THE PRACTICAL EXAMPLE OF CONNECTING THE PLANT PROCESSING INDUSTRY INTO A SINGLE SUPERVISORY AND CONTROL SYSTEM

PRAKTIČNI PRIMER POVEZIVANJA POGONA PROCESNE INDUSTRIJE U JEDINSTVENI NADZorno UPRAVLJAČKI SISTEM

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ABSTRACT

This paper describes the connecting of different plants within the processing industry using modern technologies. The basic idea is to show the ability of linking different manufacturer’s equipment into a single supervisory system. The contemporary manufacturing requires modern solutions in the field of supervision and management so as to increase the efficiency and reduce the production costs of the final product. The connectivity solution shown in this paper is in line with modern trends and demands of the real production process. The described system was practically implemented in the plant using the internationally standardized communication media and protocols. The practical implementation provided users with a better insight into the production process by providing a number of possibilities for data collecting and analysis.

Key words: communication, process industry, connecting, supervision and control.

REZIME

U radu je prikazano povezivanje različitih pogona u procesnoj industriji korišćenjem savremenih komunikacionih tehnologija. Osnovna ideja je bila da se prikaže mogućnost povezivanja opreme različitih proizvođača u jedinstveni nadzorno upravljački sistem. Današnja proizvodnja zahteva savremena rešenja u oblasti nadzora i upravljanja radi povećanja efikasnosti proizvodnje i smanjenja troškova finalnog proizvoda. Prikazano rešenje povezivanja je u skladu sa savremenim trendovima i realnim zahtevima proizvodnog procesa. Opisani sistem je praktično realizovan korišćenjem međunarodno standardizovanih komunikacionih medija i protokola. Iskorišćene su standardne široko dostupne komunikacione tehnologije za povezivanje opreme i uređaja u okviru pogona, povezivanje se sastoji od nekoliko nivoa hijerarhije. Osnovni, nulti nivo je nivo senzora i izvršnih organa, prvi nivo je nivo na kom se nalaze distribuirane periferije PLC uređaja. Na drugom nivou se nalaze PLC uređaji, treći nivo je na kome se nalazi nadzorni sistem. Prazno rešenje je omogućilo bolji uvid u proizvodni proces obezbedujući veći broj podataka i mogućnosti njihove analize. Prikazano rešenje je danas vrlo lako moguće primeniti na širok spektar već postojećih realizovanih savremenih upravljačkih sistema dozvanjem potrebnog proširenja i kreiranjem komunikacione mreže. Osnovna ideja ovog rada je povezivanje svih proizvodnih pogona u okviru fabričkog postrojenja. U datoj realizaciji povezana su samo postrojenja u okviru iste zgrade dok je ostalo da se realizuje i povezivanje svih ostalih pogona.

Kljucne reči: komunikacija, procesna industrija, povezivanje, nadzor i upravljanje.

INTRODUCTION

The modern industrial production requires modern solutions in the areas of supervision and control. The competition in the market and reducing costs of production require the use of modern solutions, which include efficiently and cost-effective energy production. In order to achieve these goals it is necessary to apply generally accepted and standardized solutions that exist on the market. Today, a special area in the automation of industrial plants is the application of various communication solutions. Because of the production process requirements, nowadays it is very easy to find the application of contemporary communication solutions. Of course, the use of generally accepted international standardized solutions enables the interconnection of equipment from different manufacturers. In this way, the production processes, which consist of many different technical and independent entities, can be circled in a single supervisory and control system.

MATERIAL

This paper will present the interconnectivity and integration of equipment from different manufacturers using a standard industrial communication protocols. All solutions are applied practically in the real industrial processes. The basic idea is to integrate a number of machines, which existed as separate units, into a single supervisory and control system. The connecting standard, widely available in communication technologies for connecting machines within the plant, consists of several levels of hierarchy. The basic level is the level sensor and actuators, the next level is the level on which the peripheral PLC (Programmable Logic Controller) devices (Bolton, 2006) are distributed. The PLC devices are at the next level and the supervisory system is at the third level. Figure 1. shows the standard commonly known structure with levels of control and supervision in the industrial plant. Each level uses the appropriate standard of communication adapted to its speed and medium specified level of management. The distance, speed, responsiveness and size of data to be exchanged are depending on the level and characterize each of communication levels, i.e. determine the characteristics of the communication protocol needed (Klaus Bender, 1993).

DISCUSSION

The practical implementation sensors and actuators are connected in the traditional way using current and voltage signals. This is the zero level. The level one where the distributed peripherals belonging to each individual PLC controllers include: frequency converters, measurements devices for electrical networks and distributed peripherals. This requires expansion of the basic PLC module. At this level each PLC has its own independent distributed periphery (DP). In the given implementation DP
cannot communicate with other PLC devices directly, but are directly subordinated to its PLC. The described realization uses generally accepted and internationally standardized protocol Profibus, which is widely represented in Europe (Veran Vasić et al., 2006).

Figure 2. shows the two PLCs marked with symbols BIG and TSP and their mutual association with distributed peripherals using the Profibus protocol. This type of connection using the communication standards allows much simpler and more flexible way to connect devices in industrial plants with the PLC. In this way, the ability for accessing larger number of data, process data and diagnostic information rising significantly. The access to more information gives the ability for better management of the process. The collected information is used locally for the control and forwarded to higher level where it will be used for the better analysis of the process, and can be used for mutual interactions between controlled processes at a higher level.

The level two in the practical realization is the interrelationship of PLC devices that manage the process. The process control is done by the independent PLCs. The connection between PLC devices maintains mutual dependence and connection to higher levels of supervision and control. Fig 3, the connection between PLC devices and supervisor systems shows the schematic view of the two upper levels, second and third. At these levels of communication the standard Ethernet communication is used, widespread over TCP/IP protocol. All PLCs are connected into a single network with supervision system. The basis of communication is widespread and widely known TCP/IP protocol. The unique communication unit consists of two devices from Siemens S7-300 series (Jürgen Müller, 2006) with the Ethernet interface module and the three PLC units produced by Allen Bradley, two computers with Windows XP operating system and the corresponding Siemens WinCC application on them. Three panels for easier monitoring of the production process are also connected and placed near the controlled equipment units. All those devices use the communication network and exchange data over TCP/IP protocol through the same medium. A personal computer is connected to the existing network and executes identical software which is possible to perform the same operation. Therefore, the redundancy of the supervision system is achieved.
wires. Its features meet the requirements, but it can be easily replaced with some other medium if such need occurs.

**CONCLUSION**

The described solution for connecting the devices and equipment in plants of the processing industry is a result derived from the demands of modern production processes and technical capabilities that are widely available. The lower level of control consists of the independent PLC devices. However, they are extended with the possibility of communication with the higher layers of supervisory and control system. This expansion provides the opportunity to have one central place for data gathering, processing and analysis, and forwarding the information to users. Combining all the data from the plant one can obtain accurate and complete data from the factory as a whole. The given realization of supervised and controlled system is upgraded with measurement of energy consumption at the level of each individual plant. The data are collected in one place and can be easily analyzed with the aim of increasing the energy efficiency. Of course, since the supervision and control is done by means of a personal computer there is a wide range of tools that can analyze the collected data.

The described solution can easily be applied to a wide range of existing modern control systems. It can be realized by adding the necessary enhancements and creating the network. The basic idea is to connect all the manufacturing plants in the factory. The modern supervisory and control solutions should be based on the possibility of interconnectivity with the rest of the existing control and supervisory equipment. Moreover, they should not be limited to parts which are in their physical vicinity but they should be interconnected by modern communication solutions like the internet or mobile telephony. Consequently, the increase in productivity and energy efficiency will be achieved, as well as the cost reduction of production processes.

**REFERENCES**


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Received: 22.03.2010. Accepted: 01.04.2010.