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FUNCTIONAL MODEL OF A SOFTWARE-IMPLEMENTED CONTROLLER

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Abstract:

The article covers the requirements for software-implemented logic controllers, the analysis of the controller's functionality with construction of functional model has been carried out.

Keywords: Software-implemented controller, Soft PLC, functional model, technological equipment.

Development of computer technologies allows releasing computing resources from real-time control and provide the end user with additional capabilities (services) in the field of equipment diagnostics, object visualization, electrical automation control, etc.

Design, development and analysis of the operation of software-implemented logic controller, which solves a wide range of production and technical problems, requires the use of specialized description and analysis tools. It is proposed to use the IDEF0 methodology as a toolkit for the initial study of the controller's functionality and structure. IDEF is the abbreviation for ICAM Definition (Integrated Computer Aided Manufacturing). The chosen methodology allows modelling the functional of the control system with the representation of the model in graphic notation. The focus of IDEF0 on the subordination of objects allows considering the logical relationships between the functions of the system, without taking into account their sequence in time.

To build a functional model of the Soft PLC controller operation, it is necessary to systematize and describe the full set of implemented functions (**Error! Reference source not found.**). To do this, it is necessary to select the following: input and specialized data received by the function; the result of the function in the form of output data; software-implemented controller module that will implement the function

Table 1
Systematization of functions implemented by the logical control system

Function	Input data	Outputs	Specialized data	CS module implementing the function
Logic control program development	- Initial conditions	- Logic control program; - Configuration of hardware inputs / outputs;	- Technical task; Basic electrical scheme.	Development environment for logic control programs
Development of a custom subroutine -	Description of a custom object	- Custom subprogram	-	- Development environment for logic control programs
Hardware input/output configuration	Development - input/output mapping table	- Hardware input/output configuration	-	Hardware input/output configuration module
Debugging the logic control program	- Logic control program	- Error	- Test methodology	Development environment for logic control programs

Logic control program execution	- Logic control program; - Configuration of hardware inputs / outputs; - Data from hardware inputs / outputs; - Error;	- An error in the program; - Data on the operation of the system; - Data on hardware inputs; - Logic control program	-	- The module for the implementation of the logical control cycle
Saving the program to the file system	- Logic control program	- Logic control program	-	File system
System operation visualization	- System operation data	- Error	-	Supervisory control system
Exchange with the upper level control system	- System operation data	- Error	-	Upper-level control system
Remote diagnostics	- System operation data	- Error	-	Remote diagnostics and configuration system
Exchange with hardware;	- Data to hardware inputs	- Data from hardware outputs; - Error	-	- Hardware inputs / outputs

Because of the analysis of the functional of the logical control system, a functional model of the system in the IDEF0 notation was developed (Figure 1. Functional model of logic control systems in IDEF 0 notation

The logical control system is presented as a set of functions interconnected by links. "Black box" indicating the inputs, outputs, specialized data and the logic control module responsible for the implementation of the function represents each function. Input arrows come to the left edge of the function activity, arrows indicating specialized data - to the upper edge, an arrow indicating the system module - to the lower edge, exit arrows - to the right edge.

Functional modeling allows the following: to highlight the main functions of a software-implemented controller; to bind functions to individual components of a software-implemented controller.

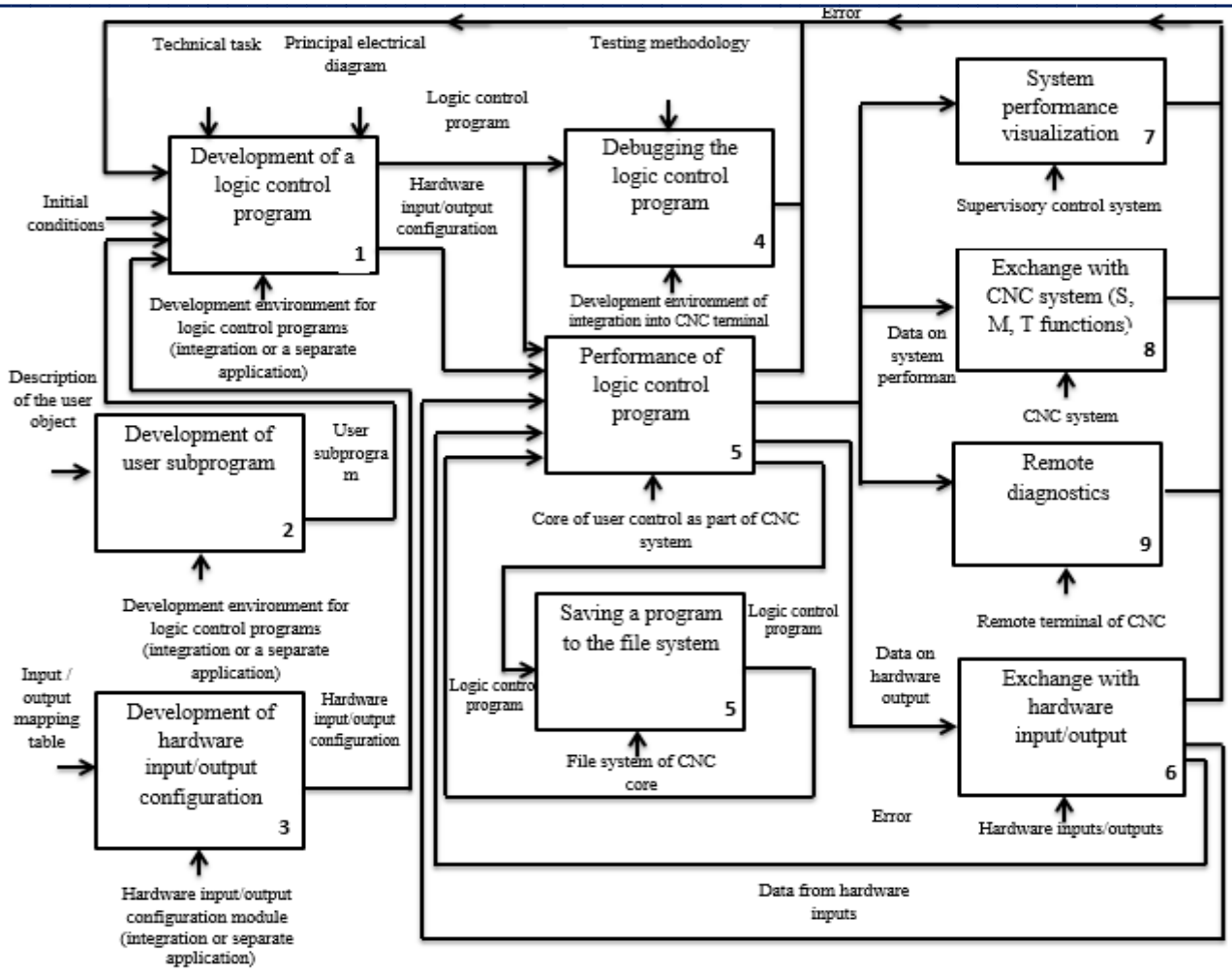

Figure 1. Functional model of logic control systems in IDEF 0 notation

Based on the simulation results, the following features can be noted:

- in order to develop a logic control program, it is necessary to have a technical assignment and a schematic electrical diagram of technological equipment, as well as to determine the initial conditions for the operation of the system;
- developed logic control program must contain user subprograms and configuration of hardware inputs/outputs;
- configuration of hardware inputs/outputs is created based on table of linking the inputs/outputs of technological equipment to the inputs/outputs of the control system;
- debugging of the logic control program is carried out according to the testing method;
- the execution of the logic control program is carried out in the module for the implementation of the logic control cycle;
- visualization of the operation of the software-implemented controller is carried out in the supervisory control system (SCADA - Supervisory Control And Data Acquisition);
- CNC system can act as a upper-level control system for a software-implemented controller;
- for remote diagnostics and configuration, a specialized application is used that is not included in the main package of the software-implemented controller;
- all the main modules of the software-implemented controller are closed by feedback by error.

The proposed approach allows automating technological equipment without the use of expensive hardware. The greatest advantages are provided by the use of a software-implemented controller in control systems, which initially included an industrial computer (for example, CNC systems); in this case the Soft PLC controller is embedded in the software and mathematical support of the control system.

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