AUTOMATED CONTROL SYSTEMS LOAD-CARRIED CRANES

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An automated control system for cranes is considered. A detailed description of the components of the ACS and the principles of their interaction in the form of structural diagrams is presented. Features of the SCADA system that implements: data visualization, archiving of all variables, the ability to receive reports on the operation of the crane for the selected period, the status of individual subsystems for a certain period of time, the frequency of the inclusions are considered.

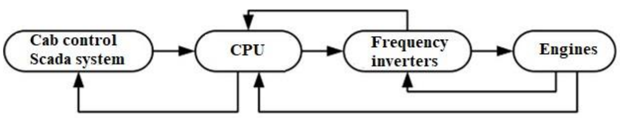
Keywords: Automated control system, microcontroller, a frequency converter, SCADA-System.

1. INTRODUCTION

The beginning of human use of lifting mechanisms refers to the most ancient times. A characteristic feature of all lifting equipment of the time is the use of wood for large units and parts, as well as manual drive, which replaced man's work only from a part. Modern cranes, built with the use of the most advanced technical solutions, continuously participate in the technological cycle and are one of the "indispensable" means of automating various technological processes of enterprises.

2. BASIC CONCEPT

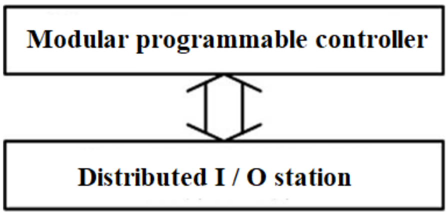
In general, the automated control system of the modern crane is presented below:



The control cabin is an automated crane operator's place intended for the supply of control signals by means of special joysticks to the central processor, as well as for monitoring the basic technical characteristics of the crane and technological parameters of the process with the help of a multimedia-diagnostic and information SCADA system. As a SCADA system, Simatic WinCC software is used, which has a powerful messaging and variable messaging system.

In addition to the visualization function, the SCADA system implements a different set of functions, such as archiving of all variables (including parameters of electric drives, information coming from sensors, mechanisms and crane devices), technological, emergency events, cents about the operation of the crane for the selected period or about the state of the individual subsystem for a certain period of time (for example, the trends of electric drive loads, the parameters of the electric network, the frequency of inclusions in percentages, etc.).

The central processing unit (CPU) is shown below:



3. CONTROLLER DESCRIPTION

Most often as a program controller, the Simatic S7-300 / 400 modular controllers are used in conjunction with distributed I / O stations. Controllers have a modular structure and include the following components:

♦ CPU module (the CPU is selected depending on the level of complexity of the problem being solved);

♦ power supply modules that provide power to the controller from an alternating current network with a voltage of 120 / 230V or from a 24/48/60 / 110V DC source;

♦ Signal modules for input and output of discrete and analog signals:

♦ communication processors, for connection to the PROFIBUS network;

♦ Functional modules capable of independently solving the tasks of automatic control;

♦ interface modules, which provide the possibility of connection to the base unit of expansion racks.

In cranes of a simpler design, the CPU unit is replaced by a relay control circuit, and the control unit (joystick) cab is replaced by an electronic system. The radio-electronic system is represented by a radio receiver and a radio transmitter operating at a certain frequency.

4. FREQUENCY CONVERTER DESCRIPTION

The block of frequency converters is designed for smooth adjustment of the speed of short-circuited lifting motors, movement of the crane, etc. in the entire range of its variation by changing the frequency of the motor supply voltage. The frequency converter is connected to the programmable controller by hardware using the PROFIBUS process bus and programmatically by assigning an address to the corresponding module. This connection involves blocking the operation of the control system in the presence of an error in any of the frequency drives (feedback between the frequency converter and the central processor).

The use of frequency converters in combination with a programmable controller for the control of cranes has several advantages:

♦ Improved positioning accuracy due to low minimum speed;

♦ Reduced mechanical impacts due to smooth start and stop:

♦ the possibility of using both a nominal minimum speed and a nominal speed limit;

♦ Reduction of brake wear due to electric braking;

♦ increase the productivity of the crane.

♦ the ability to program both separately and simultaneously an hourly

When programming the control system of the crane, high-level languages S7GRAPH are used. S7HiGraph, S7SCL, as well as additional software that allows you to embed one design environment into another, for example, the Borland programming environment for C and C ++ programming languages in the STEP 7 development environment. For cranes working in areas where the main requirement is to perform management tasks with increased reliability and efficiency. specialized highly reliable control systems are used.

Hardware and software redundancy is introduced, allowing to eliminate component errors in the central processor, software errors, processor bus interruption, etc. A software redundant system includes two central processing units that are connected via a bus system (MPI, PROFIBUS or Ethernet) and a redundant user program that is loaded into both processors.

The main principle of software backup is that part of the program, which must be performed with increased reliability, is loaded both into the main controller and to the backup one. While the CPU of the main controller processes this part of the program, the CPU of the backup controller misses it. This prevents the discrepancy between the two program parts (for example, due to interruptions, different cycle times, etc.).

Fuzzy control systems have become widespread in crane building. Hybrid ACS with fuzzy logic is mainly used in port cranes, which are characterized by increased complexity of the implementation, as well as software. These systems come into effect when the technological processes in which the lifting crane is engaged are very complex or can not be described mathematically, the behavior of the processes is unpredictable or nonlinearities appear, but an experimental study of the operating process is available.

In this case, the control system is built in the form of an integrated system and consists of two main components: traditional formal-logical thinking and fuzzy logic. The system combines analog and discrete models by applying a pair of methods, each of which has its own poles and minuses to solve complex control tasks.

5. CONCLUSION

Thus, classical control methods are used for a completely deterministic control object and a deterministic environment, and for fuzzy information systems and highly complex control objects, fuzzy control methods are optimal. At the same time, the integrator, which is the link between the two methods, is implemented as a software controller and fully "answers" not only for the interaction of methods among themselves, but also for prioritizing autonomous methods for solving the management problem. In the architecture of integrated hybrid systems, the integrator module plays a major role and, depending on the current conditions for finding the solution and the target, selects the various program modules included in the system for operation.

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