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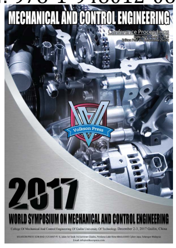

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PLC-BASED LEVEL CONTROL SYSTEM

Huidong Zhang[1], Jianhua Qin[2*]

[1]Department of Guilin University of Technology, 12 Jiangan Road, Guilin, Guangxi, 541004, China.
[2]The Guangxi Key Laboratory of Theory and Technology for Environmental Pollution Control, Guilin 541004, China.
**Corresponding Author email: qjianhua7@sina.com*

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ABSTRACT

In this paper, Siemens S7-300PLC is adopted to receive the data of liquid level sensor through the AD module. The control parameters of the collected liquid level are processed and the mathematical model is converted and the instructions are sent to the PLC. PLC adopts the PID control method, set and self-determined by the parameters of PID control. ，eliminates the control process of static poor, the control parameter reaches a given value so as to realize the precise control of the liquid level closed loop regulation. Then the WINCC configuration software is used to design the human interface to connect the configuration to the PLC, and to reflect the real-time change of the fluid in the field in real time.

1. Introduction

In the industrial process of automatic control, a very important control parameter is the liquid level. Whether the level of a system is stable or not directly affects the safety of industrial production, the efficiency of production, whether the energy can be reasonably utilized and so on [1]. With the requirements of industrial control higher and higher, the general automation control has not been able to meet the needs of industrial production control, so we have introduced programmable logic control (also known as PLC). PLC is the abbreviation of programmable logic controller (PLC). It is a kind of digital operation electronic system. It is a new type of industrial control device based on microprocessor, which integrates computer technology, automatic control technology and communication technology [2]. It has the advantages of simple structure, convenient programming and high reliability. It has been widely used in the automatic control of industrial process. In this paper, the control of liquid level is realized through the measurement of typical process number, signal processing technology and control system design in typical industrial production process.

2. THE DESIGN OF SYSTEM HARDWARE

2.1 System Hardware Design

The hardware design mainly includes a set of equipment, process control system (including three flow water tanks, a water storage tank, a plurality of water pipes, a water pump switch number, etc.), a liquid level meter, an electric valve, a converter etc.

Frequency converter: SIEMENS inverterM420
Pump motor: The a02-7112 series of three asynchronous motors produced by Zhejiang Songjiu motor co., LTD Hardware configuration: programmable logic controller CPU 314C-2 PN/DP;
Power Supply: SIEMENS power modulePS307/5A
Analog input: SM331 ;
Analog output: SM332
Digital module: SM323;

2.2 Framework

Whole system hardware design as shown in the Figure 1.

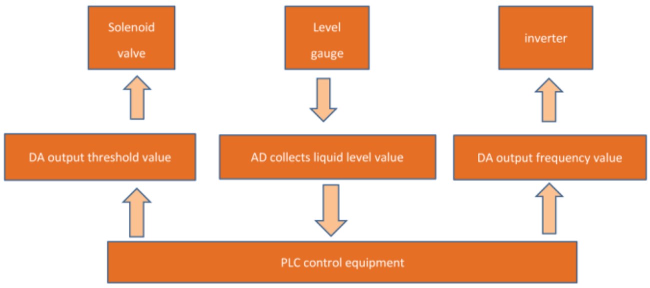

Figure 1: *System structure diagram*

Hardware connection diagram as shown in the Figure2.

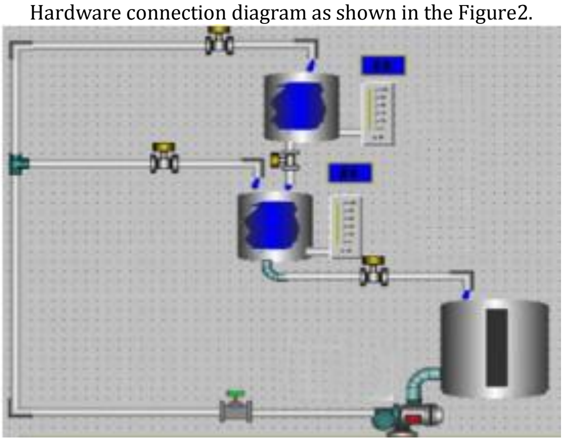

Figure 2: Hardware connection diagram

2.3 The Distribution list of the system I/O

The appellation and address of the input and output are as shown in the Table 1.

Table 1: The Allocation Table of I/O

Appellation	Address	Remarks
FC105_IN	PIW262	Analog input
FC105_OUT	MD102	Analog output

BIPOLAR	I8.0	Start conversion mode
SP_INT	MD200	Initial given value
PV_IN	MD102	Feedback input
GAIN	DB1.DBD14	Proportional value
TI	MD160	Integral time
LMN	MD150	PID regulated output
FC106_IN	MD150	Digital input
FC106_OUT	MW250	Digital output
PQW276	MW250	Given value of inverter
PQW278	27648	Given value of electric valve

2.4 HW Configuration

The hardware configuration is shown in the figure 3.

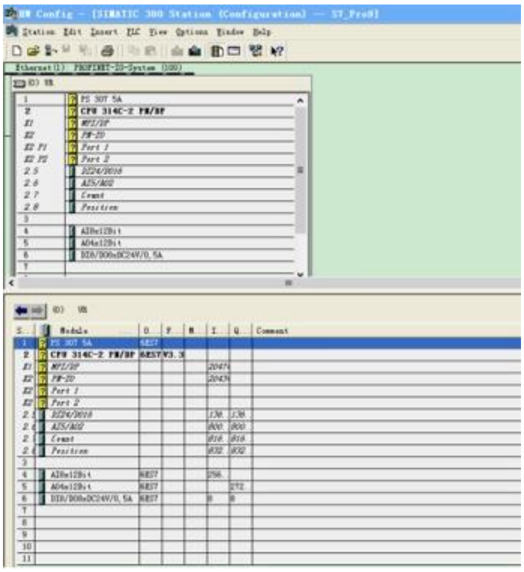

Figure 3: Hardware Configuration

3. SYSTEM SOFTWARE DESIGN

The software design part contains two parts, which are the design of control interface configuration software and the design of PLC program based on STEP7.

3.1 WINCC Configuration software design

Create a WINCC project, the design of the human computer interaction interface is shown in the figure 4.

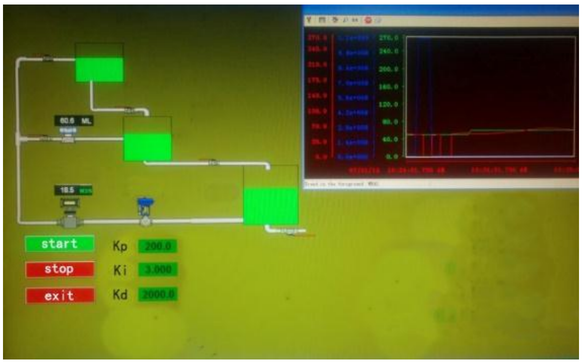

Figure 4: WINCC Design of Human Computer Interaction Interface

3.2 PLC Program design

The PLC program design mainly includes analog-to-digital conversion, digital- to -analog conversion, PID adjustment module. The flow chart is shown in figure 5.

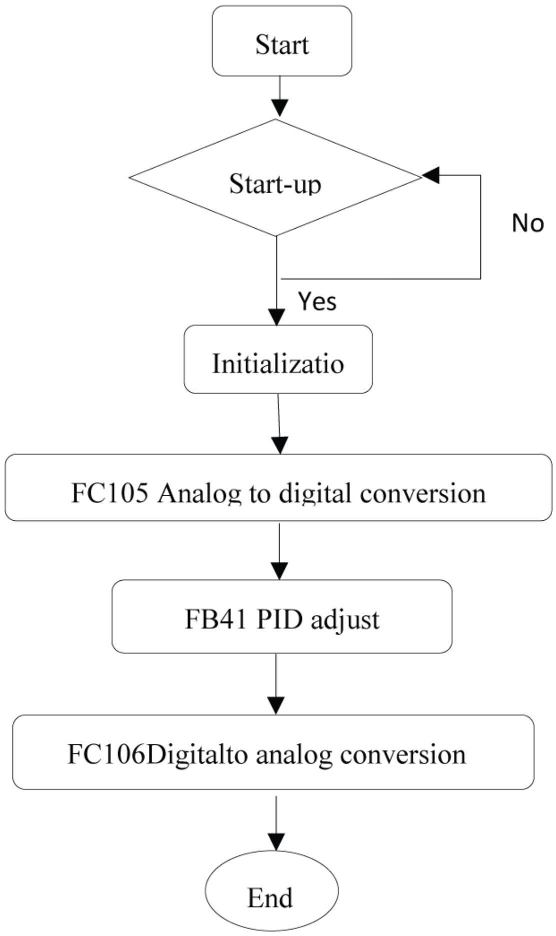

Figure 5: Flow chart of program design

3.2.1 The Analog to Digital Conversion Module FC105

The Ladder diagram of the analog to digital conversion module FC105 is shown in figure6. The analog input value is the current value measured by the current level meter. The corresponding address of PIW262 is the Current value of Liquid level meter I. Then, the input value is converted to a real shape value by FC105, and is transmitted to MD102.

3.2.2 The PID Adjustment Module FB41

The design uses continuous control mode, so we use FB41 to implement.

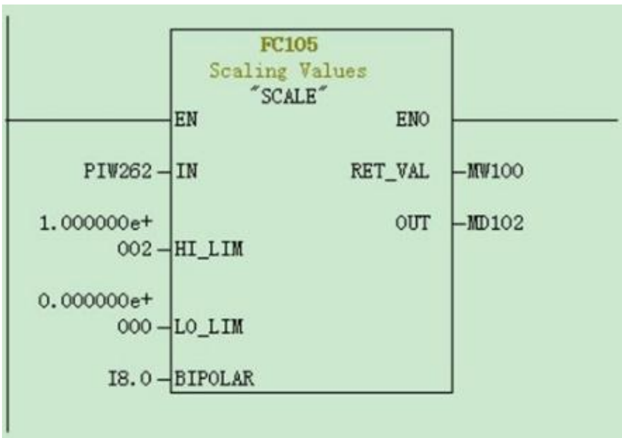

Figure 6: Ladder diagram of FC105 module

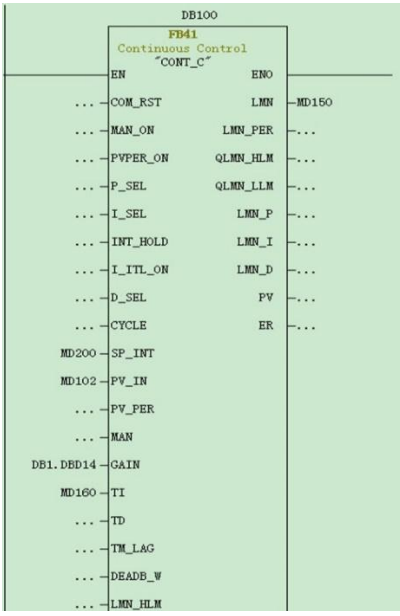

Figure 7: Ladder diagram of FB41 module

3.2.3 The Digital Mode Conversion Module Fc106

The core of this design digital mode conversion module is FC106. The output value of the PID is used as its input value. Then converter is sent to the converter. The address of the converter is PQW276.And then we can Control the liquid level by control the input voltage of the converter.

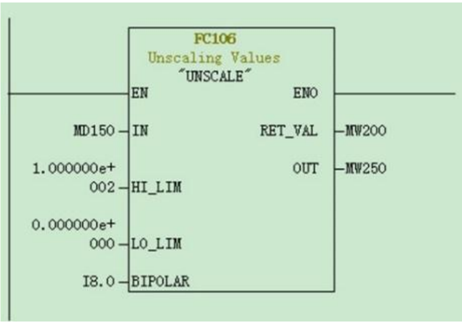

Figure 8: Ladder diagram of FC106 module

4. DEBUGGING AND RESULT

4.1 Debugging

The debugging process includes hardware debugging and software debugging, hardware debugging through current meter observation of current value data and collected the corresponding, the premise is already set for inverter control mode, each part of the line is connected [3]. The liquid level meter and the analog input module short circuit, solenoid valve and the corresponding analog output corresponding to the inverter interface converter input and analog output connection excuse. By changing the input current value of the corresponding device, debug the observation line whether there is a problem.

Software debugging includes the PC configuration software debugging and STEP7 debugging, debugging configuration software is mainly test run state variable window is abnormal, and the column chart and graph variables are set correctly. PLC programming debugging in two steps [2]. First, on-line debugging between hardware and equipment directly, to observe whether the analog to digital and analog to digital conversion is correct, and whether the PID adjustment is effective or not. Second, through the host computer and the hardware debug through the PC settings window, set the PID parameters, PID parameters obtained after the ideal observation of PID adjustment curve.

4.2 Result

The ladder diagram program is debugged with the upper computer and the hardware equipment. The change of the output response curve is observed, and the stability of the system is judged. Finally, a stable PID parameter value is determined. The final result is shown in the following picture.

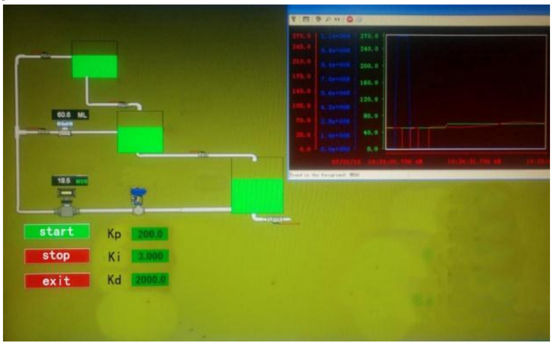

Figure 9: The simulation curve when the setting value is 60

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