PROGRAMMABLE LOGIC CONTROLLER AND SCADA SYSTEMS FOR THE CONTROL OF AUTOMATED PRODUCTION DEVICES

Avliyakulov Khayot Nodirovich –
probationer teacher
Bukhara Engineering-
Technological Institute

Annotation. The article is devoted to controllers and control systems for managing automated production devices.

Keywords. programmable logic controller, SCADA systems, logical command, control the process

Automation of production is becoming more and more widespread. Often this is understood as the replacement at some stages of production (and sometimes completely), manual labor for the performance of this work by automated systems. This leads to an improvement in the quality of products, an increase in the speed of its production and, ultimately, an increase in economic benefits. Recently, more and more prerequisites appear to increase the scale of this process, some of which are:

• understanding by the manufacturers themselves about the need to automate their production

• a significant reduction in the cost of implementing the implementation of automated systems, thanks to the development of modern technology and science.

The hardware basis for automation systems can be industrial computers, PCs, PLCs (programmable logic controllers). Of particular interest are PLCs, which have sufficient computing power to solve most production tasks.

PLC

The programmable logic controller (PLC) (eng. Programmable Logic Controller, PLC) is the basis for automated systems, performing the tasks of a control device. The PLC is a real time device. The main mode of long-term operation of the PLC, often in adverse environmental conditions, is its autonomous use, without serious service and with little or no human intervention.

Figure 1. PLC SIMATIC S7-300 (SIEMENS).

The PLC has the following features

• Has advanced devices for input-output of signals from sensors and actuators

• Installed separately from the equipment it controls

Sensors and actuators are connected to the PLC:

• Centralized. I/O modules are installed in the PLC basket. Sensors and actuators are connected directly, or with the help of matching modules, to the inputs/outputs of signal modules

fourteen.

• According to the method of distributed peripherals, when sensors and actuators are located remotely from the PLC and are connected to it through communication channels and, possibly, expansion modules using a Master-Slave connection.

The PLC in its composition does not have advanced interface tools, such as a keyboard and display. Programming, diagnostics and maintenance of the PLC is carried out by programmers connected for this purpose - special devices or devices based on more modern technologies - a personal computer or laptop, with special interfaces and with special software (for example, SIMATIC STEP 7 for the SIMATIC S7-300 PLC or SIMATIC S7-400). In process control systems, the PLC interacts with various human-machine interface (HMI) system components, such as operator panels, or PC-based operator workstations, often industrial, usually via an industrial network.

In control systems for technological objects, logical commands prevail over numerical operations, which makes it possible, with the relative simplicity of the microcontroller (8 and 16 bit wide bus), to obtain powerful systems operating in real time. In modern PLCs, numerical operations are implemented on a par with logical ones. At the same time, unlike most computer processors, the PLC provides access to individual bits of memory.

SCADA systems

SCADA system (abbr. from the English Supervisory Control And Date Acquisition, Supervisory control and data collection) is a system for monitoring and controlling the process using a PC. The process can be technological, infrastructure or service:

• Technological processes include - production, generation
energy, design, processing. It can proceed in continuous, batch, periodic or discrete modes.

• Infrastructural processes can be public or private and include: water treatment and distribution, wastewater collection and treatment, oil and gas pipelines, power transmission and distribution, civil defense public address systems, and large communication systems.

• Processes in the service sector have both private and public sides—buildings, airports, ships, and space stations. They control and manage HVAC (climate control), energy access and consumption.

A SCADA system usually contains the following subsystems:

• Human-machine interface (HMI, eng. Human Machine Interface) -
a tool that presents process progress data to a human operator, allowing the operator to monitor and control the process.

• Dispatch system - collects process data and sends commands to the processor (control).

• Subscriber terminal unit, or RTU (Remote Terminal Unit), connected to the process sensors, converts the signal from the sensor into a digital code and sends the data to the dispatching system.

• Programmable Logic Controller

• Communication infrastructure for industrial network implementation fifteen.

The term SCADA usually refers to centralized systems for monitoring and controlling the entire system, or systems complexes located in large areas (between the industrial plant and the consumer). Most control actions are performed automatically by the RTU or PLC. Primary management functions are usually limited to levels of withdrawal or control intervention. For example, a PLC can control the flow of cooling water within a part of a manufacturing process, and a SCADA system can allow operators to change flow parameters and set alarm conditions such as loss of flow and high temperature to be displayed and recorded. The closed loop control loop goes through the RTU or PLC while the SCADA system controls the complete execution of the loop.

Data collection starts at the RTU or at the PLC level and includes - meter readings and equipment failure reports (alarms or alerts) connected to the SCADA as needed. Further, the data is collected and formatted in such a way that the control room operator, using the HMI, can make control decisions - to correct or interrupt the standard control of the RTU / PLC facilities. The data can also be placed in a History, often based on a DBMS, for trending and other analytical processing of the accumulated data.

SCADA systems are typically equipped with a distributed database, often referred to as a tag database. This database contains data elements called tags or points. A tag (point) is a single input or output whose values are controlled or adjusted in the system. Tags can be hardware (hard) (external) or software (soft) (internal).

A hardware tag represents the actual input or output within the system, while a software tag is the result of mathematical and logical operations on the values of other tags. Most system implementations remove the conceptual distinction between "soft" and "hard" tags by making each property in an expression a software tag, which can, in the simplest case, equal a single hardware tag. Tags are usually stored as value-timestamp pairs: the value, and the timestamp is the time the event was logged or computed. A series of value-timestamp pairs represents the chronology of a given tag. It is also common to store additional metadata with tags, such as the path to a field device or PLC register, design-time comments, and signal information.

SCADA systems solve a number of tasks:

■ Data exchange with USO (devices for communication with the object, that is, with industrial controllers and input / output boards) in real time through drivers.
■ Processing information in real time.
■ Displaying information on the monitor screen in a form that is convenient and understandable to humans.
■ Maintaining a real-time database of process information.
■ Alarm and alarm message management.
■ Preparing and generating progress reports.
■ Implementation of network interaction between SCADA PCs.
■ Providing communication with external applications (DBMS, spreadsheets, word processors, etc.).

Figure 2 shows an example of one of the process windows in the SCADA system (Screen).

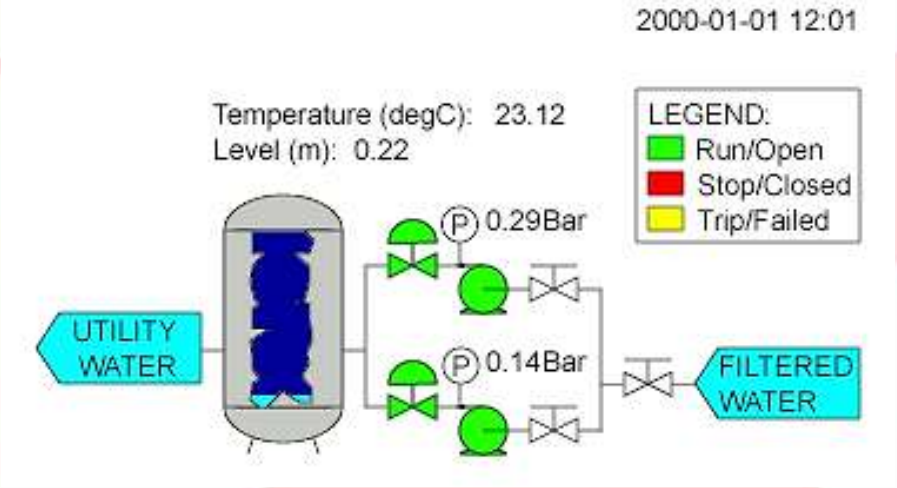

Figure 2. An example of one of the process windows in a SCADA system.

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