Application of Siemens Smart200 and S7-1200 Plc Complex Instructions in Industrial Automation

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Abstract: in the Information Age, Science and Technology Are of Great Importance to Improving the Level of Productivity and Promoting the Growth of the National Economy. in the Process of Comprehensively Promoting the Pace of Modern Industrial Construction, Plc Has Injected Power into the Realization of Industrial Automation Control. At Present, Plc Control Technology Has Been Widely Applied in the Field of Industrial Automation, Which Has Improved the Overall Level of Industrial Automation in Many Aspects. Plc Control Technology Has Become More and More Widely Used in Industry Due to Its Excellent Characteristics, Strong Technology, Wide Application Range and High Level of Science and Technology. Only by Clearly Understanding the Principle of Plc Control Technology and Its Application Performance, Can Plc Control Technology Be Better Applied in Industrial Automation. Based on Siemens Smart200 and S7-1200 Plc, This Paper Analyzes the Application of Plc in Industrial Automation and the Related Problems That Should Be Paid Attention to in the Application of Plc Control Technology in Industrial Automation, and Makes a Certain Prospect for the Development Trend of Plc Control Technology in the Application of Industrial Automation.

1. Introduction

Programmable Logic Controller (Plc) is a Control Device for Digital Operation and Operation. It is an Electronic System Developed Instead of Traditional Relay and Integrates Computer Technology, Communication Technology and Automatic Control Technology. as a New Type of Electronic Control Device, Plc Has Been Widely Used in Steel, Petroleum, Chemical Industry, Electric Power, Machinery Manufacturing and Other Industries Due to Its Advantages of High Reliability, Good Versatility, Good Environmental Adaptability, Strong Anti-Interference Ability, Simple Wiring, Easy Programming and Small Volume. the Application of Plc Control Technology in Industrial Automation Production is Another Breakthrough in the Technical Field of Industrial Automation Production in Our Country [3]. for the Industrial Field, the Application of Plc in the Automatic Control System Can Further Improve the Production Efficiency with the Advantage of This Technology, and with the Continuous Development of This Technology, the Performance of Plc Has Been Continuously Optimized and Improved [4]. with the Development of Hardware and Software Design and Development Technology, the Programming Process of Plc Has Become Simpler, But the Openness of Functions and Systems Has Been Greatly Enhanced [5]. in the Subsequent Development Process, All Aspects of the Performance of Plc Control Technology Are Constantly Improving. Plc Control Technology is the Mechanical Control of Industrial Automation Production, Which Requires the Operator to Have Certain Computer Operation Skills and Program Editing Skills. It Replaces the Traditional Manual Mechanical Operation and Improves the Production Efficiency.

In the Early Days, Plc Was Mainly Applied to Replace Relay Control System and Worked as the Core Part of Mechanical and Electrical Control. Although the Application Scope At This Time Was Not Very Wide, It Was Precisely Because of Its Excellent Characteristics That It Gradually Attracted Extensive Attention in the Engineering and Technical Field [6]. the Development of Plc is to Realize the Automation of Single Equipment Control to the Whole Factory Process in Industrial Environment. Its Characteristics Are Small Volume, Simple Programming, Flexible Assembly, High Anti-Interference Ability and Strong Reliability [7]. Plc Technology is Becoming More and

More Mature, the Cycle of Upgrading is Shorter and Shorter, and Manufacturers Continue to Introduce New Plc with Stronger Functions, Which Makes Its Cost Performance Higher and Higher [8]. Yl-335b Automatic Production Line Training and Examination Equipment is a Product Developed by Yalong Intelligent Equipment Group Co., Ltd. for the National Higher Vocational College Automatic Production Line Skills Competition and Comprehensive Training of All Colleges and Universities. There Are Three Kinds of Plc Control Systems for Yl-335b: Siemens S7-200, Mitsubishi and Huichuan. in 2010, Siemens Introduced S7-1200, an Upgraded S7-200 Product, and S7-200smart [9], a Transition Product with Higher Cost Performance, in China. the Importance of Plc Control Technology in Industrial Automation is Increasingly Prominent. Only by Clearly Understanding the Principle of Plc Control Technology and Its Application Performance Can Plc Control Technology Be Better Applied in Industrial Automation [10]. in Order to Make Plc Control Technology Serve Industrial Automation Better, It is of Great Theoretical and Practical Significance to Comprehensively Realize the Application Research of Plc Control Technology in Industrial Automation. Based on Siemens Smart200 and S7-1200 Plc, This Paper Analyzes the Application of Plc Complex Instructions in Industrial Automation.

2. Characteristics of Plc Control Technology

Plc Control Technology Can Be Effectively Used in Automatic Industrial Production Because of Its Own Characteristics in Industrial Automation Production. At Present, Plc Control Technology is Widely Used in the Field of Industrial Automation. for Example, It Has Grown into a Pillar Industry in Metallurgical Industry, Electric Power Industry, Light Industry and Chemical Industry. Based on the Continuous Development of Computer Technology and Network Communication Technology, for the Development of Automatic Control System, the Integrated Application of Corresponding Technologies Can Further Strengthen the Communication Function of Plc. the Application of Plc Control Technology Can Not Only Provide a Very Reliable Control Application for Various Automation Equipment, But Also Can Put Forward More Reliable and Perfect Solutions When Controlling, Which Well Meets the Development Needs of Industrial Enterprises [11]. the Simatic S7-200 Smart Cpu Module is Equipped with Standard and Economical Types for Users to Choose from. It Provides Six Cpu Modules, Namely Cpu Sr20/Sr40/St40/Cr40/Sr60/St60. for Different Application Requirements, the Product Configuration is More Flexible. as Plc Control Technology is Mainly Used for Computer Operation, from Information Collection to Information Input to Information Output, the Whole Process Can Be Completed by Only One Person, Thus Reducing Unnecessary Waste of Human Resources. in the Actual Design Process of Plc, It Adopts the International Standard Communication Protocol. the Standardization and Unity of This Protocol Make the Corresponding Communication Capability Gradually Strengthened during the Actual Production and Application of This Equipment.

In Traditional Industrial Production, People Mainly Rely on the Operation of Machinery to Complete the Processing and Production. as People Cannot Keep Their Attention Focused All the Time and Relax a Little, the Position of Machinery or Parts Will Shift. the Communication Protocol of Plc Control Technology is Unified, Which Provides Convenience for Users and Manufacturers to a Large Extent and Enhances the Openness of Communication. Facing the Controlled Object, the Complexity of the Controlled Object is Very High, and the Particularity of the Use Environment and the Continuity of Long-Term Work All Put Forward Higher Requirements for Plc Control Technology. Because Many Field Buses Are Developed by Plc Manufacturers, They Are Closely Related to Plc. in Practical Application, Plc Mainly Goes through Three Stages: Input Sampling Stage, Program Execution Stage and Output Stage after Execution [12]. Plc Control Technology Effectively Controls the Switching Value in Industrial Automation Production. Switching Value in Industrial Automation Production Refers to the Control of the Working State of Production Machinery. Fieldbuses That Are Widely Used in Plc and Have Entered International Standards Include Device Net, Profibus, as-I, Etc. the Communication Program of Plc Control Technology is Relatively Simple. the Communication Program Can Be Designed Only by Using Communication Interface Software and Special Computer, Which Greatly Reduces the Workload of Computer

Programming. Many Manufacturers Have Also Designed Special Interface Software for Communication between Computers and Plc to Reduce the Workload of Users in Writing Computer Communication Programs.

3. Application of Plc Control Technology in Industrial Automation

3.1 Application Range

On the control of switching value, based on the application of PLC equipment, the effective control of system actions can be realized by means of calculation of sequence controller formula. Furthermore, while ensuring the design standard, the corresponding control behavior is promoted to be more reliable. The electrical equipment automation system using PLC technology includes a master station layer, a remote station and field sensors. The master station layer and the remote station are connected through a communication bus. The remote station is connected with the sensor through a secondary cable, and the operator can control the electrical equipment through the communication module only in the control room. PLC control technology can be applied not only in automatic control, but also in centralized control of the system itself, such as system display control and fault detection control. In the position control, the automatic control is mainly realized for the stepping motor, and the pulse is sent to accurately position the corresponding displacement. According to the characteristics of the control object, PLC can flexibly realize system control by successfully assembling a complete control system through a combination of functional modules. Create data blocks DB1 and B2, and cancel "Optimized Block Access" in "Properties". It can be realized by calling GET and PUT function blocks in OB1 to read and write S7-200 SMART data area. S7-200 SMART has three motion control modes. One is pulse train output (PTO), using PLS instructions; The second is pulse width modulation (PWM), which can be realized by PLS instruction or PWM wizard. The third is the movement axis.

Automation clients can create automation objects, access objects provided by automation servers, obtain or set properties of objects, or call methods of objects. The interaction between automation objects and automation customers is shown in Figure 1.
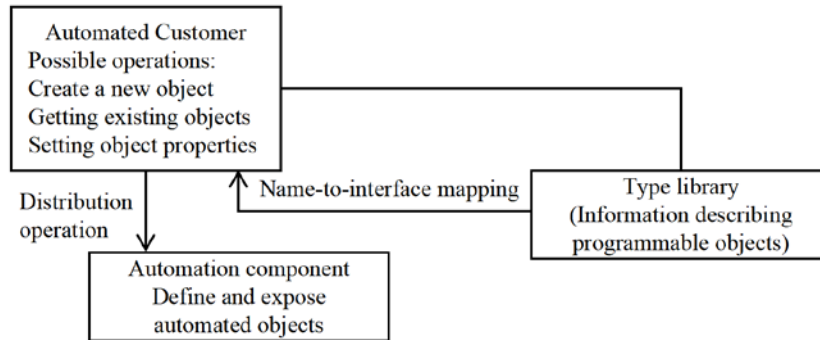

Fig.1 Interaction between Automation Customers and Automation Components

According to specific functions, the management module layer is divided into monitoring module, algorithm module and control module. In a network with I nodes, the normalized tightness index P is defined as:

$$P = P(Y = 1) = F(\beta_i X_i) \tag{1}$$

The data point is defined as the minimum of the distance from point $\theta(P)$ to any point with a higher local density point:

$$\theta(P) = Logit(P) = Ln(\frac{P}{1-P}) \tag{2}$$

The inertia weight still decreases linearly with the increase of the number of iterations, which effectively improves the search accuracy and convergence ability. The update formula is as follows:

$$\frac{dx_1^{(1)}}{dt} + ax_1^{(1)} = \sum_{i=1}^{N} b_i x_i^{(1)} \qquad (3)$$

When the equipment is in normal working condition, there is a certain logical relationship among the intermediate memory unit, output signal and input signal of the electronic control system. If the equipment fails, this logical relationship will be destroyed. The use of PLC analog control module enables it to realize not only process control, but also instrument monitoring through control statements. Based on the PLC control system, analog control is based on the characteristics of the control object itself. After combining all functional modules, the integrated system is built. PLC realizes the purpose of position control by controlling the stepping motor, sending pulses to the winding of the stepping motor and accurately determining the displacement of the stepping motor. The machine tool equipment needs to consume a certain amount of time during each work step. Therefore, it is possible to start the timer when detecting the work step, and then use the signal output by the timer as the start alarm signal and the automatic stop signal. Based on the PLC control system, the corresponding command system and frequency converter can realize effective control of the motor with the application of this system equipment, mainly controlling and adjusting the rotation speed. The execution of each work step of the machine tool equipment needs a certain time in the working cycle, and the timer can be started when detecting the work step action, and the output signal of the timer can be used as an automatic stop signal or a start alarm signal. Centralized control refers to the application of PLC equipment. With the aid of this system, the whole system can be effectively controlled on the basis of improving the level of automation control.

3.2 Problems Appearing in Application and Countermeasures

At present, in the actual application of PLC system equipment, one of the major drawbacks is the low compatibility of the system itself. Because the corresponding buses in PLC design and research and development are of special nature, there are certain differences in the structures designed by different companies. PLC control technology can realize the combination of functional modules according to the characteristics of objects to be controlled, thus forming a complete control system and finally realizing flexible control of the system. At present, the standard of specific programming software for PLC control technology is still under planning, which to a large extent affects the standardized use of PLC control technology. Although this PLC software program has been written and implemented with corresponding specifications, in the actual application process, the industrial production environment itself will still have certain influence on the practical application of this system. The insulation of PLC components is directly related to the content of water vapor in the environment. In order to ensure the stability of the corresponding components, it is required to improve the effective control of the corresponding humidity problems in the operating environment and maintain the humidity below 80%.

Many automation objects are provided in PLC control system, and there are inheritance and derivation relationships among these objects, forming a tree-like hierarchical structure. Among them, the Application object is the basic object in PLC object mode and represents the word processing program itself. Figure 2 shows a part of a PLC text object model.
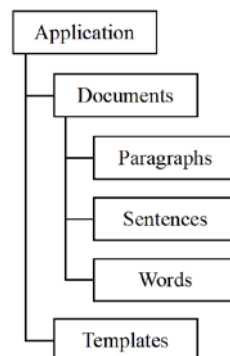

Fig.2 Plc Word Processing Object Model

According to the running time or parameters input by the user, the final result is generated. The actual output of each unit in the output layer is calculated:

$$E_{Rx}(l) = E_{Rx-elec}(l) = lE_{elec} \qquad (4)$$

The server will publish the profile according to the application. Correct connection weights and thresholds:

$$W = \alpha(\beta(\frac{E^2_{i-current}}{E^2_{i-init}}) + (1-\beta)\frac{d_i}{d_{max}})) \qquad (5)$$

When a program needs to establish a database connection, it only needs to take one from the memory to use it instead of rebuilding a connection. This problem is discussed, and its mutual calculation formula is as follows:

$$E_{non-CH} = lE_{elec} + l\xi_{fs}d^2_{toCH} \qquad (6)$$

The application of PLC control technology can control the frequency of machinery in the production process. According to the setting of machinery operating frequency in the production program, the operating frequency of machinery can be effectively controlled. The processed data is compared with the reference value previously stored in the memory, the difference between the two data is compared, and then the control operation is completed, which can also be transmitted to other intelligent devices for remote control. When PLC control technology is applied, sequence control and logic control can be effectively realized. One-to-one control can be realized, and one-to-many control with higher requirements can also be realized. Based on the corresponding operating environment, it is required to effectively control the frequency range. Usually, this factor needs to be controlled between 10 Hz and 40 Hz in order to control the corresponding vibration. Therefore, in the process of installation of PLC, the requirements of overall heat dissipation should be fully considered, direct sunlight cannot occur, and some equipment with large calorific value should also be far away. It is required to keep the temperature between 0℃ and 50℃, which means that in the actual installation process of this equipment, the heat dissipation problem needs to be fully considered. In the future PLC application, the main development trends are: high speed, large capacity, multiple varieties, advanced and diversified programming languages, and richer intelligent modules.

4. Conclusion

With the rapid development of China's industry, higher requirements have been put forward for the technology of industrial automation production, which not only meets the requirements of product quality in production, but also improves production efficiency. PLC technology advances by leaps and bounds, its function is more perfect, its application field is gradually expanding, and the problems in practical application are gradually solved. In the field of industrial automation, the adoption of PLC control technology is necessary to meet the needs of society and is also the basic premise to ensure the level of automation. This paper selects the latest PLC products from Siemens to transform YL-335B, which is widely used in various colleges and universities. The reformed equipment runs stably and well, realizing the application of the latest automation technology in teaching. With the increasing status in the field of industrial automation control, PLC will be an important guarantee and support for the development of industrial automation in the future. In order to promote the further development of our country's industry, we should vigorously promote the application of PLC control technology in industrial automation production so as to make our country's industrial technology develop continuously. Relevant researchers should also continue to increase their research efforts and continuously improve the level of PLC control technology so that it can be better applied in the field of industrial automation.

Acknowledgement

References

[1] De Souza R H, Savazzi S, Becker L B. Network design and planning of wireless embedded systems for industrial automation[J]. Design Automation for Embedded Systems, 2015, 19(4):367-388.

[2] Yu L, Schüller, Andreas, Epple U. On the engineering design for systematic integration of agent-orientation in industrial automation[J]. ISA Transactions, 2014, 53(5):1404-1409.

[3] Ramezanifar A, Mohammadpour J, Grigoriadis K M. Sampled-data filtering for linear parameter varying systems[J]. International Journal of Systems Science, 2015, 46(3):474-487.

[4] Paulo Leitão, Colombo A W, Karnouskos S. Industrial automation based on cyber-physical systems technologies: Prototype implementations and challenges[J]. Computers in Industry, 2015, 81(C):11-25.

[5] Balfe N, Sharples S, Wilson J R. Impact of automation: Measurement of performance, workload and behaviour in a complex control environment[J]. Applied Ergonomics, 2015, 47:52-64.

[6] Yin S, Wang G, Yang X. Robust PLS approach for KPI-related prediction and diagnosis against outliers and missing data[J]. International Journal of Systems Science, 2014, 45(7):1375-1382.

[7] Rodríguez, Francisco, Maria D M C, Sánchez, Jorge Antonio, et al. Architecture to develop semi-virtual industrial laboratories for the interactive learning of process automation[J]. Computer Applications in Engineering Education, 2016, 24(3):335-346.

[8] Chen H, Xu J, Zhang B, et al. Improved parameter optimization method for complex assembly process in robotic manufacturing[J]. Industrial Robot: An International Journal, 2017, 44(1):21-27.

[9] Lavrikov S A, Kotsar', M. L, Lapidus A O, et al. Automation of High-Purity Zirconium Production from Wastes and Recycled Materials on Industrial Equipment at the Chepetskii Mechanical Plant[J]. Atomic Energy, 2014, 115(6):427-431.

[10] Denkena B, Friederichs J, Fuchs J. Design and analysis of a 2-DOF synchronous planar drive for machine tools[J]. Production Engineering, 2015, 9(1):125-132.

[11] Fan Q, Li S, Zhao Q. Extremal values on the harmonic number of trees[J]. International Journal of Computer Mathematics, 2015, 92(10):2036-2050.

[12] Zhang J, Schirner G. Towards closing the specification gap by integrating algorithm-level and system-level design[J]. Design Automation for Embedded Systems, 2015, 19(4):389-419.