A Preliminary Design of a Control and Monitoring System Based on Network for a Pulsed Power Device

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ABSTRACT

In this paper, the running status of a control and monitoring system for a pulsed power device is briefly introduced. The advantages and disadvantages of the system with field bus technique are analyzed. Then combined the principal of industry control with pulsed power technology, a preliminary design of the control and monitoring system based on network for the pulsed power device is put forward in order to improve the performance of the whole large system. The primary design and implementation of hardware and software are also introduced in this paper. The new design aims at the construction of the network which is divided into two relatively independent local area network, one is mainly designed for control and monitoring the pulsed power device, and the other is for data release. Thus the paper advises a future research direction about the technology of interconnection of field control system for pulsed power device and information network.

INTRODUCTION

At present, a control and monitoring system for an energy supply which is going to be used in a pulsed power device has been finished and has been running to get some useful data. It was designed based on technology of serial interface and field bus. It controls two programmable AC power supplies which separately fulfil the linear charge of two related Marx generators through high voltage transformers. The control system also controls a digital delay device which can trigger the whole system by a kind of schedule. The hardware configuration of the system is as shown in Fig.1.

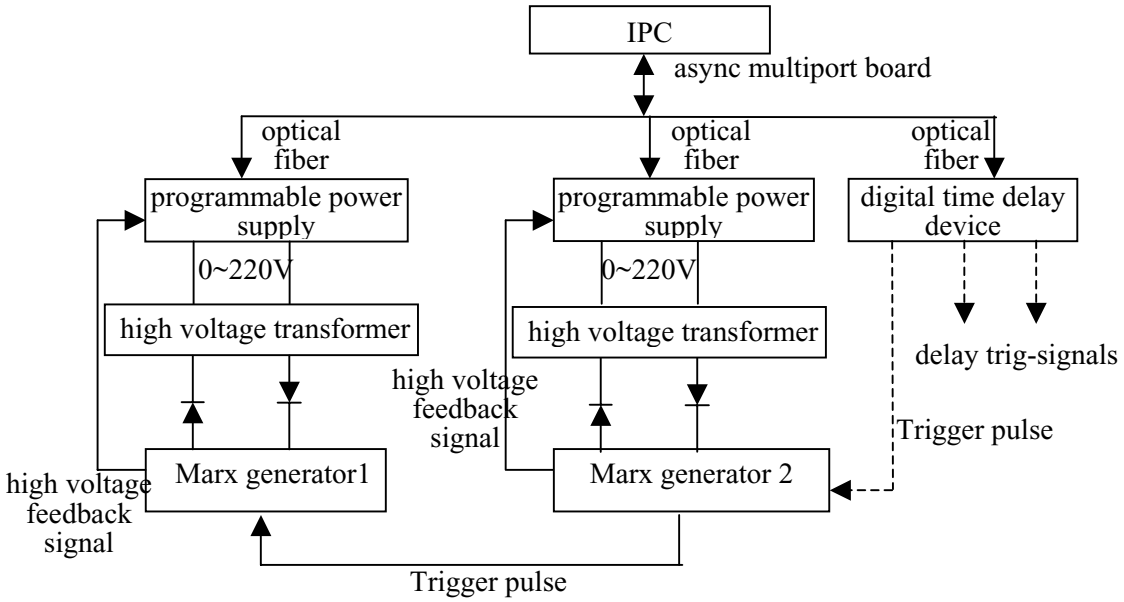

Figure 1: Structure of hardware for whole system

By controlling the programmable AC powers through RS-485, the digital delay device through RS-232, and all related communication being fulfilled through optical fiber, the computer control system can fulfil setting parameters, controlling devices, data acquisition and real-time display of the experiments. It works stably and reliably and meets the demands for the moment.

ANALYSIS

But the small system still has some shortcomings. The measurement devices, such as digital oscilloscopes were not in control, neither the safety of the experiment. And the visit, release and

access to the data of the experiment were very inconvenient by manual work. The software design of the system is finished by several kinds of development tools, which could result in unclear function or low management efficiency of the system. All the disadvantages mentioned above will seriously influence the experiments when the system expands to a large one which comprises energy supply, energy storage, power conditioning, power transmission and the load. So the present control and monitoring system will not satisfy the future requirements.

The new enlarged pulse power device will put many new demands to control and monitoring system. The system is going to be on a bigger scale because of increasing number of control and monitoring objects such as oil level in Marx tank, pressure in gas switch and so on. There are also many fast signals need to be recorded and processed. The oscilloscopes of 500MHz~1GHz bandwidth and multi-channel PXI waveform recorders must be controlled. Security and door control should be made into programmed interlocking. All the data acquired need to be processed and the related devices need to be controlled.

DESIGN OF NEW CONTROL AND MONITORING SYSTEM

According to analysis mentioned above, a preliminary design of the control and monitoring system based on network for the pulsed power device is put forward in order to improve the performance of the whole large system.

System Architecture

The hardware configuration of the system, shown in Fig.2, can be roughly divided into five subsystems. First one consists of a supervisory computer (PC1) and programmable AC power supplies. The power supplies with optical-electrical isolated serial interface are instructed by PC1. The charging DC voltage and operating conditions can be preset, measured and recorded. The second subsystem is specially designed to manipulate the digital delay devices and laser facilities by which the whole system could be orderly triggered. The third subsystem is dedicated to record and process the fast signals. The oscilloscopes and PXI device are also controlled by PC3 via network interface. So the subsystem3 is designed to form a small network of its own. The forth subsystem is designed to record and process the slow signals such as degree of vacuum, gas pressure, temperature, security and alarms etc. PXI may be chosen to fulfil data acquisition. The fifth subsystem is mainly used for real-time or afterwards video display of the experiment. It comprises programmable video cameras, projection screen, image manipulation computer, supervisory computer and so on.

The new control system consists of three levels- front-end level control subsystem based on embedded microcomputer, PLC or PXI module and so on, each subsystem being controlled by an industry personal computer (IPC); middle-level with master station, data backup server and data issue server. They make up of the core of the control and monitoring system; top level mainly designed for clients who need to get useful information from the experiments. The font-level intelligent subsystems, master station and data server together make up of control and monitoring network of the whole system. The master station supervises each subsystem and controls real-time display of experiments via operation interface by certain schedule, sending related data to backup server and issue server of which the former one fulfils collection, storage, processing of data from subsystems and master station, offering needed data to master station and implementing instructions from master station, and the latter one implements instructions from master station, and besides, issues related information to client computers connected to data exchange.

According to new design of system architecture above, it is not the front-end intelligent devices but IPC supervising them that connects to control and monitoring network directly, which differs from common design of a networked measurement and control system. Actually the new design makes for reducing data burden of the network, because some dispensable data could be pre-disposed by IPC of subsystem. On the other hand, the system is easier to upgrade and expand at front-end level by not changing software or hardware of the upper level of the system.

It is noticeable that the data issue server is under command of master station by which the data to be issued is determined. Only authorized access to specified data from issue server is allowed by master station. Clients can not directly interview data back-up server, work station or front-end IPC. So the control and monitoring network and the data issue network is relatively independent but can be connected or disconnected on demands.

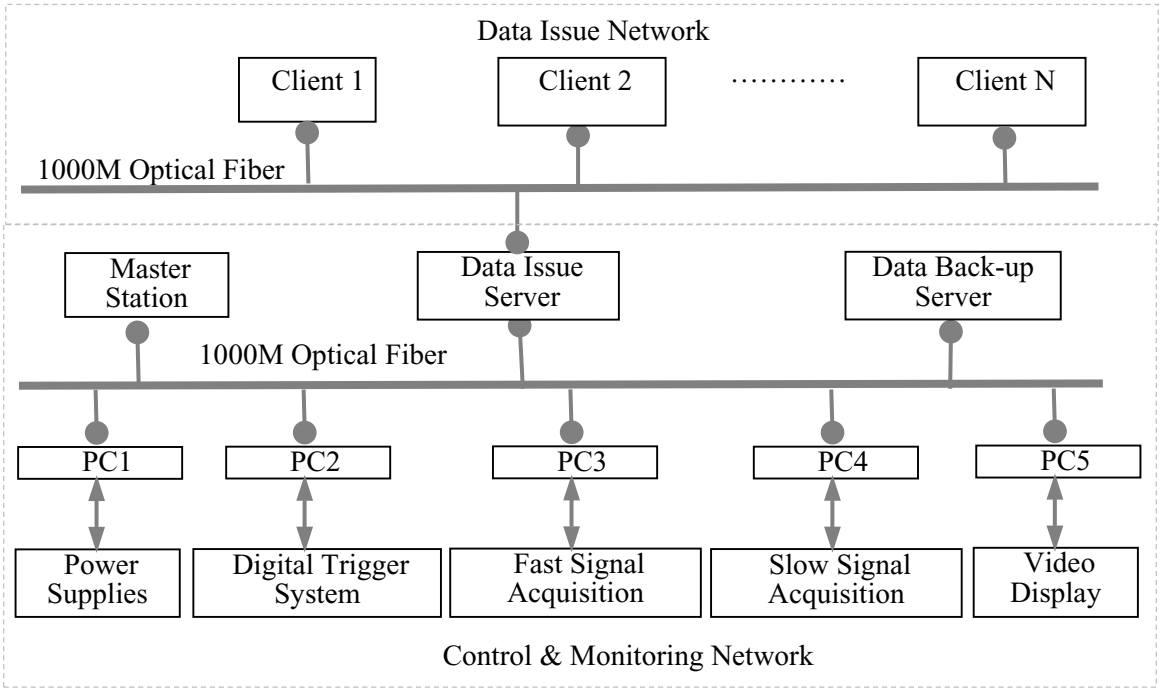

Figure 2: System architecture based on network

Software and Database

At server end, for control and monitoring network, as well as for data issue network, databases may be built by Microsoft SQL Sever 2000, Oracle and so on. The system may be designed based on technology of Web, TCP/IP, DCOM module or CORBA in Visual Basic, Visual C, C++, LabVIEW or Java etc, by all of which it is easy to program. And they are compatible with many formats of database, so the programs for data acquisition, management and data issue can be written easily. Novel Netware or Windows 2000 Server can be chosen as operating system.

At client end, appropriate development software can be used to devise client applications according to actual requirements. Client computers send out data-access request to data issue server and receive answer from data issue server via applications.

SUMMARY AND CONCLUSION

Design of control and monitoring system based on network for the pulsed power device has good expansibilities in common sense. The way of design is suitable for networked control and monitoring system, especially for multi-bus system with large numbers of equipments. It is easy to realize and we are trying to construct a control and monitoring system by this way.

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