AUTOMATED CONTROL OF THE WATER LEVEL IN AN OBJECT BEING CONTROLLED (TECHNOLOGICAL TANK)

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Abstract: The software for the partial-integral-differential (PID) controller for the system of automatic water level regulation in the condensate collector of a steam generator has been developed. It enables the following: to control the water level in the object being controlled (technological tank), to register and store statistics of all the parameters of the system operation in the database, to display the major indexes of the parameter being controlled in the graph of the main parameters, to display the state of the object being controlled with the visualization of all the changes occurring in the diagram of the controlled object.

Key words: software, technological process, pid controller, graph of the main parameters, database, automatic control system, regulated object.

INTRODUCTION

At present, automated industrial management systems of technological processes are subject to active theoretical research. Using a new technological level, researchers have returned to developing models of complex automation of processes, industries and production structures.

Unified open computing systems enable to control decentralized, evolving systems with limited interaction, which are able to support, as required, the mechanism for establishing new connections or deepen their interaction. All the necessary hardware for such systems has already been developed or can be easily developed [1]. System-independent software is actively being developed for these purposes. The main problem is the development of a system of protocols for the functioning of the network. If the solution for the tasks of accounting, marketing and other office applications can be successfully solved with the help of local computer networks, the introduction of the tasks of the automated process control system in this network presents new requirements for its functioning: the ability to work in real time, the maximum priority when working with the object being controlled, the reliability of the communication protocols with objects and the self-testing of the system in the event of the loss of communication with the process being controlled [2].

1. AIM AND TASKS OF THE STUDY

The aim of this study is to develop the software for an automatic process control system in power engineering with the help of partial-integral-differential (PID) controllers of the liquid level in industrial tank used in power engineering. The set of the developed subroutines will eventually comprise unified software for controlling the specified parameter by means of a controller within the automated control system (ACS).

The following are functions of the software:

- Input fields for the numerical values of the parameters to be set;
- Selection fields for the logical values of the parameters to be set;
- Output fields of the calculated numerical parameters;
- Output fields of the calculated logical parameters;
- Prompts for the user for each of the input and output fields;
- Start, stop and shutdown of the system;
- Validation of the entered numerical parameters and prohibition of the entry of incorrect values;
- A schematic display of the control object with visualization of the current position of the controlled value;
- Display of the calculated parameters of the controlled value in the graph of the time dependence;
- Saving all the set and calculated parameters in the database with no possibility of making any changes.

2. ANALYSIS OF THE SUBJECT DOMAIN

The term "controller" comes from the theory of automated control. A controller is a device that monitors the functioning of the object being controlled and produces a certain control action (control signal) constantly analyzing its state. The PID controller is a link in the feedback control loop

used to maintain the set value of the measured parameter. The PID controller measures the deviation of the stabilized value from the set value (the so-called setting) and generates a control signal that is the sum of three summands, the first of which is proportional to this deviation, the second one is proportional to the deviation integral and the third one is proportional to the derivative of the deviation. Let us consider the use of PID controllers as an example of an abstract technological process. The water in the container must be heated and maintained at a certain temperature. For heating the water, a gas burner is used which is under the container. The combustion intensity is regulated by the gas supply valve. The temperature setting is done manually by the operator. The controller analyzing the difference between the setting and the temperature sensor readings generates a signal for controlling the valve supplying gas to the burner [2].

In automated control systems, maintenance of the set value of the controlled parameter or its change according to a certain law is provided by hardware means with a common name - automatic controllers.

As to the type of the controlled parameter, the automatic controllers are divided into controllers of temperature, pressure, humidity, discharge, flow rate, composition, etc.

Digital control algorithms are an essential part of the software of microprocessor controllers. The controllers interrogate the signals from sensors, calculate the values of the control signals according to the given law of control, and then distribute them for the actuators. The sampling time (quantization) varies depending on the dynamic parameters of the process from fractions to several tens of seconds.

At present, it is common to replace analogue control systems with digital control. This is explained by the wide possibilities for implementing the most advanced control algorithms, which, in turn, guarantees high accuracy and good performance in a closed system of direct digital control.

The most common algorithms are PID algorithms for digital control. With proper adjustment, these algorithms provide a high quality control for most objects of industrial technology [3].

3. DESCRIPTION OF THE DESIGN DECISIONS

The functional software for the PID controller used in the power industry has been developed within the framework of this study. This software is developed individually for a specific task and is not a product intended for bulk sale, but it can be used to solve similar tasks when making certain settings and changes.

The distinctive features are the implementation of object control algorithms with precise parameter maintenance, the ability to fine-tune the control process, the ability to set and correct parameters during the program execution, to display the values obtained, to read and store data, and to monitor the state of the object using its displayed model.

The developed software is designed for the PID controller of the water level. The general digital algorithm of the controller is implemented as a sequence of subroutines in Fig. 3.1.

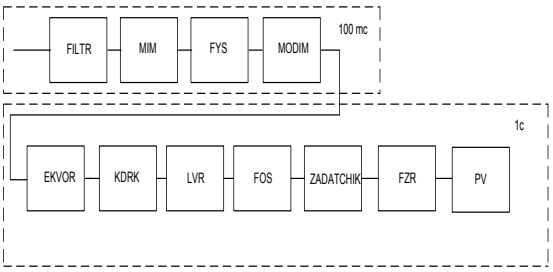

Fig. 3.1 - General algorithm of the controller

4. SOFTWARE CONTROLS

The developed software is designed to regulate the water level in the condensate collector of a steam generator. This software functions in the controller of the automatic control system. The regulation is carried out by controlling the output valve with an electric motor that receives discrete signals from the controller. The controller, in turn, receives the digitized analog signals from the sensor of the condensate collector level. The developed software is presented in the form of an application intended for use in the Windows operating environment.

This software is loaded into the modules of the automatic control system and is designed to control the water level in the condensate collector of the steam generator used in the power industry. In this case, the user of the software is the operator who controls the specified parameter. The application is presented in the form of a window interface convenient for the operator with the ability to enter and display data in different views.

After launching the software, the main window appears to the user. The main application window contains input fields for specifying the necessary parameters for the system. They are presented

in the program window under the general title: "FIELDS FOR ENTERING THE SETTINGS". Entering data into the fields is done after clicking on the field with the cursor. Then the user can enter all the necessary parameters. Input fields accept only numerical values in the format of real or integer numbers. Fields that have the format of real numbers as separators are treated with a period or comma. If you enter two separators, alphabetic characters, undersized or understated values, and negative numbers and if you try to enter the first separator character and other values, the system will generate an error. There is also a limit on the number of decimal places (no more than 4 characters). In all these cases, after issuing an error message, the user can enter a new value.

The value must be entered with the Enter key. Correction of values in fields is carried out by means of the keys "Arrow to the left", "Arrow to the right", Delete and Backspace.

If the value is entered correctly in the data field after pressing the Enter key, the system loads the entered value, and the user watches the displayed changes: the system response to them.

CONCLUSIONS

The functional software for the PID controller, used in the power industry, has been developed. This software is developed individually for a specific task, but it can be used to solve similar tasks when making certain settings and changes. The distinctive features are: implementation of object control algorithms with accurate parameter maintenance, the possibility of fine-tuning the control process, the possibility of setting and correcting parameters during the execution of the program, displaying the received values, reading and storing data, as well as the ability to monitor the state of an object using its displayed model. The developed software provides high-precision adjustment of the level parameter through the implementation of the PID digital control algorithm. Currently, preference is given to digital control systems. This is explained by the wide possibilities for implementing the most advanced control algorithms, which, in turn, guarantees high accuracy and good performance in a closed system of direct digital control. This software, with the introduction of certain adjustments, can be used to control various parameters of technological processes, but individual adjustments and adaptation of the software to the requirements of the consumer are necessary.

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