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Features of Automation of Technological Processes in Oil and Gas Industry

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Abstract

Today, almost any industrial enterprise manages automated process control systems and uses HMI/SCADA software. This integrated software solution is a set of applications that provide a complete set of capabilities for the collection and storage of disparate data, their presentation to employees, subsequent analysis and, on its basis, efficient control of production processes, product quality indicators and fixed assets on-line.

Keywords

Automated Control Systems, Production Processes, Environmental Monitoring, HMI/SCADA Software, İntegrated Software Solution, Application of SCADA iFix System

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1. Introduction

Oil companies of Azerbaijan are giant, geographically distributed multifunctional production and commercial enterprises. They cover the whole chain of oil business: exploration and production, refining and petrochemicals, wholesale and retail. The enterprises have preserved old systems built many years ago. All of them, as a rule, were built in stages and solved only problems at a time when they were developed and implemented. Often, these systems do not take into account modern building principles, such as scalability, flexibility, unification, reliability and openness. This has led to the fact that information about production processes is either unreliable or insufficiently complete, or nonexistent, or inaccessible to decision makers, or available in a form that does not allow the use of modern methods of integrated analysis [1-4].

Supervisory control and data collection (SCADA) is a software package designed to develop or provide real-time systems for the collection, processing, display and archiving of information about a monitoring or control object. SCADA can be a part of automated control systems for technological processes (ACS TP), environmental monitoring system, scientific experiment, building automation, etc. Human machine interface/supervisory control and data acquisition (HMI/SCADA) systems are used in all sectors of the economy where real-time operational control of processes is required. This software is installed on computers and uses input / output drivers or Dynamic Data Exchange interface or object snap-in and implementation (OPC / DDE) servers to communicate with the object. The program code can be written in one of the programming languages or created in a design environment.

2. Formulation of the Problem

Sometimes SCADA systems are equipped with additional software for programming industrial controllers. Such SCADA-systems are called integrated, and the term SoftLogic is added to them. The term SCADA has a double interpretation. The most common understanding of SCADA as an application, that is, a software package that provides these functions, as well as tools for developing this software. However, often under the SCADA-system a software and

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hardware complex is meant. This understanding of the term SCADA is more typical for the telemetry section. The meaning of the term SCADA has undergone changes along with the development of automation technologies and process control. In the 1980s SCADA systems were more often considered as software and hardware systems for real-time data collection. Since the 90s, the term SCADA has been used more to designate only the software part of the human interface and the machine of the process control system.

The highest level of any automated system is, of course, a person. However, in the current technical literature, the upper level is understood as a set of hardware and software that serve as a semi-automatic dispatch node of an automated process control system, the core of which is a PC or a more powerful computer. Man-operator introduces the system as one of the top-level management links. This approach has both positive and negative sides. The positive thing is that the duties of the operator in this case are predetermined in advance, and detailed knowledge of the technological process is not required. In other words, not only a qualified technologist can manage the process. Negative aspects are a consequence of the fact that the flexibility of management is reduced by reducing the impact on the process.

3. Resolving the Problem

In this regard, the developers of the process control system must take into account additional requirements. It is necessary not only to take into account the hardware component of the process, and not only to select the modes of operation of the equipment, but also to develop reliable and correctly operating software. Of course, the best option is to organize the work, when the same team of developers is responsible for both the process map, and for choosing and debugging equipment, and for developing software. In this case, developers should be equally strong in the technology of a particular process, as well as in the use of special equipment and in writing complex management, maintenance and communication programs. However, such a command is difficult to find [5-7].

To simplify the development of the software component of the automated process control system, so-called MM-programs (Man-Machine Interface) and SCADA are currently used. Using these packages allows you to automate the development of software for an automated process control system; Constant monitoring and control of the technological process; Receive and process information about the process in a convenient way.

The most exciting and seemingly simple step in the use of SCADA systems is the simulation of the technological process on the monitor screen. The graphical Windows-like interface of the system is intuitive and simple. To install actuators, motors, valves, tanks, pipelines and other equipment used in the process, just click the mouse. Binding hardware parameters to the needs of the process is also simple, performed with a few mouse clicks. Global and "tactical" process parameters are entered into forms organized as tables or databases. Standard process control elements are installed, monitoring of monitoring sensors is organized. Then you can click the "Start" button and start working with the workflow. This happens in theory or when demonstrating the capabilities of a specific SCADA system. But in practice everything is more complicated.

The development of process control systems using SCADA systems, regardless of the process and specific SCADA package, includes the following main steps:

a. development of the architecture of the system as a whole. The process control system is built in the client-server architecture. The functional purpose of individual automation units and their interaction is determined;

b. create an application management system for each automation node (or rather, an automatic control algorithm for this node);

c. analysis and elimination of emergency situations;

d. consideration of issues of interaction between the levels of the automated process control system; Selection of communication lines, protocols of exchange; Development of algorithms for logical interaction of different subsystems;

e. addressing issues of possible expansion or modernization of the system;

f. creation of operator interfaces;

g. debugging the software and hardware of the system.

All these issues should be solved at the stage of designing and creating precisely the top level of the automated process control system, otherwise situations can arise where different functional modules of the technological process will be difficult to link to a unified management system in accordance with Ideology and technical implementation. Using the SCADA system allows you to successfully complete all the above stages of design and debugging.

SCADA packages consist of several software blocks: access and control modules, alarms, real-time databases, databases and I/O modules and emergency situations.

The main requirement for SCADA systems is correct operation in real time. And the main priority in the transmission and processing are the signals coming from the technological process or on it and affecting its flow. They

take precedence even more than access to the disk or operator operations to move the mouse or minimize windows. For this purpose, many packages are implemented using real-time OS operating systems, but recently more and more developers are creating their SCADA products on the Microsoft Windows NT platform, integrating the RTX (Real Time Extension) subsystems into it. With this approach, you can use Windows NT as a single OS when creating multi-level systems, use the standard Win 32 application programming interfaces (API) functions and create integrated information systems – American Society for Industrial Security (ASIS).

The reliability of the communication drivers is very important. Drivers should be able to protect and recover data in the event of a failure, automatically notify the operator and the communication loss system, if necessary, give an alarm.

SCADA systems support protocols that do not depend on the type of database, so most popular databases can act as a data source: Access, Oracle, etc. This approach allows you to quickly change the settings of the workflow and analyze its progress beyond the Real Time System, Various, specially created for this program.

Applications that include a standard DDE (Dynamic Data Exchange) interface or OLE (object snap-in and implementation) that enable you to include and embed objects. This allows you to use even some standard office applications as a data source, for example, Microsoft Excel.

The input and output of the transmitted data are organized as a system of special function blocks. The current process information is stored in special I/O databases. The input blocks receive information and bring it into a form suitable for further analysis and processing. The processor modules implement control and management algorithms, such as proportional integral derivative (PID) controller, delay, summation, statistical processing; With the help of digital data it is possible to perform operations of Boolean algebra, etc. Output blocks transfer a control signal from the system to the object. For communication with objects, the interfaces RS-232, RS-422, RS-485, Ethernet are widely used. To increase the transmission speed, various methods of data caching are used, which eliminates the overload of low-speed networks. In other words, if two different clients simultaneously request the same data from the server, it sends the controller not two requests, but only one, returning the data from the cache to the second client.

Perhaps the most important moment in creating an automated process control system is the organization of a control system that would ensure the reliability and operational development of emergency situations both in the control system itself and in the technological process. Alarms and the development of emergency situations in the process in most SCADA systems are allocated to a separate module with the highest priority. The reliability of the control system is achieved through hot backup. You can reserve everything: the server, its individual tasks, network connections and separate (or all) communications with the equipment. Redundancy occurs using an intelligent algorithm: in order not to create a double load on the network, the main server interacts with the equipment and periodically sends messages to the backup server that keeps the current status of the system in memory. If the primary server fails, the backup takes control and runs until the master server starts working. Immediately after this, the primary server databases are updated with the backup data, and management is returned to the primary server.

All SCADA-systems are open for further expansion and improvement and have for this purpose built-in high-level languages, most often Visual Basic, or allow you to connect software codes written by the user himself. In addition, you can connect to the development of other companies, ActiveX objects, standard Windows DLL files. To implement these technologies, special tools and a specialized interface have been developed.

The SCADA system can be integrated with a wide range of networks: other SCADA systems, office networks, recording and alarm networks (for example, security and fire alarms), etc. To effectively operate in this heterogeneous environment, SCADA systems use standard Network Basic Input/Output System (NETBIOS) and Transmission Control Protocol / Internet Protocol (TCP/IP) protocols. Simply mentioning the TCP/IP protocol already shows that SCADA-systems can work on the Internet, especially as the transfer of operational and static information about the process to websites becomes more relevant.

I would like to say that the concept of automated technology management systems is initially wider than SCADA. When the literature sometimes speaks of SCADA-systems, implying an automated system for managing technological processes, this is not entirely correct. SCADA was developed specifically as a system that allows the operator to provide information services at the top level of process control. But they cannot provide fully automated control from top to bottom, for the simple reason that it's just a software product installed on a personal computer. And any technological process requires, in addition, still a variety of special equipment, and this happens in real life, and not in a virtual environment.

However, the established practice of constructing automated control systems of sufficient complexity indicates that the use of SCADA-systems in the design of an automated process control system greatly simplifies the life of developers and allows organizing reliable and high-quality control during the

operation of the Systems.

Today almost any industrial enterprise operates automated process control systems Therapy Planning System (TPS) and uses HMI/SCADA (Human Machine Interface/Supervisory Control and Data Acquisition) software. There are many decent products on the market, and the end user and system developers have a choice. At the same time, the requirements imposed by customers for newly implemented management systems are constantly growing with the development of information technology. One such program is Proficy from GE Fanuc (www.gefanucautomation.com). This integrated software solution is a set of applications that provide a complete set of capabilities for the collection and storage of disparate data, their presentation to employees, subsequent analysis and, on its basis, optimal management of production processes, product quality indicators and fixed assets on-line.

Proficy allows to eliminate the existing information gap between business systems and process control systems, provides comprehensive and effective operational control of production and prevents potential conflict of many inapplicable programs, systems and automation devices. In accordance with user expectations, GE Fanuc has made its products as open and easy to use as in one integrated solution, and individually, in integration with third-party programs, devices and interfaces. Each of these components embodies the most advanced software achievements [8-12].

4. Conclusion

Using this mechanism, the same iFix-imitation can be associated with different tag groups in the database, and therefore one mnemonics can be used to display several similar technology partitions.

Thus, the use of the SCADA iFix system should serve as a tool for increasing the economic efficiency of technological processes in the oil and gas industry. For this, first of all, the correct choice of automation tasks is necessary.

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