

# Research on Monitoring and Alarm System of Ship Power Station Based on PLC and Labview

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## Abstract

The ship's power system plays a very important role in the entire ship's sailing process. Its stable operation is of great significance to the normal operation of communication equipment, navigation equipment and power equipment. Therefore, the performance requirements of the shipboard equipment on the power station are getting higher and higher. With the rapid development of computer communication technology, power station monitoring systems are becoming more intelligent and real-time. The monitoring network based on PLC industrial control computer has been widely used in the field of industrial automation, which has the characteristics of low cost, stable performance, and simple installation. This paper proposes a power station monitoring system based on Siemens S7-1200PLC, combined with Labview software management platform. The human-machine interaction monitoring function is realized, which has a good application prospect.

## Keywords

Labview; PLC; Ship power station; Monitoring alarm.

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## 1. Introduction

With the rapid development of the world shipping industry, the ship's own functions have become more and more diverse, equipped with more electrified equipment. In order to ensure the normal operation of each device, the power system of the ship has become a very important part. Generally, as the core part of the entire shipboard power system, the reliability and safety of the power station can meet the power supply requirements of most equipment in real time. Especially during ocean voyages, the harsh environment on the sea surface will cause great challenges to its stable operation. To this end, only by establishing a suitable power plant monitoring system, real-time monitoring of the power plant's operating status, and corresponding warnings can be given to sudden conditions. To ensure the normal operation of the ship's electrical equipment and navigation safety. In order to meet the above requirements, there have been many monitoring systems, but the early monitoring is generally simple relay control, contact devices and other non-intelligent systems. With the rapid development of computer network technology and single-chip microcomputer technology, a PLC-based field automation monitoring system has emerged. In combination with a remote Internet network, the crew can also realize remote control, which greatly reduces the monitoring cost and improves the monitoring effect. This paper is based on PLC technology to propose a power station monitoring system based on Siemens ST-1200PLC. With the help of Labview software platform, the software control of the computer interface is realized.

## 2. Monitoring principle of ship power station

Marine power station is different from ordinary industrial power station. Because of its special purpose and harsh working environment, it needs to face more technical difficulties, but its basic component modules are similar. Generally consists of the following functional modules:

- 1) Generator system, which is responsible for converting chemical energy or other forms of energy into electrical energy, usually diesel generators;
- 2) As an important carrier connecting the power generation system and electrical equipment, the power configuration network must be able to effectively transmit power, reduce losses, reduce costs, and also include necessary monitoring and debugging equipment;
- 3) Electrical equipment management is also a very important link. This part is responsible for monitoring the power load of the equipment, classifying the type of power consumption, divided into strong power, weak points and emergency power. The monitoring system of the ship power station includes a control part and a monitoring part. The control part is responsible for handling the conventional fault handling of the power station and helping the power system to switch to the standby power generation system. When a fault occurs, it can adjust the power consumption of the equipment and reduce the system's laws and regulations. Or start the battery power supply to avoid major accidents. There is also an automatic monitoring system. This system is responsible for collecting the mechanical parameters, operating parameters and other electrical states of the power station equipment in real time [3]. And can make automatic analysis of these data, give early warning of potential failures, and notify the crew of the ship's cabin through acoustic and optical equipment to take appropriate measures.

## 3. Design of ship power station monitoring system

### 3.1 System hardware composition

The hardware composition principle of the marine power station monitoring system based on PLC and Labview designed in this paper is shown in Figure 1.

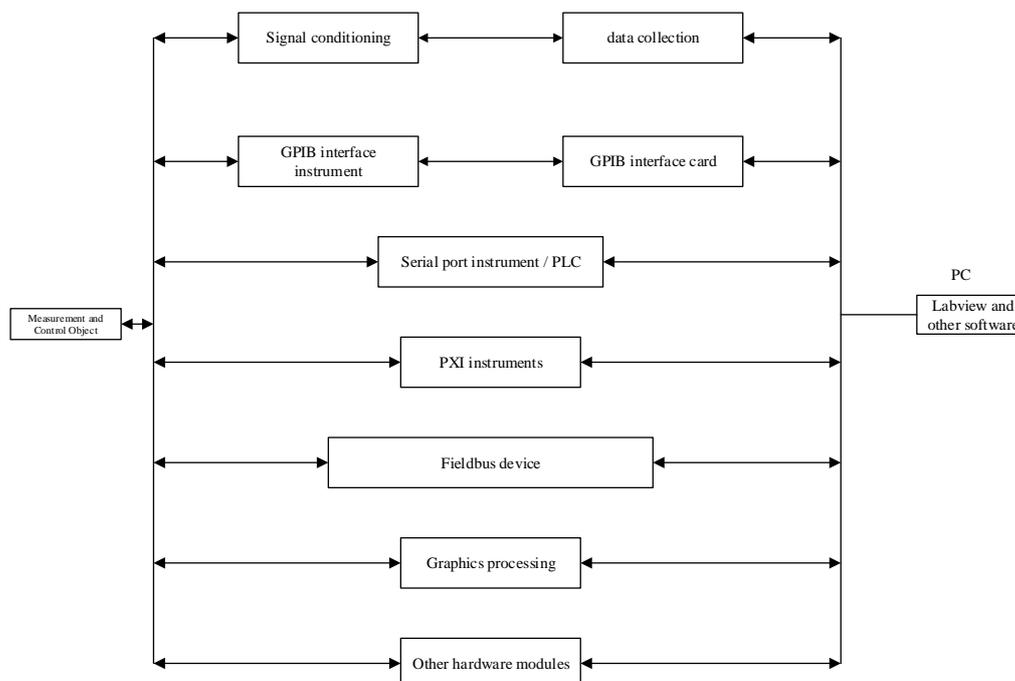


Figure 1 Hardware composition diagram of power station monitoring system

The system includes a PC bus built-in data acquisition board, a serial bus interface card, a universal interface bus interface card, a PXI bus instrument and a Labview working platform. Here are some of the important modules:

### 3.2 Hardware design of ship monitoring system

#### 3.2.1 The main hardware configuration of the monitoring system

Programmable controllers (PLCs) are widely used in industrial control. PLCs are generally used as negative data collection and logic control for lower-level machines in industrial field control. Industrial control machines are used as upper-level machines to collect and visualize data. This form is used in the monitoring system of this ship's power station:

(1) The upper computer is an IPC-610 industrial control machine produced by Advantech, a workstation with a liquid crystal display.

(2) The lower computer is composed of S7-1200PLC and four protection and power management controllers (PPM). S7-1200PLC controls four PPM300 at the same time, and each generator set is controlled by its corresponding PPM300. The PROFINET Ethernet of S7-1200PLC The network communication interface and the four PPM300s are connected by a ring network composed of Ethernet, so as to realize the communication between the upper and lower computers.

#### 3.2.2 The composition and characteristics of PLC

##### (1) Composition and characteristics of Siemens S7-1200

In the monitoring system of the ship's power station, the main task of Siemens S7-1200 PLC is to accept the input of external electrical signals, calculate the input signals through internal programs, and finally refresh the output to the PLC output to control the corresponding electrical components to complete Expected tasks.

Siemens S7-1200 PLC is a small and medium-sized controller. It has its own advantages and is widely used. The composition and characteristics of Siemens S7-1200 series PLC are described below for reference by programmers during configuration.

##### 1) Composition of Siemens S7-1200 series PLC

The composition of the S7-1200 programmable controller includes:

A, controller, integrated PROFINET interface, used for communication between programming devices or other controllers.

B, the signal board can be directly inserted into the controller.

C, signal module, output and input channels of the expansion controller.

D, communication module, communication interface of expansion controller.

E, accessories, such as SIMATIC memory cards, switch modules and power supplies.

##### 2) Features of Siemens S7-1200 series PLC

A, The CPU has an integrated Ethernet interface.

B, through the expansion of the communication module, the signal board can be directly expanded on the CPU, keeping the original space of the CPU unchanged, thereby saving space.

C, users can choose a variety of memory cards with different capacities to achieve data storage.

D, with motion control function, can perform simple motion control; has a well-defined PID control algorithm function;

E, with password protection, hardware interrupts, function library functions, online / offline diagnostic functions, and terminals on all modules can be easily removed for easy installation and commissioning.

This article chooses the CPU 1212C DC / DC / Rly model. Expansion module: Analog input and output module SM1234 AI4 / AQ2, SM1234 contains 4-channel 13-bit analog input and 2-channel 14-bit analog output, module AI4 + AQ2; plug-in terminal block; optional frequency suppression; optional filtering; Diagnosis is configurable; PLC hardware wiring is shown in Figure 2, and the actual object is shown in Figure 3:



Large memory 10KB user program and 10KB user data can meet the required design requirements. Easy to switch between programming mode / remote / run via LCD display. The recipe data can be accessed through the ladder program, which allows fast and simple batch data update of timer, counter, and other data types. Channel 0 supports RS-485 serial communication. RS-485 supports direct connection to DH-485, DF1 half-duplex master-slave, ASCII, Modbus RTU master-slave network. One packet of the channel has a RJ45 communication port, which supports point-to-point Ethernet communication.

### 3.3 Monitoring system software application

#### 3.3.1 Introduction to graphical programming languages

LabVIEW is programming software developed by National Instruments. LabVIEW is a programming language like C language, but LabVIEW is different from other computers. The difference is that LabVIEW is a graphical programming language, commonly known as "G language", and the general computer programming language is a text-based programming language. Three elements of the LabVIEW programming language: front panel, block diagram, and data flow. The user can select the virtual instrument through the front panel controls to display the acquired signal in the instrument, and design the program according to the block diagram. LabVIEW runs the compiled VI according to the data flow mode. The so-called data flow means that the designed block diagram node can run only when all input terminals have the necessary input data. The data flow determines the order in which VIs execute.

LabVIEW software has the following characteristics:

- (1) Graphical programming language with good visual display. It is widely used in data acquisition, instrument measurement and process control.
- (2) The user can set a breakpoint on the source program. Through the single-step run button, the probe can monitor the data running on the data stream with the probe in the source program, which is convenient for the user to debug.
- (3) LabVIEW's rich function library is available for programmers to shorten the development cycle.
- (4) Has powerful Internet functions: LabVIEW supports TCP / IP and other functions.

#### 3.3.2 TIA V14

TIA V14 is a fully integrated automation programming software developed by Siemens. It is used for system self-diagnosis, fail-safe, expansion of new PROFINET interface communication capabilities, and enhanced support for Siemens S7-1200 controllers. , Can be programmed under the windows10 operating system, while improving the speed of the software to facilitate the use of developers.

The energy suite integrated in TIA V14 can automatically generate energy management project procedures, and it is simple, convenient, and efficient to manage energy data records, and the data is highly transparent. TIA V14's advanced simulator helps users reduce on-site debugging time and reduce debugging costs. The new version of the programming language greatly improves the programming efficiency, and at the same time strengthens the protection of the program to prevent unauthorized modification and illegal access by others. This system design S7-1200 PLC uses TIA V14 for programming, which saves development costs and shortens the development cycle.

#### 3.3.3 RSLogix 500

RSLogix500 programming software is a programming software of Rockwell PLC. Its software programming content includes: hardware configuration, I / O port configuration, and communication module configuration under RSLink. RSLogix500 programming software consists of task-specific applications and specifies applications within specific programming tasks. RSLogix500 programming software can automatically identify the configured hardware through software according to the hardware configuration, without manual configuration, read in the software and complete the input and output port configuration. This programming software implements unified management of the information exchanged.

RSLogix 500 programming software has a complete set of development tools, which can be mapped to field control equipment one by one through the application program. Its application program is divided into functional blocks for easy programming. RSLogix 500 programming software is easy to configure, and it provides the manager of controller, motion configuration, and tool I / O port configuration dialog box. A network configuration suite is integrated in the software, which can be embedded into RSLogix 500 programming software through RSlinx network component configuration, binding the built project with network communication information.

#### 4. Monitoring interface design

Using the visualization function of Labview, the power plant monitoring interface shown in Figure 4 is implemented. This interface can monitor the switching status of the switch and the power operation parameters.

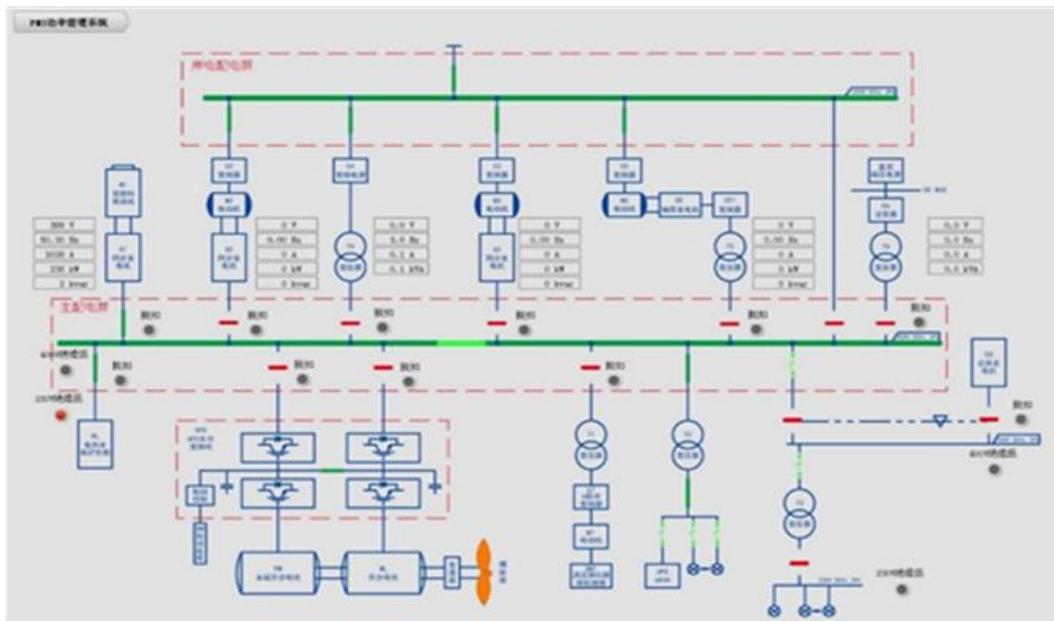


Figure 4 Power plant parameter monitoring interface

#### 5. Conclusion

Based on the analysis of the ship power station system, this paper proposes a feasible technical solution to realize real-time monitoring of the power station work. The analysis shows that the real-time visualization monitoring scheme based on PLC serial port control and Labview can be competent for the operation monitoring and fault early warning of power plant systems, and has certain application value.

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