

Development of Data Acquisition System of Yalong YL-163A Innovative Motor Application Training Device

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Abstract: According to the limitations of Yalong YL-163A innovative motor application training device, this paper uses automatic control technology to design a motor test acquisition system, which completes the test of various characteristics of the motor, and collects, manages, displays and saves the experimental parameters of the tested motor in the test process. It is helpful to improve the teaching effect and the theoretical research of motor technology, and to improve the experimental teaching effect and efficiency.

Keywords: Data acquisition, PLC, MCGS.

1. Introduction

Motor is widely used in national defense industry, aerospace, industrial and agricultural production, as well as in various fields of daily life. It plays a huge role in modern manufacturing industry, and is used more and more widely. In recent years, with the vigorous development of the national economy, the market demand for motor assembly and operation technicians has been increasing, and higher and higher skill requirements have been put forward for motor professionals.

Yalong YL-163A innovative motor application training device combines the actual working scene of motor assembly and operation testing, equipped with adjustment and load changes, which truly reflects the actual work flow of motor drive. Its training content is extensive and varied. However, due to the lack of data acquisition system, the traditional manual testing method is still used, resulting in inaccurate experimental data. In order to facilitate classroom teaching and research experiments, there is a relatively perfect data acquisition system of motor application training equipment to enhance its application level in automatic testing, recording, data archiving and other aspects, this paper completes the development of data acquisition system of Yalong YL-163A innovative motor application training equipment based on PLC. It is of great practical significance to improve the teaching effect and the theoretical research of motor technology.

2. Overall Design of Data Acquisition System

Since Yalong YL-163A innovative motor application training device was designed and put into use, the overall operation has been normal, which is helpful for students to learn motor theory well in the process of practice. In order to make the test functions of the training device more diversified and realize the test and inspection functions that cannot be realized by the traditional manual test, the schematic diagram of the data acquisition system of the innovative motor application training device is shown in Figure 1.

(1) Yalong YL-163A innovative motor application training device is composed of detected system, detection and conversion system, measurement and control system and

output system. The detection and conversion system and the control system are composed of a motor, an instrument and a PLC, and the detection and conversion system is used for detecting field parameters such as torque and rotating speed and converting the field parameters into standard electric signals.

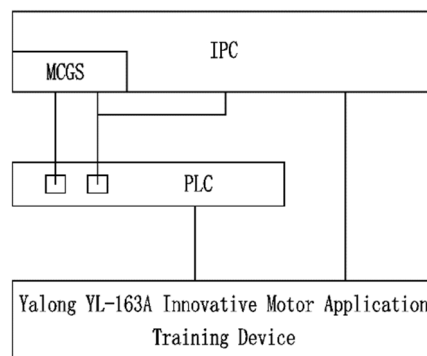


Figure 1. Schematic Diagram of Data Acquisition System Structure of Innovative Motor Application Training Device

(2) PLC is the center of the whole system. According to the requirements of the system for the controlled object, it collects the data of each node through the sensor network, calculates and processes the collected data, and finally feeds it back to MCGS for integration.

(3) MCGS can not directly collect data from the field node, but must forward it through the PLC field terminal. All parts of the system work together to complete the data collection, transmission, storage, analysis and display of Yalong YL-163A innovative motor application training device.

3. Hardware Design

(1) XMT808-I intelligent display controller

Under the ModBusRTU communication mode, the XMT808-I intelligent display controller does not need the upper computer to send data, and the instrument can send data continuously from the serial port.

1) Communication interface: standard serial RS-232/485 bidirectional interface, multi-machine address range 0-99; Baud rate 2400-38400 bps;

2) Data format: 1start bit + 8 data bits + 2 stop bits (no check bit, one stop bit);

3) Baud rate: settable (2400 — 38400), baud rate of 9600 and above is recommended;

4) Example of serial port setting (if the baud rate is 9600): 9600, 8, N, 1.

(2) Zn96 intelligent counter/raster meter

1) Setting method of Zn96 instrument counting mode: press and hold "SET" key for 3s to enter parameter sign display, and press "SET" key to display each parameter sign in turn. Descriptions of the main criteria are shown in Table 2.

2) P-XXXX setting method of pulse equivalent multiplying power: press "SET" key to hold for 3s, and display "P-XXXX" Parameter sign. At this time, the decimal point flashes. Press the " ^ "key to set the position of the decimal point. After the decimal point is set, press the " < "key to move the flashing position. At this time, the setting is the same as the above method.

(3) Serial debugging

Commix is a common serial port debugging tool, which can realize the reading and writing operation of the serial port. Because this design does not know whether the serial port of the PLC and the instrument is communicated, we use Commix to debug the serial port communication, determine the equipment communication parameters, and confirm the completeness of the equipment communication.

First, determine the serial port number of the machine, then select the communication parameters of the serial port, including data bit, baud rate, check bit and stop bit, then select the check mode and the data format for sending and receiving, and finally open the serial port to send messages. If the PLC communicates with the serial port of the instrument, the output box returns blue data.

4. Software Design

The software design is based on Mitsubishi PLC, and the core motor drive and control program is compiled, which is tested and verified by the experimental method, and can realize the data acquisition of the innovative motor application training device, and a set of configuration interface is developed to facilitate the use of students.

(1) Design of data acquisition system

1) Communication between Mitsubishi FX3U PLC and intelligent instrument Modbus

The data acquisition system of Yalong YL-163A innovative motor application training device is composed of Mitsubishi FX3U-32M PLC host and 485ADP-MB expansion module to communicate with the speed and torque module, which mainly realizes the acquisition of the actual motor speed and torque value of the speed and torque module by PLC. Set the communication parameters of the module as follows: baud rate: 9600 bps/s, 1stop bit, 8 data bits, no check.

2) PLC programming

After 485ADP-MB module is used for hardware, Modbus read and write commands can be directly used to communicate with Modbus equipment. First, PLC communication parameters are set according to the communication format of speed and torque module.

Modbus communication setting flag M8421 is used to set the communication parameters, and then the ADPRW command program is written to communicate with the speed and torque module. If communicating with the speed module, the ADPRW command format is ADPRW H2 H3 K0 K2 D200. Where, H2 is the slave station number; H2 represents the batch reading operation of the speed module register; K0

is the address number of the read register; K2 is the number of access points; D200 indicates that the data is stored in the storage area beginning with D10.

- The parameters of the master station are as follows:
- The program is set as port 485, MODBUS protocol;
- Baud rate: 9600, data length: 8 bits, stop bit: 1 bit;
- The main station is H1;
- The response timeout of the slave station is 2000 ms;
- Playback delay 400ms;
- The delay between requests is 10ms.

The data acquisition instruction is shown in Figure 2. As long as the M8000 PLC is running, the M8000 is always in the closed state until the PLC stops running. The M1 coil is energized, the normally open contact of M1 is closed, and FNC276-ADPRW starts to read the data of different D200 and D202 registers. When M8029 is executed, the pulse command is sent, and M8029 has a rising edge to reset M1. The PLC cyclically reads the data.

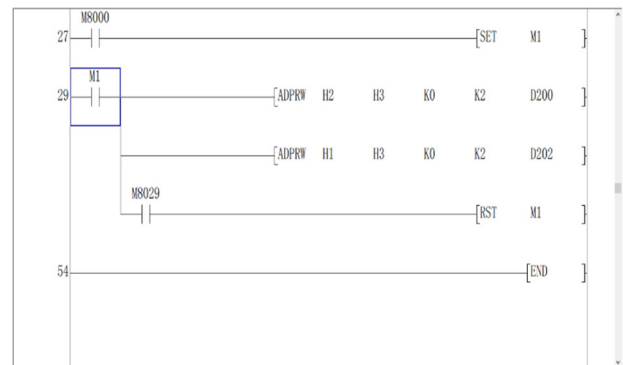


Figure 2. Data acquisition instruction

(2) Human-computer interaction interface design

The function of the design window of the motor speed and torque parameters acquisition system based on MCGS is mainly to control the operation of the screen, and the function of the data monitoring window is mainly to collect, monitor and analyze the data. In order to realize the acquisition better, the following functions are developed: remote control, system operation management and trend curve display.

1) Connection to the measurement object

In the MCGS user window interface, find the tab in the toolbox, click the attribute and find the display output, and find the object that needs to display the output in the expression. And selecting the motor torque parameter and the motor speed parameter which are set in the real-time database before.

2) Display of data acquisition

Connect the PLC and the computer, and make two input boxes for torque and speed to specify variables. The corresponding value will be displayed in the output box. Add the real-time curve graph in the data display window, select the motor speed or torque parameter in the real-time curve attribute expression, and divide by the corresponding value as required. Make three real-time curve tables, which are motor speed parameters and time, motor torque parameters and time, motor speed parameters and motor torque parameters, and set the abscissa and ordinate values as required.

5. Test Verification

According to the needs of practical teaching, this paper takes the practical training project of measuring the operating

characteristics of three-phase cage asynchronous motor as an example to illustrate the correctness of the data acquisition system.

The motor wiring is shown in Figure 3, and the motor winding is Y-shaped, connect the motor to the test unit through the synchronous belt and fix it. The load of the three-phase asynchronous motor is changed during operation, and the influence of the load increase on the operation characteristics of the motor is analyzed.

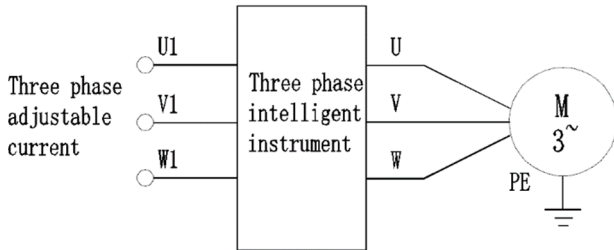


Figure 3. Wiring principle diagram of three-phase squirrel-cage asynchronous motor

According to the training data of working characteristics, the characteristic curve of torque and speed is drawn with the horizontal axis of torque and the vertical axis of speed, as shown in Figure 4.

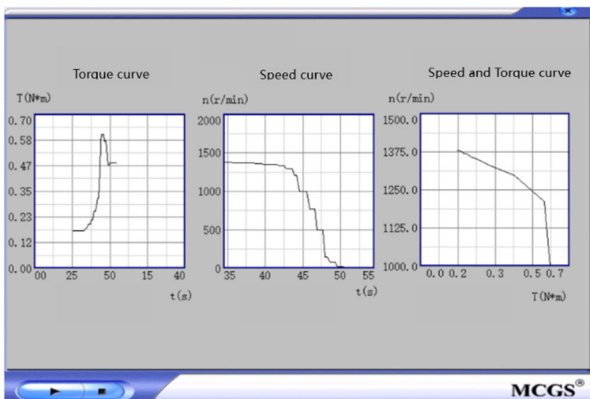


Figure 4. Speed and Torque Characteristic Curve

6. Conclusion

The implementation of the project is convenient for

teaching and research experiments. A relatively complete data acquisition system of innovative motor application training device is established, which can complete the data acquisition of speed and torque parameters according to the needs of training teaching. The data acquisition system of Yalong YL-163A innovative motor application training device consists of three parts: sensor, PLC field terminal system and MCGS. The MCGS exchanges data with the field terminal system through the communication bus, and the PLC field terminal system collects the data of each node through the sensor network. All parts of the system work together to complete the functions of data acquisition, transmission, storage, analysis and display of Yalong YL-163A innovative motor application training device. PLC is the center of the whole system. According to the requirements of the system for the controlled object, the collected data are calculated and processed, and finally fed back to MCGS for integration, and the characteristic curve is derived.

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References

- [1] Cheng Qiyun, Sun Caixin, Zhang Xiaoxing, et al. Short-Term Fang Aiping. Communication between Mitsubishi FX3U PLC and intelligent instrument based on Modbus protocol [J]. Automation Applications, 2017 (8): 97-98.
- [2] Zhang Jian. Application design of PLC control in motor test platform [J]. Design and Analysis, 2013 (12): 142-143.
- [3] Wang Xueyan. Design of monitoring system based on PLC and industrial computer. Coal Technology, 2012, 31 (1): 63-64.
- [4] Jiang Hao. PLC real-time measurement and control system of hydraulic integrated test platform. Hangzhou: Zhejiang University, 2006.
- [5] Huang Xiangning. Research on automatic test and control system of three-phase asynchronous motor. Master Thesis, Hunan University. 2003.