

The Principle of PLC And Application in Constrction Materials Industry

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Abstract—The paper introduces PLC, analyzes PLC's feature, application in building materials industry, trend of development in future. It also disusses the fact that development of controll theory and tecnology of computer together with communication pushes PLC ahead. As one of four most important tecnology in controll application scope, PLC will develop and play an important role in control field.The paper is prospective and directive for PLC.

Keywords-PLC;Scope of Application;Feature of PLC;Trend of Development;Building Materials Industry

I. INTRODUCTION

With the development of computer technology, controll theory, digital communication technology and microprocessor technology,PLC's birth and development conformed to modern industry requirements for rapid changes of market demand.It is only forty years that Since the first PLC was made in 1969^[1],but by right of its own advantages of very high reliability and performance-price ratio, well expansibility and good real- time performance , maintainability, now PLC is the most important technology in contoll and automation field and one of four pillars, which includes PLC, Numerical Control Technology, computer aided design technique and robotics^[2]. PLC is widely applied not only in industry but also in civil application, such as elevator,washing machine, traffic signal light and so on^[3].

II. PRINCIPLE OF PLC

The program in CPU of PLC includes operating system and user program.Operating system is used for dealing with tasks,for example start-stop of PLC,refreshing process map area,calling user program, processing errors,managing storage area and communication.User program is made by user,which is used to finish automation controll tasks^[4].

PLC adopts working mode of cycling scanning which is also called scan mode(See figure 1).

- 1.Operating system starts cycling time monitoring.
- 2.CPU writes data from out process map area to output module.
- 3.Read data from input module and store them into input process map area.
- 4.CPU deals with data from input module and executes program.

5.At the end of cycling scan, operating system implement all hang-up task,for example to download and delete block,recevive and send data.

6.Return to 1,start new cycling scan.

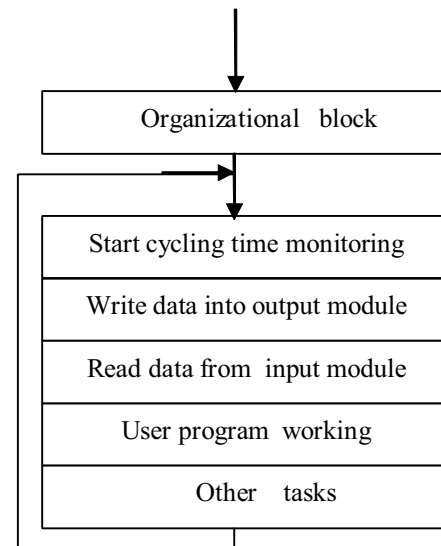


Figure 1.Principle of PLC

III. MAIN FEATURE OF PLC

PLC control system is that it regards PLC as control key component, utilize special I/O module to form hardware of control system with a small amount of measurement and peripheral circuit , to realize control to the whole system through programming.

1. High Reliability

Strong anti-interference quality and very high reliability are the most important features of PLC^[5]. In order to make PLC work stably in strong interferential circumstance,Many techniques are applied in PLC.Software controll instead of relay controll reduces ectronic components and hardware, therefore the controll mode can **decrease** faults which are brought about by original electric contact spot outside working badly. Industrial grade components made by advanced processing technology can resist interferences, and self-diagnosis messures of watchdog circuit for protecting memory can improve performance of PLC greatly. These way reduce hardware fault.The application of redundancy technique, Power failure protection technique, fault

diagnosis and display technique improve stability of PLC and reduce operation fault of PLC^[6].

2. Good Flexibility

There are several programming languages for PLC including ladder diagram, SFC, STL, ST and so on^[7]. If operator can master only one of programming languages, he can operate PLC well. Every who want to use PLC has a good choice. Based on engineering practice, capacity and function can be expanded by expanding number of module, so PLC has a good flexibility^[8].

3. Quality of Strong Easy-operating

It is very easy to edit and modify program for PLC by computer off line or on line^[9]. It is very easy to find out where the fault lie by displaying the information of fault and function of Self-diagnosing Function, and all these make maintenance and repair for PLC easier. It is very easy to configure PLC because of modularization, standardization, serialization of PLC.

V. APPLICATION FIELDS OF PLC

PLC is widely applied in all industrial departments in developed countries, which include Steel Industry, [petroleum industry](#), chemical industry, automobile industry, electricity industry, construction material industry, machine manufacturing industry and so on. With the development of all kinds of technology, function of PLC has improved dramatically, therefore application scope of PLC has enlarged continuously^[10].

1. Logical Control of Switch Signal

This is the most important function. The design idea of PLC is logical control of switch signal. PLC substituting for control of relay can realize combinational logic control, timing control, sequence logical control. The logical control of switch signal is used on single machine, for example injection molding machine, printer, modular machine Tool, grinding machine and so on. It also can be used on automatic production line.

2. Motion Control

Proper motion control module possessing function of simulating motion law precisely control position and speed which is widely applied in processing machinery, elevator and robot.

3. Analog Signal Processing Control

PLC can realize digital - analog conversion and analog - digital conversion by means of I/O analog module, and finish PID closed-loop control. The function is used in some situation, such as temperature, liquid flow.

4. Data Processing

The newly PLC possesses mathematical operation function, such as four arithmetic operations of integer, matrix operation, function operation, logical operation of word, complementary operation, cyclic shift operation and so on, and transmit data, then finish collecting data, analyzing data, processing data.

5. Network Communication

PLC can communicate with other PLC, remote I/O module, can communicate with several PLCs, can constitute DCS with intelligent device.

VI. APPLICATION OF PLC IN CONSTRUCTION MATERIAL INDUSTRY

In Construction Material Industry, PLC is used in two ways. One way is that PLC is used independently to control one or several machines, such as mill and cutting machine. The other way is that PLC as lower computer constitute DCS with intelligent device through Bus Communication to control a part of Production Line. Schematic diagram is as follows: Figure 2.

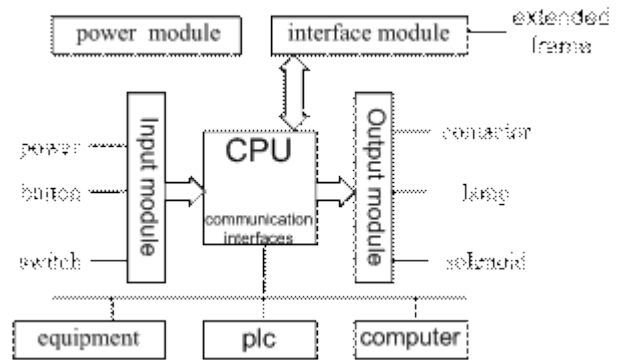


Figure 2. Schematic diagram of control system

1 Application of PLC in Glass Industry

PLC was applied in Glass industry in 1980s^[11]. Since then, PLC was assembled bit by bit. Nowadays PLC has been used in every procedure and every workshop to control many machines, such as electronic scale used to control material ratio, equipment of cold forging, the processing of flat glass and so on.

With development of PLC and enhancement of productivity demand, the control mode of PLC together with intelligent device is being applied in Glass Industry. Under the production of Float Glass, only PLC by itself can not finish control tasks because of complexity of control system and processing analog, a large number of data. Now we can use Bus Technology to construct the control mode of PLC together with DCS (i.e. Distributed Control System), in which DCS deal with data recording and analog controlling and PLC is responsible for position control and digital quantity control^[12]. This kind of control mode can bring advantage of both DCS and PLC into full play to improve reliability and flexibility of control system. In the meantime in Production Line of toughened glass, control system adopts the other control mode, that is to say, PLC as lower computer constitute DCS with Industrial Computer. This control mode gives full play to function of both PLC and Industrial Computer, in which PLC is responsible for position control and digital quantity control and Industrial Computer deal with data acquisition and display^[13]. In this mode human-computer interaction technology is conveniently used to improve function of control system.

2 Application of PLC in Cement Industry

Nowadays, various control systems of DCS come into being in view of various conditions and various network form through Bus Technology to achieve Automatization of

production and management in factory^[14]. Existing DCS based on original control system in which PLC is widely used mode of SCADA, that is to say this kind of mode is composed of configuration software and PLC. The SCADA mode is composed of host computer and PLC. Host computer contains master station and slave station. PLC as a lower computer to control real device, such as batching system of raw materials, kiln of coal mill, ball mill, shaft kiln and so on. Due to openness and performance-price ratio, this kind of DCS is widely applied in middle and small process control system, subsystem of large process control system in cement factory^[15].

3 Application of PLC in Steel Industry

In the early 1980s our country began to import complete sets of production equipment for steel in which PLC is used for control system. At that time, there are tens of kinds of brands of PLCs containing up to two hundred of PLCs on a set of equipment. Nowadays, in view of advantage of combination with real machine PLC as lower computer has been used widely in production line for steel. PLC has played an important role in every procedure and machine, such as controlling temperature and pressure in boilers, lifting electrodes, feeding [oxygen lance](#) for steel, controlling cooling bed and so on^[16,17].

4 Application of PLC in fly ash brick Industry

Effective utilization of fly ash not only is beneficial to environmental protection but also increase social and economic benefit and promote circular economy. Fly ash brick is an effective way to utilize fly ash. The control system is of significance to the quality of brick. The production line contains many unit equipments, such as Proportioning System, Brickmaking Machine, autoclave and so on. DCS and PLC are put into use in control system. PLC is used for simple production, at the same time DCS is applied in sophisticated production, in which PLCs as lower computer control the machines^[18,19].

VI. DEVELOPMENT TREND OF PLC

In control field, Real-time Property, stability and reliability determine development trend of PLC, in which PLC should be more easily to use structurally. Guiding ideology of development of PLC is that PLC possess quality of power function, high reliability, high performance-price ratio, more easily application^[20].

1. In order to adapt itself to control field, PLC will develop towards maximization and miniaturization.
2. In order to hence reliability and improve operability, PLC will develop towards intellectualization and standardization.
3. In order to hence flexibility and improve openness, PLC will develop towards diversification of function^[21].
4. In order to exchange data and information easily, PLC will develop towards network.

VII. CONCLUSION

Since it was born, PLC has been developing, being improved because PLC was made according to design idea of computer and adaptation of any circumstance of industrial field. Therefore with development of computer technology,

control theory, digital communication technology and microprocessor technology, PLC must ultimately resort to these new technologies to improve its development and perfect its function, so it can catch up with development trend of industrial automation^[22].

REFERENCE

- [1] HAO Zhan-cun. Summary of Programmable Controller's Developing Process[J]. HEBEI JOURNAL OF INDUSTRIAL SCIENCE & TECHNOLOGY, 2004, 2(2):53—56.
- [2] HU Xue-lin. Course of Programmable Controller[M]. Beijing Electronic Industry Press, 2005.
- [3] Liao Chang-chu. Course on PLC[M]. Beijing China Machine Press, 2006.
- [4] SIEMENS AG. SIMATIC S7-200 Programmable Controller System Manual. 2004
- [5] Wang Jun. Summary of PLC[J]. SCIENCE & TECHNOLOGY INFORMATION, 2008 (4) 80—82.
- [6] Zhao Rong, Zhang Wei-qiang. Application of PLC in Industrial Automation[J]. SCIENCE & TECHNOLOGY INFORMATION, 2007 (19) 310.
- [7] Xia Jie. Application And Development of PLC[J]. Consume Guide, 2007 (7) 247—248.
- [8] Yang Jin-zun. Characteristics and Development Trend of PLC [J]. Modern Electronic Technology, 2007 (14) 1—14.
- [9] Zhang Dong-ming, Wen You-xian. Development And Application of PLC[J]. Modern Agricultural Equipment, 2008(3):60-64.
- [10] Yao Dong, Xin Yang-ming. Application of PLC [J]. Science and Technology Consulting Herald, 2007 (19) 310.
- [11] Wang Yi-tuo. Application and Development of PLC in Glass Industry[J]. GLASS, 2008, 27(4):11-20.
- [12] Chen Jianhua, Chen Wenzhi. Application of PLC and DCS at Float Glass Production [J]. GLASS, 2008 (11): 25—27.
- [13] Lu Jianzhong. The Application of S7-300 Control System in the Production Line of Toughened Glass [J]. SCIENCE & TECHNOLOGY INFORMATION, 2008 (30):379—343.
- [14] Tang Zong -jun, Duan Zhen-fei, Liu Hang. Application of parallel control system of IPC and PLC on plexiglass stretcher [J]. Modern Manufacturing Engineering, 2008(1):118—120.
- [15] Luo Gui-long, Li Gao-dou. Application of Control System in Cement Industry[J]. China Cement, 2007(6):91—93.
- [16] Tang Jianjun, Li Changrong, Hong xin. APPLICATION OF PLC CONTROL TECHNOLOGY IN IRON AND STEEL INDUSTRY[J]. Research on Iron & Steel, 2003(8) 50—53.
- [17] Li Yue-mei. Application of PLC in Steel Industry[J]. SCIENCE & TECHNOLOGY INFORMATION, 2008 (19) 94.
- [18] QU Yun-qing, SHI Peng, ZHANG Yong-heng. The production procedure of the PLC controlled burning brick machinery [J]. Journal of Shijiazhuang Vocational Technology Institute, 2008, 20(4):35—80.
- [19] Fan Zhen-guo, Bai Feng-e. The Application of Supervisor and Control System Based on PLC in Production Process for Gangu Brickmaking[J]. Manufacturing Automation, 2008, 30(2):57—59.
- [20] Wei Yue-guo, Chen Bin-bing. Development Trend of PLC[J]. SCIENCE & TECHNOLOGY INFORMATION, 2008(22):45.
- [21] SUN Zhenqiang. The developing trend of Programmable Logic Controller [J]. Automation And Control, 2008 (4):80—82.
- [22] LIANG Chang x i n , JIATi n g gang , CHEN X i aoqi. The Status Quo and the Developing Trend of Industrial Automation

[J]. JOURNAL OF SHAN GHAI DIANJ I
UNIVERSITY,2008,11(3):235—238.