, Siemens uses Windows 7 version Legasy (adapted version for Siemens controllers with real-time extension) and Embaded, Rockwell Automation - Windows 10 IoT, B&R - Windows 7 Embaded, Windows 10 IoT, Debian 8, Russian company Fastwell – Windows XPe, Linux RT, QNX [2], etc. The specified operating systems (OS) support, among other things, real-time operation on mobile platforms. Open source real-time operating systems (RTOS) are developing rapidly, dynamically and faster than highly specialized operating systems designed to work with specific hardware options. When using publicly available RTOS in industrial control systems, it is necessary to take into account the legal aspect, according to which a license for an RTOS can only be purchased by control system developers who sell ready-made equipment with pre-installed OS to end users. Sale and resale of the OS separately from the finished device is not possible. The use of a publicly available RTOS offers a number of advantages, among which the following can be highlighted:

• Work in a familiar user interface based on windowed applications when designing and debugging program code. Most RTOS systems have analogs among general-purpose operating systems (for example, Linux - Linux RT, Windows - Windows Embaded, etc.), in which applications can be developed and debugged. The user's style of work will not differ from the style of work with home PC and will be intuitive. At the same time, standard libraries of elements are available for programmers of interface applications (for example, operator terminals), which greatly facilitate development. For general-purpose operating systems, the

instrumental support of software development is at a high level, there are well-proven development tools, including hose used for large projects [3].

• Use of unified execution environment in which the main functional modules of the control system operate. In the frame of single execution environment, the operation of the logical control kernel, operator terminal, programming subsystem and other modules is assumed, one of the standard mechanisms (shared memory, TCP / IP protocol on the local bus) provides the interaction of which.

• OS installed in hardware management systems has a long sales and support cycle. On average, based on data from various RTOS vendors, a full support cycle lasts about fifteen years since the last update was released. At the same time, full support with the provision of development tools and licenses lasts about ten years, then partial support is provided, which includes the transfer of critical updates and the availability of licenses limited in time. However, the use of RTOS in the frame of control systems also has its drawbacks, which include the following:

References

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