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Information Technology, Automation and Robotics

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RESEARCH OF THE LOGO! MICROCONTROLLER PROGRAMMING SYSTEM

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Abstract

In this scientific paper the programming system of the microcontroller LOGO! is considered. To design a switching program written in a programming language, a programming system is used. A programming system is software designed for the development of an ACS (automatic control system) and written in a specific programming language, which is developed by manufacturers of controllers and microcontrollers (or firms specializing in creating software for automation systems). Programming of controllers and microcontrollers recorded in IEC 61131-3 languages is carried out using specialized software. Microcontroller LOGO! (logical Siemens controller) is programmed using FBD (function block language) or LAD (relay ladder language) using the LOGO! Soft Comfort. In the research part of the scientific project, the microcontroller LOGO! Programming system is considered.

The LOGO Soft Comfort program is used for programming microcontrollers LOGO! via a PC (personal computer). The program allows you to create a microcontroller switching program (in the programming language of the international standard IEC 61131-3), in the form of a diagram (diagram) of functional blocks (FBD - Function Block Diagram) or in the form of a relay-contactor circuit (LAD - Ladder diagram). The functionality of the circuit program can be tested on a personal computer in emulation mode, which does not require a connection to the LOGO! Microcontroller. In the research part of the scientific work, the switching program Automatic control system for internal lighting is considered.

The program allows you to create a microcontroller switching program (in the programming language of the international standard IEC 61131-3), in the form of a diagram (diagram) of functional blocks (FBD - Function Block Diagram) or in the form of a relay-contactor circuit (LAD - Ladder diagram). The functionality of the circuit program can be tested on a personal computer in emulation mode, which does not require a connection to the LOGO! microcontroller. In the research part of the scientific work, the switching program Automatic control system for internal lighting is considered.

Introduction

A feature of the modern development of production is the emergence and massive use of qualitatively new technical means that reduce human participation in the production process. At the same time, these funds allow increasing the intensity of the production process, reducing costs and expenses, as well as almost completely eliminating errors caused by the so-called human factor.

Modern industrial automation systems allow solving a wide range of tasks, which can be divided into several groups with their own characteristics:
- Automation of control of technological processes (ACS TP);
- Interaction of the system by the dispatcher (operator);
- Automated control and measurements (monitoring);
- Security;
- Remote control, measurement, signaling (telemechanics tasks).

To solve the problems listed above, high-level universal programming languages and a team of professional programmers were initially used. However, practice has shown extremely low efficiency of such development. It turned out that the development of the system should be carried out not by programmers, but by specialists of the subject area that needs automation, i.e. technologists, as well as system integrators who carry out complex implementation of the system.

The emergence of the IEC 61131 - 3 standard for programming languages for controllers in 1993 was a big step towards the creation of open automation systems and provided a reduction in development costs, shorter lines, improved implementation of automation algorithms and the possibility of detailed study of programming languages suitable for any controller. IEC 61131-3 established the standards for five programming languages intended for professionals in a variety of non-programming professions.

At present, custom programs are naturally ousted from the industrial automation market by means of programming controllers in the languages of the IEC 61131-3 standard.

Programming of controllers and microcontrollers in the IEC 61131-3 languages described above is carried out using specialized software, which is developed by manufacturers of controllers and microcontrollers specializing in design of software for automation systems [1].

Микроконтроллер LOGO! позиционирует данное устройство как «интеллектуальное реле», позволяющее строить несложные системы автоматизации. Ниже на рис.1 приведен микроконтроллер LOGO! .

Fields of application of LOGO! microcontroller

Siemens LOGO! includes the logic modules LOGO! , digital input / output modules DM8 / DM16, analog input / output modules AM2 / AM2 AQ, CM communication modules, silent switching modules for 3-phase AC circuits LOGO !, LOGO! power supplies, accessories and LOGO! Soft Comfort software. For more demanding applications, there are modifications of the LOGO! modules.

The LOGO! microcontroller is designed to solve the simplest problems of automatic control; software implementation of control algorithms and flexible adaptation of the equipment to the requirements of the tasks being solved, allow using logic modules in all sectors of industrial production.

LOGO! microcontroller positions this device as a "smart relay" that allows you to build simple automation systems. Fig. 1 below shows the LOGO! microcontroller.

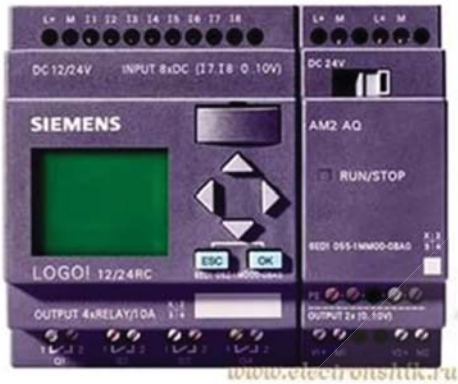

Fig. 1 . LOGO! microcontroller

As examples of such systems can be garage doors, staircase lighting, traffic light control, and simpler systems that include several actuators and controls (buttons and switches). Fig. 2 below shows the LOGO! with additional module [2].

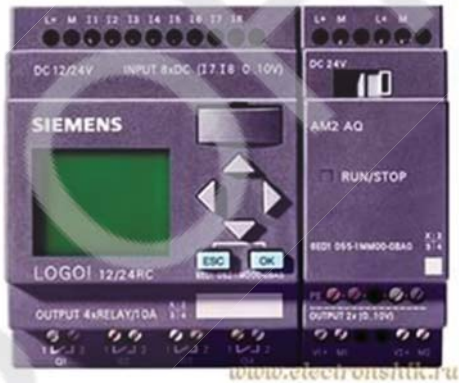

Fig. 2. LOGO! microcontroller with additional module.

Programming the LOGO! microcontroller

The LOGO! Soft Comfort is designed for programming the LOGO! microcontroller using a PC (personal computer). The program allows you to develop a switching program in the language of the international standard IEC 61113-3, in the form of a function block diagram FBD (Function Block Diagram) or in the form of a relay-contactor circuit LAD (Ladder diagram). The introduction of the IEC 61113-3 controller programming language standard in 1993 was a major step towards open automation systems and reduced development costs.

The standard was originally called IEC 1131-3 and was published in 1993. But in 1997 IEC switched to a new notation system and the number “6” was added to the name of the standard.

IEC - International Electrotechnical Commission - a world organization that has been developing international standards in the field of electrical engineering, electronics, telecommunications and information technology since 1906; in 1975 the working committee 65A for the development of a PLC (programmable logic controller), which in 1993 adopted an international standard IEC - 1311 (currently IEC 61113-3), the third part of which deals with languages for PLCs. It includes five languages.

FBD (Function Block Diagram) - Function Block Diagram Language is a graphical, functional programming language that uses analogy with digital diagrams. A program in this language is a collection of functional blocks connected by lines). FBD languages are chosen by specialists in automatic control systems (ACS) and circuitry**.**

LAD (Ladder diagram) relay program language is a graphical language, the program in which is an analogue of a relay-contactor circuit. The LAD language is chosen by specialists with experience in relay logic.

SFC is a language of sequential functional diagrams, (is a graphical language in which a program is described as a sequence of steps united by transitions. This language is convenient when you need to describe a sequence of relay operations spaced out in time and check the conditions that arise for their execution).

ST - structured text language, (is a high level text language (BASIC, Pascal).

IT- the language of system commands.

Programmers tend to choose IL (similar to assembler language) or ST (similar to high level language).

LOGO! Soft Comfort in IEC 61113-3 or FBD (Function Block Diagram) programming language is designed to program the LOGO! microcontroller.

LAD (Ladder diagram) are graphical programming languages.

Development of switching programs for logic modules LOGO! can be performed using the LOGO! Soft Comfort. LOGO! Soft Comfort runs on Windows 95/98 NT 4.0 / ME / 2000 / XP, Linux, MAC OSX operating systems.

It can be used in client / server applications and provides maximum convenience for developing, debugging, documenting and archiving LOGO! (and also in an interactive mode).

Program development and debugging can be performed automatically without communication between the computer and LOGO! as well as in the interactive mode. In the latter case, the connection between the computer and the logic module is established using the PC-LOGO! connecting cable.

The finished program can be loaded into the memory of the logic module via the LC cable (PS-232 interface). Below is an example of a commutation program in FBD (Function Block Diagram) language.

LOGO! Soft Comfort

- develop programs for logic modules LOGO! Soft Comfort
- develop, debug, document and archive LOGO! Soft Comfort programs in both automatic and interactive mode.

- use LAD (Ladder diagram), FBD (Function Block Diagram) languages for program development.
- Configure the parameters of modules and used functions.
- Carry out a quick view of all or some parts of the program.
- Use symbolic addressing for inputs, outputs and functions. Introduce for all variables and functions.
- Simulate the work of the LOGO! on the computer. Load the finished program into the logical module or read the program from the memory of the logical module.
- Display the connection of all variables and functions in the modulation mode of the program or during the program in the logical module.

LOGO! Microcontroller programming system.

A programming system is software designed for the development of an ACS (automated control system) and written in a specific programming language, which is developed by manufacturers of controllers and microcontrollers. Microcontroller LOGO! programmable in FBD (Function Block Language) or LAD (Ladder Language) using the LOGO! Soft Comfort.

To develop and debug programs, the LOGO! Soft Comfort is designed. This software package allows you to graphically enter and edit the program, as well as debug the program in the logic module emulation mode. The finished program can be loaded into the memory of the logic module via a special cable or written to the memory module via a special device LOGO !.

LOGO! Soft Comfort provides a well-designed operating environment in which it is convenient to display and change the circuit program. Using the function panel, you can call connections, basic and special functions and simply drag them into the program, move them, and combine them in any order. In emulation mode, you can check and debug the created program. It is possible to add your comments not only to the inputs and outputs, but also to the function blocks.

LOGO! Soft Comfort runs on Windows 95/98 / NT 4.0 / ME / 2000 / XP, Linux and MAC OS X operating systems. It can be used in server applications and provides maximum convenience for developing, debugging, documenting and archiving LOGO! .

Programming of LOGO! modules can be performed from the keyboard using the built-in display. The programming process is reduced to the serial connection of the built-in function blocks and setting the settings (on / off delays, counter values, etc.). All these operations are performed using the built-in menu system. The finished program can be copied to the memory module [3].

Development of the switching program for an automatic interior lighting control system.

LOGO! Soft Comfort allows you to design a switching program. In the scientific paper, the switching program of the automatic control system for interior lighting is considered.

The automatic control wiring diagram of indoor lighting and its description. (Fig. 3)

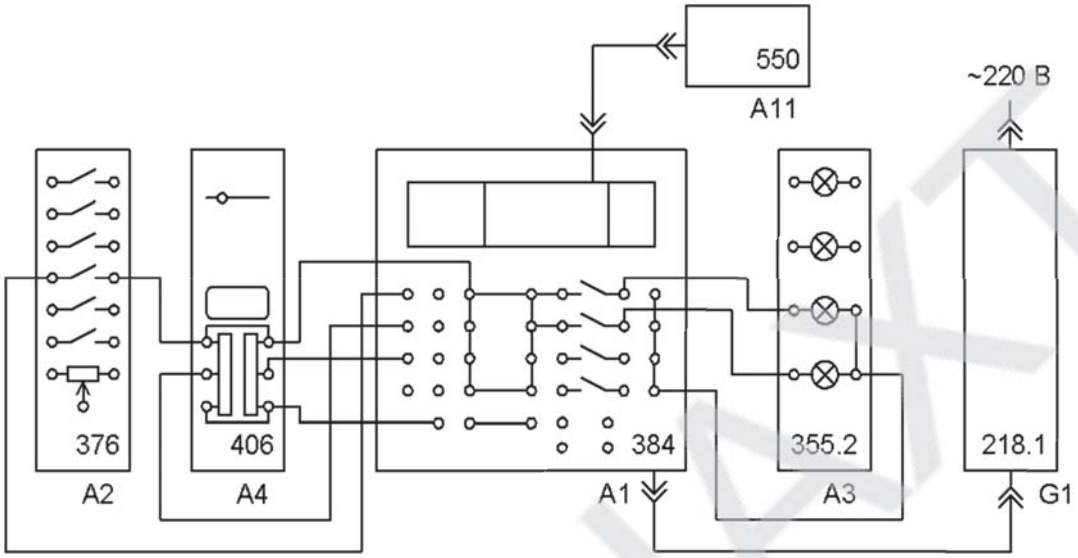

Fig. 3. Basic electrical diagram.

The single-phase power supply G1 is designed to safely supply the A1 programmable controller unit.

Computer A11 is connected with a cable to the connector on the front panel of the controller and is intended for downloading and debugging the switching program. The locking button of the A2 control station is designed to turn on (turn off) the system.

The block of optical switches A4 simulates an illuminated room with a moving object (person).

The lamps in block A3 simulate lighting lamps.

Algorithm of the internal lighting control system

1) The system is switched on (off) by a locking button.

2) When the object crosses the beam of the optical switch, the zone illumination is turned on. When the object crosses the beam of the next optical switch, the illumination of the zone is stopped and the illumination of the next zone is turned on.

The switching program of the automatic interior lighting control system is designed in the language of the international standard IEC 61113-3, in the form of a diagram of functional blocks FBD (Function Block Diagram).

After designing the switching program for the automatic interior lighting control, the LOGO! Soft Comfort will take the form shown in the figure.

FBD diagram of the interior lighting control system.

FBD diagram of the interior lighting control system. (Fig. 4)

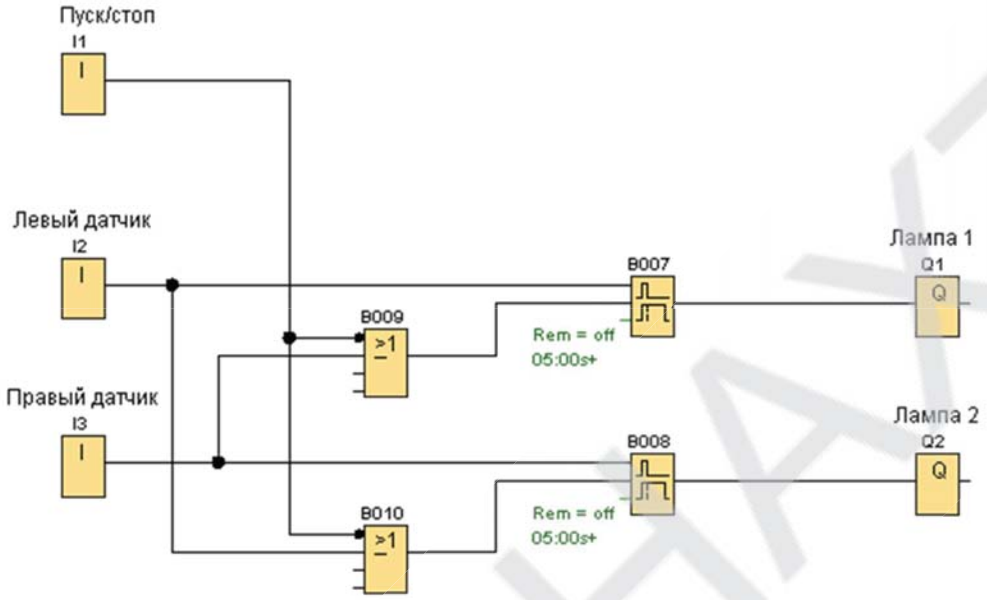

Fig. 4. FBD diagram of the interior lighting control system.

The functions listed in the table are used in the switching program. (Table 1)

Table 1

I	**I1 –** input (Co list). Controls system on / off (0 - off, 1 - on). I2, I3 – sensor signal inputs 1 (left sensor of block A4) and 2 (right sensor A4). The signal is 1 when the sensor is triggered.
≥1	**B009, B010** – OR function (list GF).
	B007, B008 – off delay (list SF). The top input is the relay start (the relay output is set to 1 and remains in this state after the input pulse transitions from 1 to 0 for the set delay of 5 s), the second input from the top is reset (the output is immediately set to 0).
Q	**Q1, Q2 –** programmable controller outputs (Co list). The lighting lamps of zones 1 and 2 of the sensors are controlled, respectively.

I1 – input (Co list). Controls system on / off (0 - off, 1 - on).

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Q1, Q2 – programmable controller outputs (Co list). The lighting lamps of zones 1 and 2 of the sensors are controlled, respectively.

The point near the input of the function denotes the inversion of this signal (logical NOT operation).

Description of the switching program

- when the system is off (the signal at input I1 is 0) through the inverting inputs the OR function (B009, B010) to the reset inputs of the delay functions (B007, B008) 1 is applied. The outputs of the delay functions and the controller outputs are in state 0 (off).

- when the system is turned on (1 is at input I1), the signal is removed from the reset inputs of the delay functions (B007, B008).

- in the absence of signals from optical switches (0 is at inputs I2, I).

- outputs of off-delay functions and controller outputs are off.

- when a signal from one of the optical switches (1 at input I2 or I3) appears 1at the input and output of the corresponding off-delay functions (B007 or B008). The controller output contacts (Q1 or Q2) close the power supply circuit of the "zone" lighting lamp of the corresponding optical switch. At the same time, a signal is given to reset the off delay of another lamp (second from top input B007 or B008).

- when the optical switch is turned off (the "object" has left its area of action), the lamp continues to burn for the set delay of blocks B007 and B008 (5 s), or instantly turns off when the optical switch of another channel is triggered [4].

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The collection includes student works of the participants of the competition, which were not included in the number of prize-winners. The texts of the competitive works are published in the form in which they were submitted by the authors. The authors of the articles are responsible for the content and form of submission of the material.

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