International Journal of Engineering Research and Technology. ISSN 0974-3154, Volume 13, Number 12 (2020), pp. 5301-5304

APCS Software Integration Based on Opc Server

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Abstract

An automatic control system for a mixing plant has been developed, a module for managing concrete mix recipes, a module for working with OPC server tags and an order history module have been implemented. The work can be used to automate the production process. Based on the analysis results, custom requirements were generated, and a UML use case diagram was developed. Functional development requirements were developed based on user requirements. As a result, an OPC client application was developed. The functionality of the application allows you to manage the concrete mix production process, work with concrete mix recipes, make some settings for connecting to the OPC server and save the order history. Before starting the process of preparing the concrete mixture, the operator must select the desired recipe and enter the required weight of concrete. After that, based on the selected recipe, the values of the components of the concrete mixture are calculated. The client application sends the results of calculations to the controller and changes the value of the Start tag, which is responsible for starting the process, from false to true. After the production cycle, a record of consumed materials is generated in the database.

Keywords: automation; production; OPC; algorithm; manipulator.

I. INTRODUCTION

Process automation is a set of tools and methods designed to create a system that will control the process itself without direct human participation. With the help of automation, an increase in the safety and efficiency of the production process is achieved.

The most current automation technology at the moment is the use of programmable controllers with electronic weighing systems.

Automation of the technological process for the preparation of concrete mix using microprocessor technology saves raw materials, increases the quality of the mix itself and reduces the number of maintenance personnel. In automatic control systems for concrete mixing plants, specialized industrial controllers are used, such as Desna Batch Control from Desna Contro, C-PAK from Practical Control Systems, CB2 from BMG Seltec Concrete Enterprise, etc.

At present, concrete mixing plants are equipped with outdated batching equipment and operate on outdated control systems for the technological process of concrete production.

The relevance of the work lies in the fact that when using this ACS, the consumption of concrete mix components is minimized and jobs are reduced to one operator.

KEPServerEX [1] is an OPC server developed by Kepware. This server provides direct communication between hundreds of different PLCs, devices and systems, as well as OPC clients.

The goal of this project is to improve the efficiency of the concrete production process and save raw materials through the use of a client application for the dispatching control of a concrete mixing plant and monitoring of the concrete preparation process, developed using the ClientAce tool [2] and the C # programming language [3].

KEPServerEX supports serial and Ethernet connections with the widest range of industrial devices: Allen Bradley, AutomationDirect, BACnet, DNP 3.0, GE, Honeywell, Mitsubishi, Modicon / Modbus, Omron, Siemens, Texas Instruments, Yokogawa and many more.

This OPC server supports a list of different technologies:

1) OPC Data Access Version 1.0a;

2) OPC Data Access Version 2.0;

3) OPC Data Access Version 3.0;

4) FastDDE for Wonderware;

5) SuiteLink for Wonderware;

6) DDE format CF_Text;

7) DDE Advanced DDE format.

KEPServerEX is used in thousands of SCADA systems around the world.

II. METHODS

Concrete production technology consists of several operations:

1) reception, storage and processing of raw materials;

2) dosing by the component of the concrete mixture;

3) mixing and delivery of ready-mixed concrete.

To obtain a particular concrete mixture, you must observe the correct dosage of water, sand, cement, etc. [4] Therefore, the most important operation is the dispensing of materials. This operation is carried out using dispensers.

By the nature of their work, dispensers can be divided into cyclic and continuous. With the cyclical nature of the work in the measuring hopper, the required dose of the component is measured, and then discharged into the mixe. [5] Then the cycle is repeated. In continuous operation, each component is continuously fed into the mixer.

By the dosing method, there are volumetric, weight and volumetric-weight batchers.

The quality of concrete mixing largely depends on its duration. In batch mixers, it is determined from the moment the components used are loaded to the moment they are unloaded. [6] Insufficient mixing time leads to a deterioration in the homogeneity of the concrete and reduces its strength. An increase in the duration of mixing over the optimal period has almost no effect on the properties of the concrete mixture (the strength of concrete increases, but very slightly). [7] The optimal mixing time is directly dependent on the composition and characteristics of the concrete mix, as well as on the type of concrete mixing plant used. When preparing heavy concrete mixtures (with a density of more than 2200 kg / m3) in free fall mixers, the mixing time should be 1-2 minutes.

Let's consider a BPMN model of a concrete production business process. [8] The starting event here is the customer's order for the concrete mix. Before starting mixing, the operator of the concrete mixing plant must check that all component containers are full. If this is not the case, then the operator must add components to the desired level. [9] Then the concrete production process starts. The start of production is the addition of components to the mixer. Components are added in parallel. With the help of appropriate dosing devices, the required amount of the component is weighed and unloaded into the mixer. After unloading, the OPC client starts the mixing process, which lasts 2 minutes. Next, the ready concrete mix is unloaded from the mixer.

III. RESULTS AND DISCUSSION

Control of the APCS must fulfill the following business requirements:

- preservation of the history of orders, taking into account the spent raw materials and concrete produced for a certain period of time;

- improving the quality of the produced concrete mixture due to the high accuracy of dosing components;

- decrease in the number of jobs;

- more economical use of raw materials.

Using a use case diagram, you can show custom scenarios for working with a client application. In the course of the analysis of the requirements, the only role of the “APCS Operator” was identified.

The analysis of business requirements and business processes revealed the main use cases:

1) view the list of recipes - UC-1;

2) create a recipe - UC-2;

3) edit recipe - UC-3;

4) prepare concrete mix - UC-4;

5) stop the process of preparation of concrete mixture - UC-5;

6) open the metering valve - UC-6;

7) close the metering valve - UC-7;

8) viewing order history - UC-8.

Each use case is described in the form of a specification, which contains the basic properties of the use case and the scenario.

The BOM template contains the following fields:

- name of the use case;

short description;

- actors appearing in the precedent;

- main stream.

Based on the analysis results, custom requirements were generated, and a UML use case diagram was developed.

Functional development requirements were developed based on user requirements.

IV. SUMMARY

A SIMATIC S7-300 controller was chosen to control APCS

- communication with the controller will be carried out using the OPC server KEPServerEX 6;

- The OPC client application will be developed using the object-oriented programming language C # and the ClientAce tool;

- the NetToPlCsim extension [10] will be used to test the client application.

SIMATIC S7-300 is a universal modular programmable controller designed for solving automatic control tasks of medium and low complexity. This controller can use several types of central processors of different performance, has a wide range of input-output modules for discrete and analog signals, functional modules and communication processors, the use of which increases the efficiency of the controller.

Siemens SIMATIC S7-300 programmable controllers have a modular design and can consist of the following elements:

- Central processing unit - central processing unit. Depending on the complexity of the task, different types of central processing units can be used in controllers;

- Signal modules (SM) - designed for input and output of analog or discrete signals with various electrical and time parameters;

- Functional modules (FM) - modules that are able to independently solve problems of automatic control, have a built-in microprocessor, so they can perform their functions even if the controller's central processor fails;

- Communication modules - communication processors that provide the ability to connect to PROFIBUS, Industrial Ethernet, AS-Interface networks or organize communication via PtP (point to point) interface;

- Power supply unit (PS) - designed to power the controller from a DC or AC network;

- Interface modules (IM) - modules that provide the ability to connect to a base rack with a central processor of I / O expansion racks.

The features of the SIMATIC S7-300 controller include:

- A wide range of modules for maximum adaptation to the requirements of the problem being solved;

- Use of distributed I / O structures and easy inclusion in network configurations;

- Convenient design and work with free cooling;

- Free expansion of functionality when modernizing the control system;

- High power due to the large number of built-in functions.

Thus were compiled:

- business requirements for the system;

- user requirements based on use case diagrams;

- functional system requirements;

- precedent specifications.

This data allows you to make a complete solution and is sufficient for the design of an information system.

V. CONCLUSIONS

The OPC (OLE for Process Control) standard was developed by the international organization OPC Foundation. The main goal of creating this standard was to ensure the possibility of operation of automation tools operating on different hardware platforms. Prior to the creation of the OPC standard, the SCADA software package was widely used, which had to be adapted for each equipment individually. With the advent of the OPC standard, this problem was solved, and the developers of dispatching systems gained independence from the specific type of controllers and I / O devices.

The OPC communication standard is based on the common client-server scheme. This architecture allows one client to connect to different OPC servers or multiple clients to connect to one OPC server. Establishing a connection between the automated process and the OPC server is carried out as follows:

1) The OPC server and the client application are installed on the dispatch computer. Then, using COM technology, it searches for available servers on this computer. Then, communication is established between the client application and the selected server.
2) Link data from the OPC server configuration to the OPC client configuration. This can be done by loading data, if the server and client have this capability. Otherwise, you will have to bind the data manually.

3) APCS control must comply with the formulated IT requirements.

ACKNOWLEDGEMENTS

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

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