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Design of centralized control system for water curtain dust removal based on Wonderware system platform

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Abstract: *This paper designs a centralized control system for water curtain dust removal based on Wonderware system platform. With the transformation of industry to information technology and intelligence, the requirements for equipment control continue to increase, and it is necessary to shift from local control to centralized control. The system integrates Siemens 1500 series PLC, data acquisition server and client for condition monitoring and data integration. The key technologies include equipment configuration, program running instance, alarm management and trend recording. The new system has been verified by experiments, which proves that it can effectively monitor and control the water curtain dust removal system, which helps to reduce the failure rate, and lay a foundation for the future information transformation.*

Keywords: *Wonderware system platform; Water curtain dust removal; Centralized control system; PLC; Condition monitoring*

1. Introduction

There are usually multiple processes in the industrial production of the assembly line. Taking the cutting production process of cigarettes as an example, it can be divided into chip moisture recovery, premixing, feeding, leaf storage, cutting, drying, blending, mixing and adding fragrance[1]. Each process has the corresponding professional manufacturer providing host equipment, usually used in the manufacturing of the PLC Siemens or Rockwell brand, while equipped with the control of the computer. With the gradual advancement of information intelligence and digital transformation, the requirements for equipment control are also constantly improving, and the original local control mode of some auxiliary equipment is no longer suitable for the current development direction, and it is urgent to develop in the direction of centralized control. Wang Yong[2] developed and applied the centralized control system of fully mechanized mining face in coal mine based on WinCC development environment. Sun Fujian, Li Qi, Liao Chengsheng, et al.[3] designed a centralized control system for air-cooled radiator based on LAN monitoring. The design method of water curtain dust collection control system based on Wonderware system platform is rarely reported. Taking the design of water curtain dust collection control system of Nanning Cigarette Factory of Guangxi China Tobacco Industry Co., Ltd. as an example, the system platform was developed to realize the transformation from local control to centralized control.

2. Problem analysis

(1) Existing problems

The water curtain dust removal system[4] applied to the two air drying machines in the tobacco cutting making process can only be controlled and monitored locally. If the monitoring and control is carried out by local operators, the workload of operators will be increased, which may cause process quality problems. If one person is specially responsible for the control and monitoring of water curtain dust removal, it will cause a waste of personnel.

(2) Cause analysis

The water curtain dust removal system is used in two CTD air dryer in the cutting workshop, which

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is mainly used to remove the dust from the process gas produced by the CTD dryer and reduce the temperature of the process gas at the same time. The operation station of the water curtain dust removal system is controlled separately, and its control and monitoring can only be carried out in the local operation station, which is not in line with the development direction of centralized control of the equipment. The main reason is that the centralized control system of water curtain dust removal is not connected to the centralized control system of the cutting workshop, and its equipment status data and production data are not connected to the data collection database, which forms a data barrier for the tracking analysis of equipment status and the application of automation functions. Therefore, it is urgent to design a set of water curtain dust collection control system based on monitoring and database technology.

3. System design

3.1 Structural composition

The water curtain dust collection control system based on the Wonderware system platform[5] includes: Siemens 1500 series PLC[6], PLC network card 1: which is used for communication with the slave station equipment, PLC network card 2: which is used for communication with the host computer, number 1 redundant data acquisition server, number 2 redundant data acquisition server, database server, multiple clients. Its structure is shown in Figure 1.

Principle: PLC collects information of field equipment, including IO, inverter, etc. The data acquisition server of the upper computer reads the label value inside the PLC in the form of one-to-one point table through the PLC network card 2. The screen shows that the example is deployed in the server 1 and 2. When one of the servers fails, the software can automatically detect and realize the switch of the server. The client reads the value from the server.

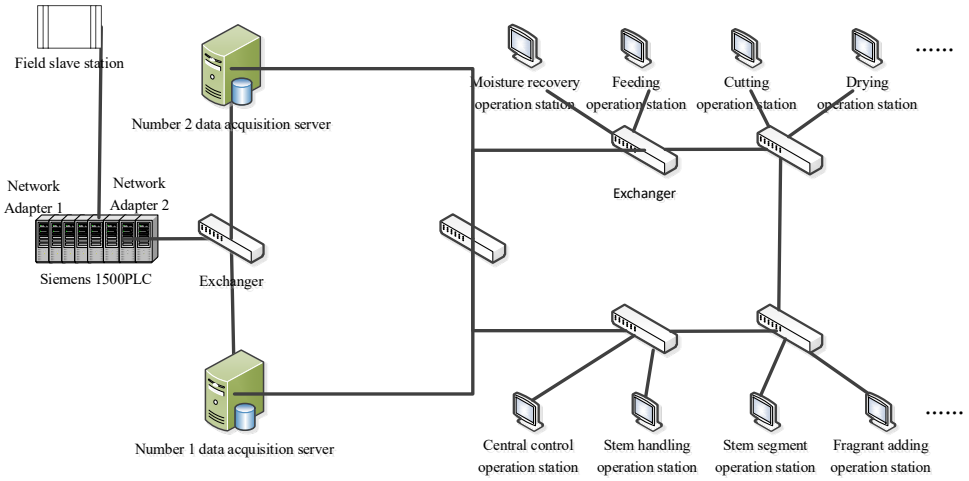

Figure 1: Water curtain dust collection control system structure

3.2 Key technology realization

3.2.1 Device configuration

Based on the Wonderware system platform, the PLC of the water curtain dust removal system is configured, as shown in Figure 2. Processor Type is S7 PLC, and the Networld Address in the S7 Connection is the address of network card PLC2: 193.80.0.140, a new Topic named SMCC is created in the Device Groups, so that it can communicate with PLC and access the centralized control system of the silk workshop, so that the status information data can be collected.

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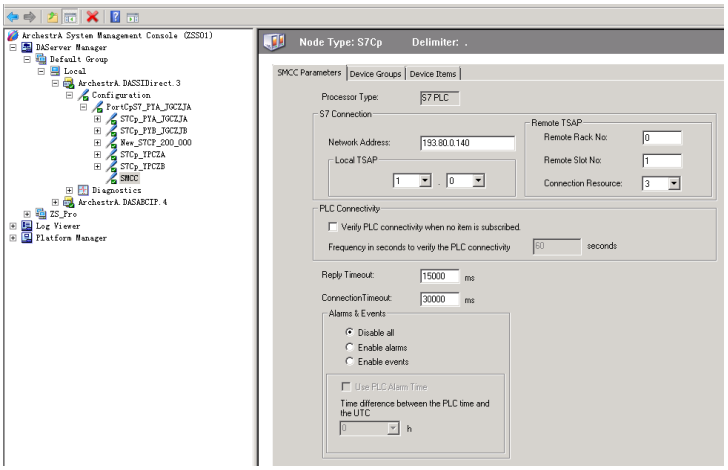

Figure 2: Wonderware system platform configuration

3.2.2 Program operation instance

① Data acquisition example: We need to build the data architecture of the host computer and create a new data point table. Figure 3 shows the establishment of the DI program instance. The Topic is selected as SMCC, which is consistent with the Device Groups, and the corresponding connection is established. The host computer label is established in Attribute, which corresponds to the data points in S7-1500 Siemens PLC, and the addressing mode is absolute. For example, DB900 real8 represents the database DB900 and the real data type. Starting from the 9th byte, and the real data type is 4 bytes and 32 bits, that is, the next data is DB900 real12, starting from the 12th byte.

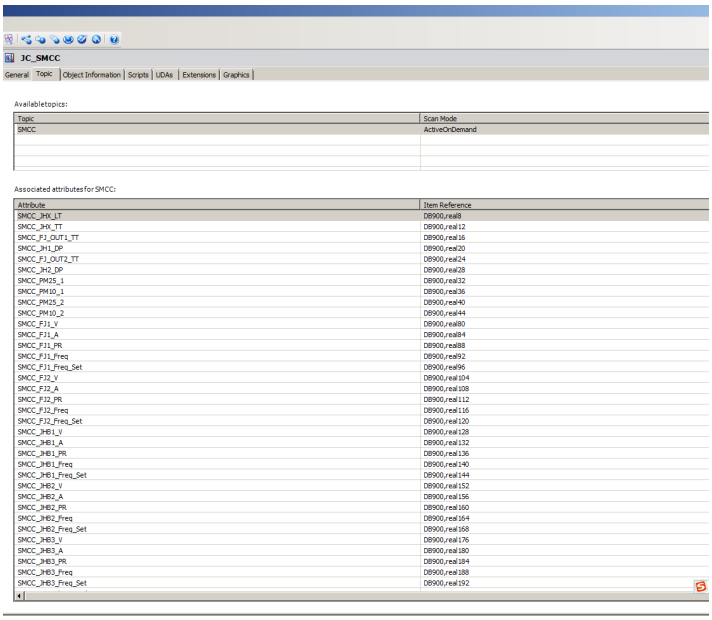

Figure 3: Switch data acquisition program

② We need to create an alarm example. Alarm information is generally completed in the PLC program, even if the analog amount of high and low alarm limits can be set in the upper computer software alarm, but in general, it is still in the PLC after completion in the form of Boolean quantity, because in the PLC program we also need these high and low limit alarms to do chain linkage. Therefore, we directly use the host software of the PLC to deliver Boolean alarm values. We need to set Attribute type to Discrete, enter a corresponding input source, and select Enable state alarm to set alarm prompt information.

③ We need to create a trend instance. The trend instance is used to record the Analog trend of key parameters. Set Attribute type to Analog and Data type to Float, we need to fill in the corresponding input source, and select Enable history. The corresponding data history trend can be stored in the database server and can be queried using the history trend graph, as shown in Figure 4.

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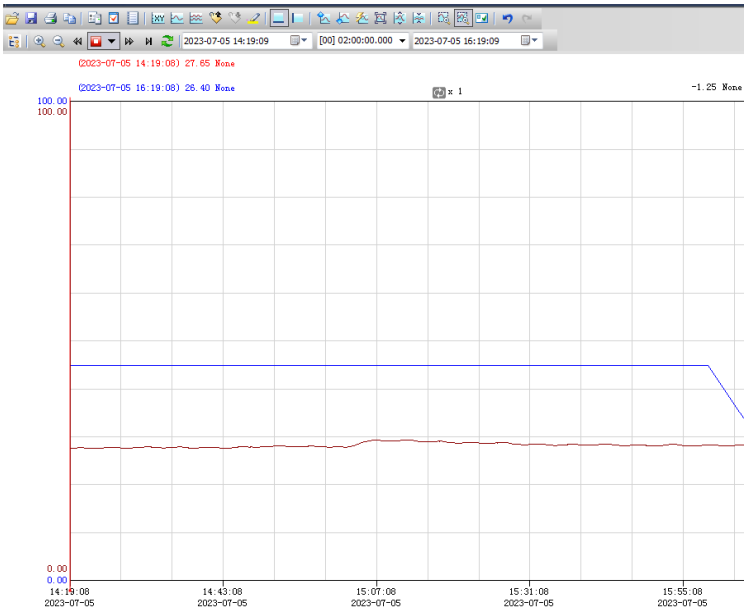

Figure 4: The creation of a historical trend chart

3.2.3 Surveillance screen

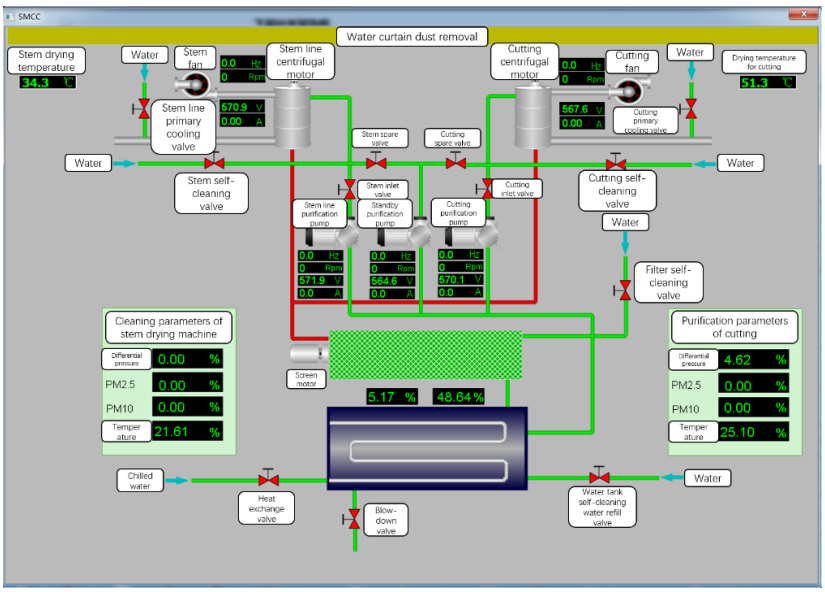

Figure 5: Upper computer screen design

According to the equipment process of the water curtain dust removal host, we need to design the upper computer screen and bind the data label, as shown in Figure 5. The moisture exhaust fan draws the air from the air drying machine into the purification system, carries out centrifugal cyclone dust removal in the cyclone cylinder, and the dusty sewage after dust removal flows into the sewage cache tank, and then the sewage pump pumps into the rotary drum filter slag filter device to complete the slag discharge and filtration work. The water is automatically filled when the machine is started, and the water is evenly distributed into the water storage chamber of the gas-liquid mixing impeller spray plate. The professionally designed multi-stage mixing impeller spray plate and high-speed rotating jet will fully mix and atomize the water with the dusty air. The power cyclone gas-liquid mixing will intercept and filter the large particles of dust and the residual twine, and the dusty water will settle and be collected, and then be recycled and filtered. The centrifugal water washing gas-liquid exchange system carries out differential gas-liquid exchange and high-speed separation, and the clean air is discharged to the drainage room. After cooling and dust removal, the water is discharged into the collection tank after the impurity filtration system. The system is equipped with a heat exchange module, which can quickly cool down the high-temperature water and transfer the hot water exchanged to the waste heat recovery pipeline. The heat transfer module is a stainless steel finned tube, which is composed of several groups to further ensure

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the cooling capacity of the cooling water. After heat exchange and cooling, the water is recycled and transported by the pump to the spray plate of the mixed water impeller for repeated use. The upper computer screen is shown in Figure 5.

4. Application effect

4.1 Experimental design

Equipment and instruments: two CTD air drying machines, water curtain dust removal machine, Wonderware system platform.

Test method: After any CTD air drying machine is started, the water curtain dust removal host is controlled to start automatically through linkage control signal, and the system status of the water curtain dust removal host is read based on Wonderware system platform, including the opening and closing state of the valve and motor, the simulation value of the drying temperature, the motor current frequency and the historical trend chart. We need to compare with the parameters read on the touch screen of the water curtain dust removal host.

4.2 Data analysis

After using the Wonderware system platform to monitor the water curtain dust removal in a centralized way, the valve motor status, analog parameter value and historical trend chart read by the centralized control system were tested, and the collected values were consistent with the touch screen of the host itself, as shown in Table 1.

Table 1: Numerical statistics of system platform data collection

Data reading mode	Valve, motor status				Analog parameter value			Historical trend chart		
	Stem fan	Stem line centrifugal motor	Screen motor	Filter self-cleaning valve	Drying temperature for cutting	Stem fan frequency	Cutting purification pump frequency	Purge tank level	Purifying tank temperature	Stem line cleaning pressure difference
Water curtain dust removal machine	Open	Open	Open	Close	164.0℃	35.0Hz	45.0Hz	Consistent	Consistent	Consistent
wonderware system platform	Open	Open	Open	Close	164.0℃	35.0Hz	45.0Hz	Consistent	Consistent	Consistent

5. Conclusion

Using the centralized control system of water curtain dust removal based on Wonderware system platform, the running status of equipment can be controlled and monitored by the upper computer in real time, and the equipment status information can be collected, which helps maintenance personnel to find and deal with problems in advance, as well as reducing the failure rate of water curtain dust removal system. At the same time, it also breaks the data barrier and provides the basis for the transformation of information intelligence in the later stage.

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