Research on Ethernet Communication and Remote Control of PLC and PC

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Abstract. The communication mode of PC and PLC based on Web and Ethernet is made of PC, PLC and Ethernet module .In the view of the limitation of the scope of PLC control, the poor integration of control system, the bad unified control of real-time, and the communication mode of PC and PLC based on Web and Ethernet is proposed. A hardware system which included LabVIEW web server, PLC, Ethernet module, TP-Link, and stepper motors is designed. In addition, the software system of the Ethernet communication between PC and PLC based on TCP/IP Modbus protocol is developed by using the LabVIEW graphics software. Through the Web server of LabVIEW, the VI control panel is released to the Internet aiming at achieving the remote control. The feasibility of this communication mode is verified by the experiment of the speed feedback of the encoder.

Introduction

In the field of industrial control, PLC is applied widely in actual production because of high reliability, strong anti-interference ability, flexible function module, easy combination, but because there are all kinds of the Field buses, making the integration of control system inconvenience. In addition, the current control of the PLC is limited to the close range of control, but also to limit the construction of a fully open, fully decentralized, unified control of industrial control system [1]. Therefore, on account of the TCP / IP protocol, the LabVIEW of TCP / IP function and LabVIEW integrated remote panel technology, the article put forward the communication mode of PC and PLC based on Web and Ethernet by using PLC Ethernet module.

The component of the communication system between PC and PLC based on Web and Ethernet

Hardware system and software system comprise the communication system between PC and PLC based on Web and Ethernet.

The component of hardware system

Figure 1 shows the system hardware components, it consists of the client PC, LabVIEW server, TP-Link, PLC, stepper motor group. The remote client get access to the Internet by visiting VI Web server based on LabVIEW remote panel technology [2]. Remote clients can achieve remote control by control panel without installing LabVIEW, DCI Soft and WPL Soft software, so the remote control mode makes those nonprofessional technical personnel easy to operation in the control process. In addition, it has achieved the goal of remote control, real-time data acquisition and processing. LabVIEW Web PC server connect to PLC Ethernet module of the static IP through the TP-Link LAN .Data transmission is based on the TCP/IP Modbus protocol to achieve the function of the instruction code (data frame) transmission.
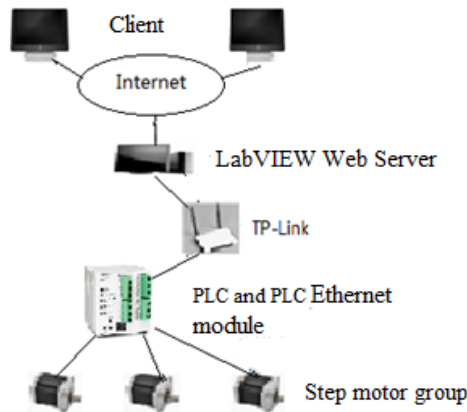
Fig.1 Hardware System Composition

The component of software system

The software system of the communication between PC and PLC based on Web and Ethernet consists of PC and PLC, including the PC cover remote clients have access to visiting to the LabVIEW of Web server and the Ethernet communication between PC and PLC, while PLC includes the Ethernet communication of between PLC and PC. Communication protocol is Modbus TCP / IP protocol and Ethernet communication realized by PLC module, the   component of software system as shown in Figure 2.
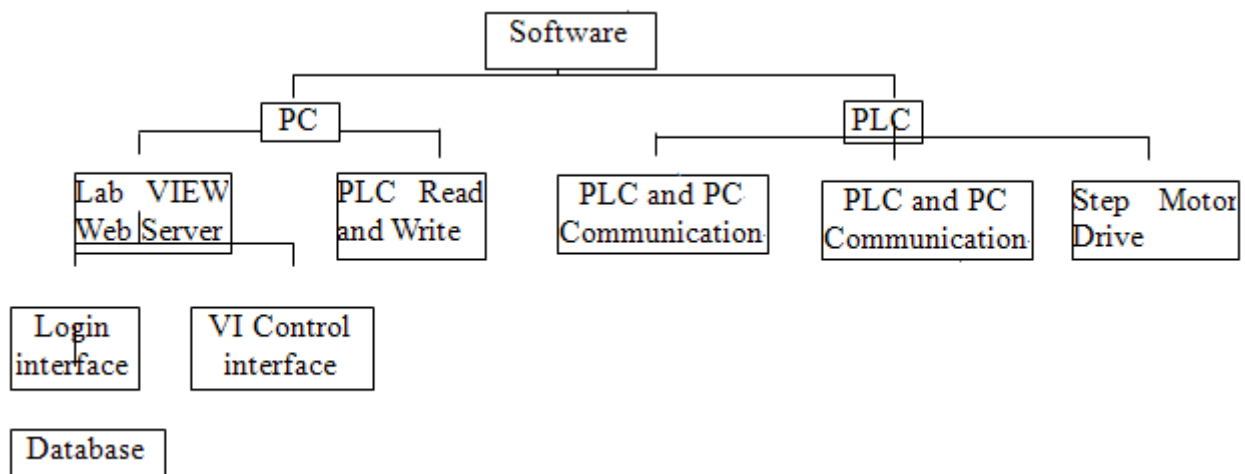

Fig.2 Software System Composition

Communication protocol and Communication process

Modbus TCP/IP protocol

The communication protocol of the communication mode of PC and PLC based on Web and Ethernet is Modbus TCP/IP protocol, TCP/IP Modbus protocol is formed on the Modbus application layer protocol, and its data (ADU) contains the message header, function code, data 3 parts. As shown in table 1.

Table1 Modbus TCP/IP data frame

MBAP header	Function code	data

The length of MBAP Header is seven byte, it is composed of four parts [3] such as the transaction identifier for the transmission symbol, in master / slave communication the sign of MODBUS request or response of transmission, usually by the master to generate, from the station in response to a request for copy the value; protocol identifier for the deal marks, its value is 0 that indicates the Modbus protocol, while the value is 1which indicates UN-TE protocol; Length

indicates the length of the sum of the domain subsequent bytes; Unit identifier is mark unit, used to define the device address of the station.

Table.2 MBAP Header

Transaction	Protocol Identified	Length	Unit Identifier
00 00	00 00	00 06	01

MBAP header the transaction identifier usually sets to 00 00, indicates the server copy; protocol identifier usually sets to 00 00, indicates MODBUS protocol; the value of Length is 06 00, representing the data length; unit identifier value is 01 indicates the device address of the station.

Communication process

According to communication mode, remote control system is divided into two types: client and server mode (C/S mode) and browser / server mode (B/S mode) [4]. B/S simplifies the client, you do not have to install different programs in different clients, and can also set the permissions of access to improve the security of the system. The system update is mainly completed by the Web server. LabVIEW in the remote panel (Front Panel Remote) technology is one of B/S mode [5], the customers have access to acquiring the power of control mainly through the Web LabVIEW server.
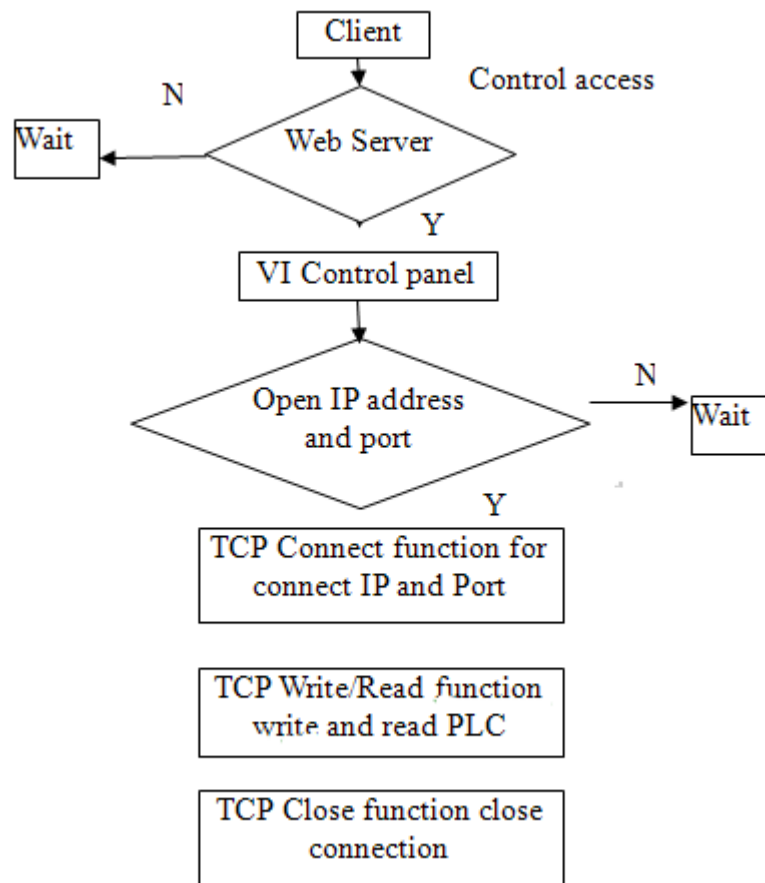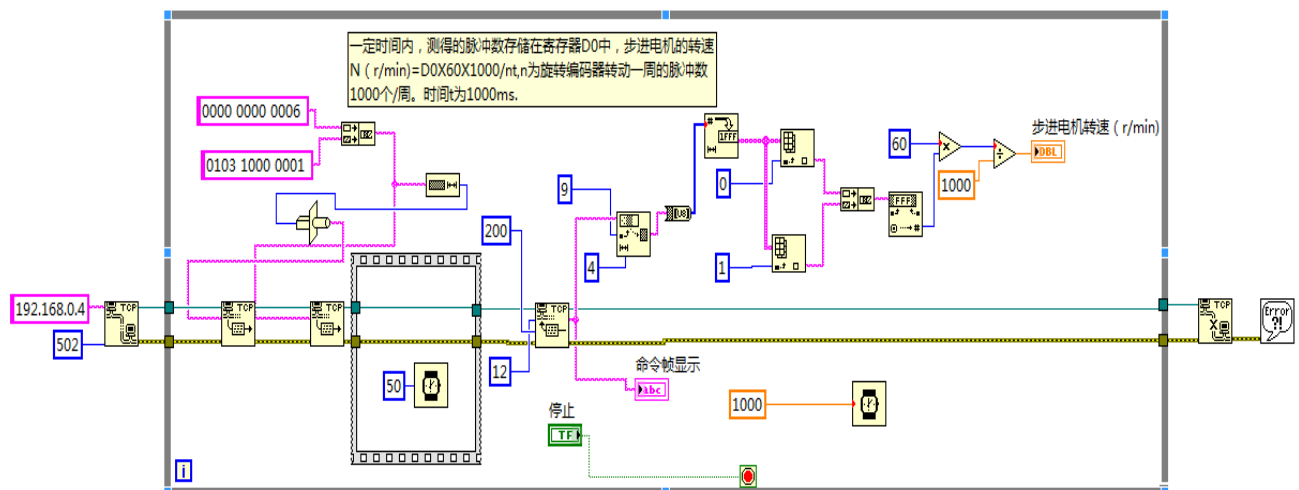

Fig.3 Communication Flowchart

As shown in Figure 3, the clients get control permissions from the Web LabVIEW server for controlling the VI front panel. When PLC Ethernet ports open, LabVIEW adopts embedded TCP / IP protocol of network communication, this paper makes PLC as the server and PC as the client, using LabVIEW node function TCP Open [6], the port number 502 and the default IP of DVPEN01-SL to establish the connection between PC and PLC. For example, IP's DVPEN01-SL address: [192.168.0.4]; subnet mask: [255.255.255.0]; default gateway: PC; IP [192.168.0.1] for 192.168.0.3. Use the write function of TCP nodes to send function instruction code to PLC, for example, a group of data frames for 0000 0000 0006 0105 0800FF00, 0000 0000 0006 represents fixed data packet headers, 01 indicates the PLC of station number, 05 represents the function code of drive a single coil, 0800FF00 indicates stepper motor driver data code expression.

Communication and control experiment

In order to verify the feasibility of the communication between PLC and PC based on Web and Ethernet, That the PC read and write operation of PLC is carried out under the condition of Ethernet communication in Ethernet module. In the experiment, it is mainly to monitor and adjust the speed of the 57BYGH250C step motor, the upper computer is based on the LabVIEW development of the man-machine interface and monitoring interface. In communications, the LabVIEW of TCP toolkit and DVPEN01 Ethernet module finish communication connection in TP-Link Lan. Information feedback, the rotary encoder stepper motor speed real-time feedback to the PLC, and then, the host computer read or write the PLC of internal register, thus completing the data interaction of the host computer and stepper motor.

Figure 4 shows that PC and PLC achieve Ethernet communication through the PLC of IP address 192.168.0.4 and port number 502. Using TCP/IP Modbus communication protocol, the header part of the code is 00000000000601, the function code is 03, the data is 10000001. This data frame convey the command of read the internal register D0 to PLC, read TCP function starts reading the encoder registers in the register D0, the sampling period of the program is 1 second. Finally the LabVIEW graphical interface display the stepper motor speed feedback.

Fig.4 Stepper Motor Encoder Feedback Code

一定时间内，测得的脉冲数存储在寄存器D0中，步进电机的转速
N（r/min）=D0X60X1000/nt,n为旋转编码器转动一周的脉冲数
1000个/周。时间t为1000ms.

0000 0000 0006

0103 1000 0001

步进电机转速（r/min）

命令帧显示

停止

In addition, written in WPLSOFT PLC program code [8] as shown in Figure 5, which PLSY k1000 K0 Y0 said sends pulse frequency 1000Hz to PLC continuously, pulse infinite number of pulses, SPD x1 k1000 d0 represented read send existing registers d0 pulse number every second , the formula n = 60 * [10] ^ 3 x D0/nt (n for the encoder to turn a circle of pulse number is 1000, and t is the pulse time 1000ms) is used for translating into stepper motor speed.

```
M1002
 |  |                                              MOV    K0      D0
M1000
 |  |                                              PLSY   K1000   K0      Y0

                                                   SPD    X1      K1000   D0

                                                   END
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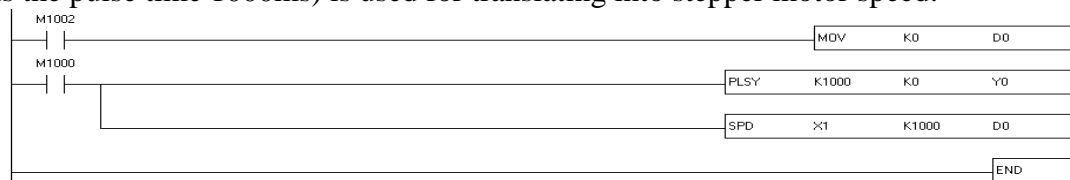
Fig.5 PLC Program Executing Code

Due to the LabVIEW embedded web server function, so there is no need to develop a web service application, only need simple to set up remote clients can upgrade the original stand-alone version of the measurement and control system for web remote measurement and control system. Remote clients can access the web publishing LabVIEW VI in VI control conditions to achieve remote control client, according to the need of actual production, the user can set the parameter values in order to achieve the control objective, the remote control interface as shown in Figure 6.

Fig.6 Remote Control Interface

Conclusion

The control mode of Web page has changed the traditional one to one, short distance control mode, this kind of control mode is easy to operate for nonprofessionals, and strong real-time operation enable the operator conduct real-time data interaction [9] with the control object. LabVIEW graphics software remote panel technology enables Web server easy to create and accessible. In addition, in the communication between PC and PLC. Compared with the traditional RS232 serial communication, Ethernet communication mode not only in the data transmission speed and the amount of data occupy obvious advantages, importantly, it expands the communication range and the lower position machine control, not just a PC controls a PLC, but a PC can conduct with a plurality of PLC to realize the data read and write between PLC and can be used for data of each transmission, greatly increased the flexibility of real-time control, speed, distance [10].

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