

Construction of Automatic Detection and Maintenance System for Measuring and Controlling Device Based on Virtual Instrument

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Abstract: With the continuous progress of science and technology in various countries, a large number of special testing and monitoring equipment are urgently needed in scientific research experiments. Therefore, in order to meet the requirements of a large number of experimental state detection and various parameters monitoring in scientific research and production activities, a large number of scientific researchers and research institutions have carried out research on it. Taking the special environment of underwater exploration as an example, this paper discusses and designs an automatic detection and maintenance system based on virtual instrument measurement and control device. The actual research and design of this paper are mainly divided into two parts: hardware design of automatic detection and maintenance system of virtual instrument measuring and controlling device of detecting equipment and corresponding software design based on LabVIEW technology platform. Experiments show that the detection equipment automatic detection and maintenance system based on virtual instrument designed in this paper has the advantages of stable and reliable operation.

1. Introduction

With the rapid progress and development of science and technology, aerospace and underwater exploration have become an area of development for all countries, and the rapid development of science and technology can not be separated from the update iteration of relevant scientific research equipment [1-5]. Every progress of modern science and technology is inseparable from the accurate measurement of instruments and equipment, data acquisition and corresponding analysis and processing. As an important part of scientific research and production equipment, virtual instrument technology increasingly uses virtual test and control instruments composed of large computers and corresponding test and control interfaces to achieve its corresponding scientific research tasks [6-9]. With science and technology feeding back to virtual instrument technology, the corresponding measurement and control devices of virtual instrument technology are mainly developing in the direction of miniaturization and software. They rely more and more on the data acquisition of computer technology and the processing of digital signals. LabVIEW software design platform is the current mainstream development platform on the development platform of virtual instrument measurement and control device [10-12]. In this paper, LabVIEW software design platform is also used in the design of automatic detection and maintenance system based on the actual underwater detection virtual instrument measurement and control device.

Based on the importance of virtual instrument technology to the development of scientific research in various countries, a large number of scientific researchers and research institutions have analyzed and studied it. National Instrument [13] first developed virtual instrument technology, and its representative development platform was LabVIEW software platform, which provided the development environment of related design language C language, and it has been widely used in data acquisition, testing and analysis. Since then, corresponding virtual instrument development platforms such as DasyLab, Visual C++ have been launched, and their main characteristics are convenient. For image programming, users can easily get started, understand and develop applications [14-15]. Corresponding European scholars have put forward the concept of “software is instrument” for virtual instrument, which considers that the software of hardware system is the

main direction of the development of virtual instrument in the future [16].

Based on the above problems, this paper chooses the subject of underwater detection as the background of designing the automatic detection and maintenance system of virtual instrument measurement and control device. In this paper, the actual research and design are mainly divided into two parts: the hardware design of the automatic detection and maintenance system of the virtual instrument measurement and control device of underwater detection equipment and the corresponding software design based on LabVIEW technology platform. Experiments show that the automatic detection and maintenance system based on virtual instrument of underwater detection equipment designed in this paper has stable and reliable operation advantages.

This paper makes the following arrangements on the content and structure of the article:

The second section of this paper will design the software and hardware design of the automatic detection and maintenance system of the virtual instrument measurement and control device based on the scientific research environment of underwater detection.

The third section of this paper will carry out underwater detection experiments and analyze the experimental results for the automatic detection and maintenance system of the virtual instrument measurement and control device designed in this paper.

Finally, this paper will make a summary.

2. Software and Hardware Design of Automatic Detection and Maintenance System Based on Virtual Instrument for Underwater Detection Environment

The virtual instrument measuring and controlling device for underwater detection environment designed in this paper only considers the electrical requirements of water pressure, water temperature and related equipment in the actual design of relevant detection indicators. In the actual design level, we mainly consider the related hardware and software design. The relevant details are as follows:

2.1 Hardware Design of Virtual Instrument Measuring and Controlling Device System for Underwater Exploration Environment

The hardware of this system is mainly composed of computer, control module, water temperature and pressure sensor, display device, data processing and storage device. The corresponding control module is mainly responsible for data interface mode conversion and related power supply control. Sensor equipment is mainly responsible for data acquisition, processing and analysis storage. The corresponding hardware block diagram is shown in Figure 1.

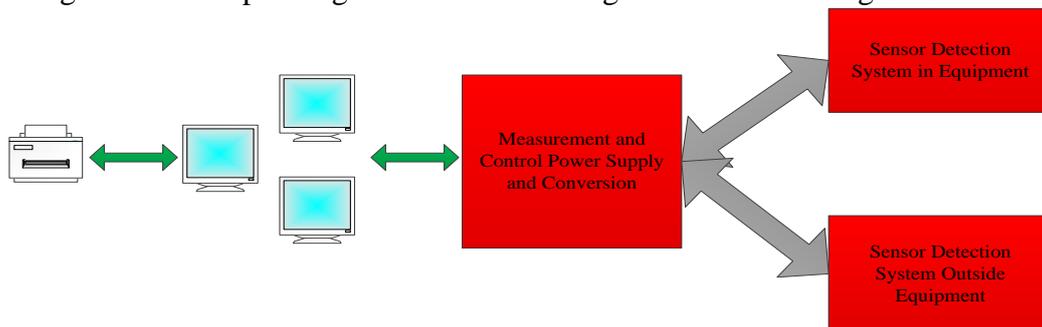


Figure 1 Hardware block diagram of virtual instrument measurement and control system for underwater exploration environment

In the specific module hardware design level as follows:

2.1.1 Design of water temperature and pressure sensor

Water temperature and pressure sensor is mainly used to detect the water temperature and pressure of the corresponding water depth. In this paper, the sensor used in the actual design is PT100. In practical application, PT100 sensor is fixed with stainless steel buckle. In this paper, eight water temperature and pressure sensors are used in practical application. In the data

acquisition hardware level, ADAM-4015 and ADAM-4117 are mainly used as the data acquisition module.

2.1.2 Design of measuring mode for water temperature and pressure sensor

At the hardware level, the conditioning circuit of the water pressure and temperature sensor is placed near the sensor. The corresponding connection schematic diagram is shown in Figure 2. Its main advantages are short connection distance, high signal integration, relatively independent sensor, corresponding maintainability and good replacement.

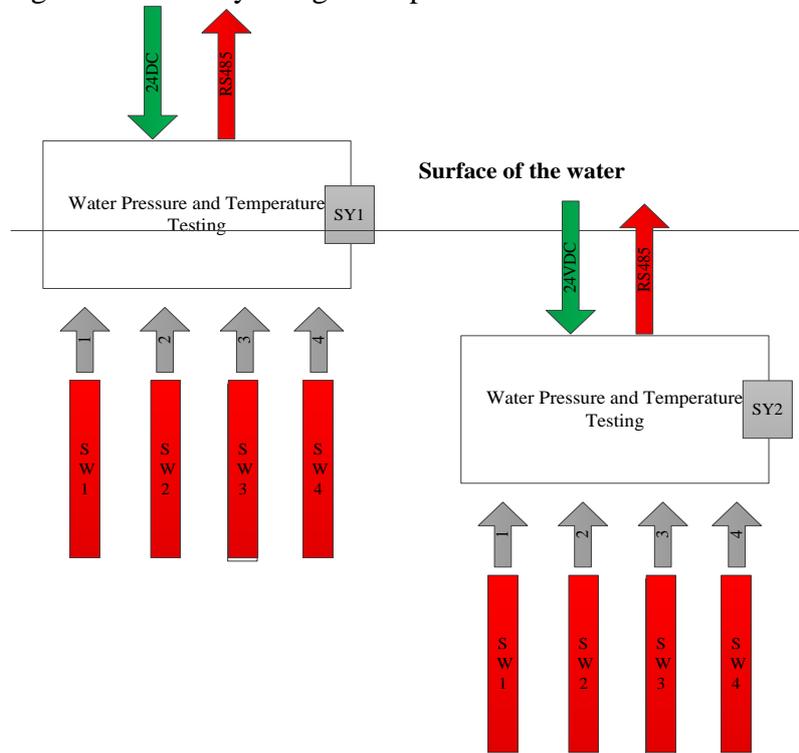


Figure 2 Hardware connection diagram of water temperature and pressure measuring and controlling device system of virtual instrument for underwater detection environment

2.1.3 Design of power supply system

In order to ensure the safe and reliable operation of the whole system, the corresponding hardware design block diagram of the power supply system is shown in Fig. 3. Its main supply voltage is DC24V.

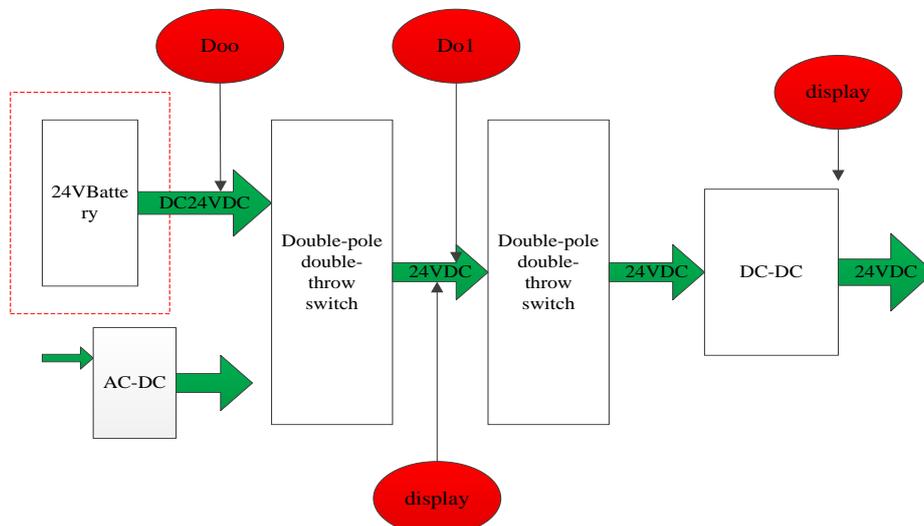


Figure 3 Power supply design of water temperature and pressure measuring and controlling device system of virtual instrument for underwater exploration environment

2.2 Software Design of Virtual Instrument Measuring and Controlling Device System for Underwater Exploration Environment

At the software level, the main consideration of the software module is the underwater equipment parameter detection device. Its main analysis object is the internal parameters of the equipment and the external parameters of the equipment. In the actual design, the data acquisition device collects the data corresponding to different water depths of the equipment, and converts the data processing to the monitoring device of the parameters of the equipment. This paper deals with its number. RS485 communication interface is used in data communication layer. The serial port of underwater monitoring equipment realizes the signal conversion between RS485 and RS232 through conversion mode. The corresponding basic software architecture is shown in Figure 4. LabVIEW is used in software design to program, and a complete set of data acquisition and data processing process is realized in each cycle of program execution.

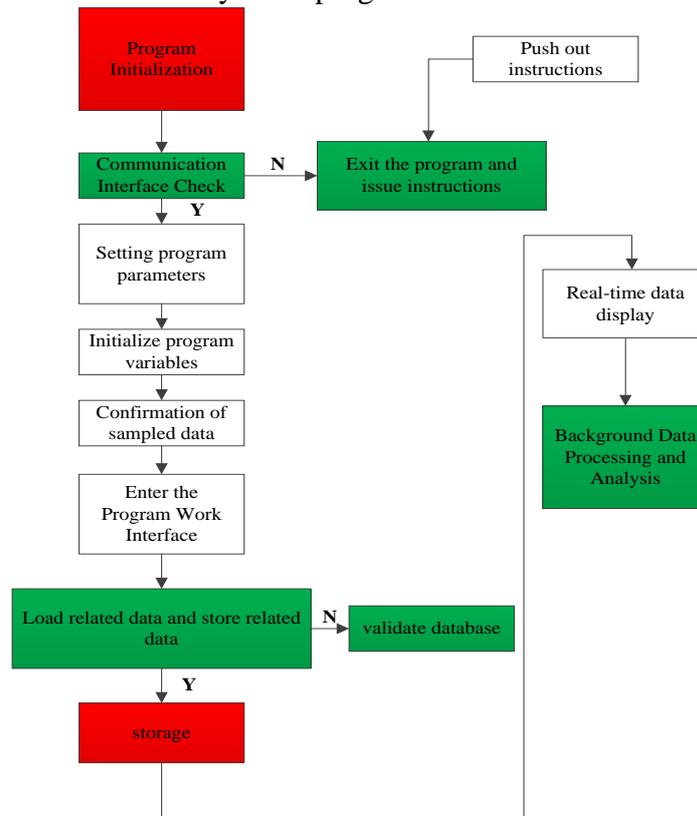


Figure 4 Software design flow chart of water temperature and pressure measurement and control device system of virtual instrument for underwater detection environment

At the state detection level, after the initialization of the software, the system first checks whether the communication interface is normal, and at the same time checks the working condition of the lower computer outside the equipment and inside the equipment. When all the above checks are normal, the system can work normally. In practice, this paper uses the upper computer to communicate with the lower computer. The upper computer is responsible for sending instructions and interpreting the data returned by the lower computer. The lower computer is responsible for receiving instructions from the upper computer and answering them in real time.

At the data storage level, the corresponding background storage is stored in the form of EXCEL. At the initial stage of the program operation, the relevant experimental names are entered. At the same time, the relevant experimental date and time are entered to ensure the uniqueness of the experiment and avoid the background storage coverage accident.

At the real-time parameter display level, there are two main directions in software design: engineering parameter display interface and corresponding man-machine interaction interface. In the software design, the key parameters of this paper are processed in a single column and displayed

by relevant waveforms.

3. Experiments and analysis

Based on the above analysis and the hardware and software design of the virtual instrument measurement and control system for underwater detection environment, this paper tests and verifies the system in the artificial underwater environment of the laboratory. Among them, the test items include two items: parameter detection state test and sensor parameter setting test. The corresponding test data are shown in Table 1 below. The data show that the system designed in this paper can run normally.

Table 1 Experimental data sheet

Water depth(m)	Water temperature (Celsius)	Water Pressure (Pascal)	power supply system
0.5	26	0.671	normal
1	24.3	0.112	normal
1.5	24.1	0.1341	normal
2	23.5	0.231	normal
2.5	22.1	0.2679	normal
3	21.5	0.3014	normal

In order to verify the reliability of the system designed in this paper in the actual environment, the test equipment is placed in a river for a month. The experiment shows that the system of the virtual instrument measuring and controlling device for underwater detection environment designed in this paper has strong stability and reliability.

4. Conclusion

This paper mainly analyses the related development of virtual instrument technology and the research status of countries all over the world under the background of increasingly fierce competition in science and technology. At the same time, taking the scientific environment of underwater exploration as an example, an automatic detection and maintenance system based on virtual instrument measurement and control device is designed. In the research and design of the automatic detection and maintenance system of the virtual instrument measurement and control device, it is mainly divided into two parts: the hardware design of the automatic detection and maintenance system of the virtual instrument measurement and control device of underwater detection device and the corresponding software design based on LabVIEW technology platform. Experiments show that the detection equipment automatic detection and maintenance system based on virtual instrument designed in this paper has the advantages of stable and reliable operation.

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