NEW INTERLOCK SYSTEM FOR BEPC

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ABSTRACT

A new interlock system for BEPC (Beijing Electron Positron Collider) has been developed in order to improve the reliability of the personal safety and the subsystem's interlocks . Another role of the system is to update the BEPC TV status screen once every 6 seconds. Since March of this year, the system has been operational normally.

The hardware for the new interlock system is based on industrial Programmable logic controllers (PLC). By means of the PC_links, the interlock system is composed as a distributed control system. One inexpensive multimedia IBM/486 PC that is equipped with a two-screen interface card, a sound card and a 4-serial ports card, is used as the host computer of the PLCs.

The application programs dedicated for the system is written in visual C++ language under Chinese MS-Windows. In case there is a failure in a subsystem, the message is displayed visually, supplemented by a voice message, which causes the operators to pay attention.

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1 INTRODUCTION

The new interlock system consists of four layers:

- the central layer, which manages the interlock among BES (Beijing Spectrometer) system, BSRF (Beijing Synchrotron Radiation Facility) system, LINAC system and Storage Ring system.
- the system layer, which manages the interlock among the subsystems belong to the system.
- the subsystem layer, which manages the interlock among the equipments in a local control station.
- the equipment layer, which is included in an equipment. For example, one power supply for some Q-magnets should not feeds the current and gives alarm while the magnets lost cooling water.

The interlock process nearly is a logic conditions control, therefore choosing industrial PLC used as the basic components of the interlock system is a fast and reasonable solution.

2 SYSTEM CONFIGURATION

OMRONTM C-series PLCs, which are modular products and the C200H units can be flexibly integrated to a local controller that is located in a local control station.

A schematic diagram of the new interlock system for BEPC that we developed is shown in Fig. 1. One HOST_ link with an RS-232C interface is mounted on the CPU rack of the central interlock system. The host computer communicates with the central PLC and acquires I/O status.

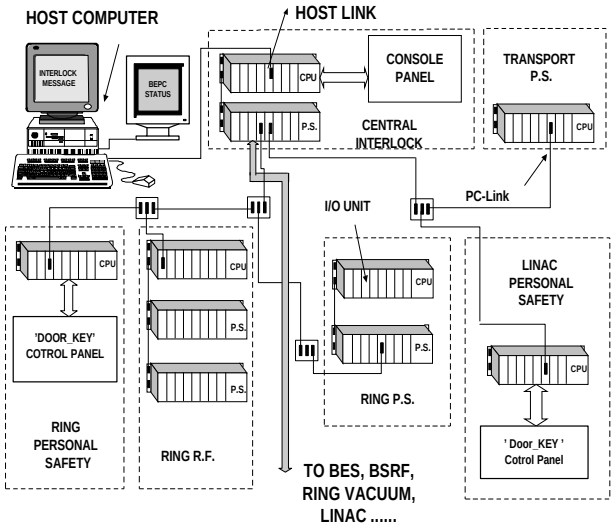

Fig. 1 New Interlock System for BEPC

PC_link units with RS-485 interface are used to interconnect local controllers and to exchange the LR (Link Relay) area's data automatically. It is necessary that the LR area of each PLC is programmed by means of the ladder support software before subsystem's integration, i.e., every bit in a LR area is assigned to a I/O state. Two PC_link units are mounted on the

expansion I/O rack of the central interlock system. One is set to level '0' and used to poll the status concerning LINAC and transport systems. Another is set to level '1' and to poll the status in the Ring area.

3 THE CENTRAL INTERLOCK AND TV SYSTEM

The central interlock system is located in the BEPC control room. The architecture of the system is shown in Fig. 2. There are two PLC racks. The host computer communicates with the HOST_link in the CPU rack of the central PLC. The two PC_links are put close to the power supply (P.S.) unit of the expan- sion rack. Every I/O unit can connect up to 16 signals.

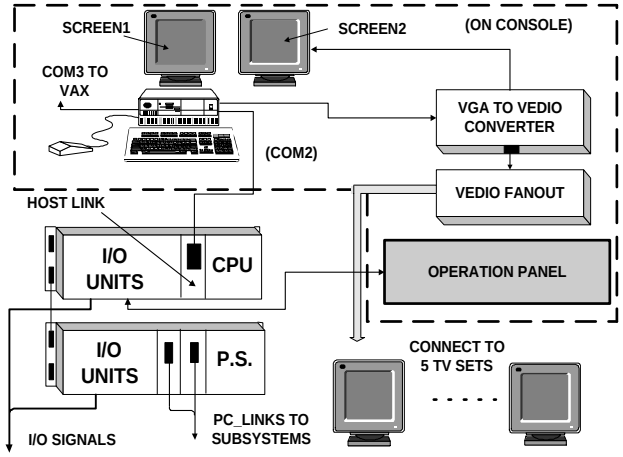

Fig. 2 Central Interlock System and TV Sets

The I/O signals of the central interlock system are main interlock signals that are directly sent to or took from the operation panel, systems and subsystems. The more detail information can be token from the LR area in the CPU unit.

The host computer is located on the console very near the VAX-4500 of the BEPC control system. The message of the beam parameters which is trans-ferred from VAX-4500, includes 65 characters and the communication rate is only once every 6-second. For these reasons as mentioned above, the serial port Com3 of the host computer is used to communicate with a serial pot of the VAX-4500 at 9600 Baud.

The Host computer is equipped with a two-screen interface card which drives two color monitors, are called screen 1 and screen 2. The screen 1 displays BEPC interlock status. The VGA signal of the card's second port is converted to video signal. The fan-out video signals are sent to 5 color TV sets which are placed at the main areas for displaying BEPC status and operation message.

4 PERSONAL SAFETY

The personal safety system is divided into two subsystems, one is related to the LINAC and another is related to the Storage Ring.

In order to make easily for operation, 'Mosaic' simulation panels are chosen as the operation panels. If every key takes its place on the panel, all doors into the accelerator tunnel are closed and no emergency button in the tunnel is pressed down, the machine can start to run. When the machine is running, once an emergency button is pressed down by someone, the machine is stopped immediately, a red LED which indicates the emergency condition is flashed on the operation panel.

5 SOFTWARE FEATURES

The Microsoft Visual C++ development system for Windows is a very powerful Workbench that provides a perfect visual interface for programmers. So the application programs dedicated to the system are written in Visual C++. The application software is divided two parts:

- the 'data base generation' program which builds the data base called the common data pool off-line.
- the Windows application software is executed under the Chinese Windows3.2. The block diagram of software structure is shown in Fig. 3.

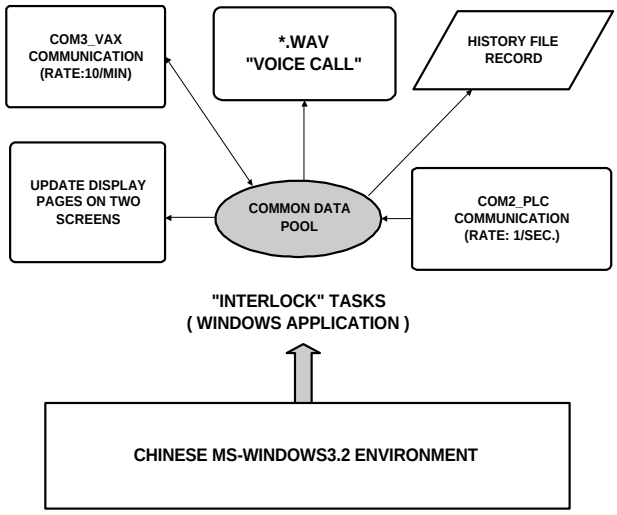

Fig. 3 Block diagram of Software

The 'Com2_PLC communication' task acquires all interlock and I/O data from the HOST_link of the central interlock system once per second and fills the data to common data pool.

The 'Com3_VAX communication' task gets the beam message from the serial port of the VAX-4500.

The 'display update' task fetch the data in the common data pool and update the screens. In case there is an alarm in a subsystem, the 'display update' task

shows the alarm state on the screens and the “Voice Call” task opens the *.wav file corresponding to the event and makes the sound card output the voice 3 times causes the operators to pay attention and to deal with the problem.

The history record task records the failure status as the reference for maintenance.

The graphic page design was made by means of the application studio tool of the Visual C++. The general display page on screen1 is shown in Fig. 4.

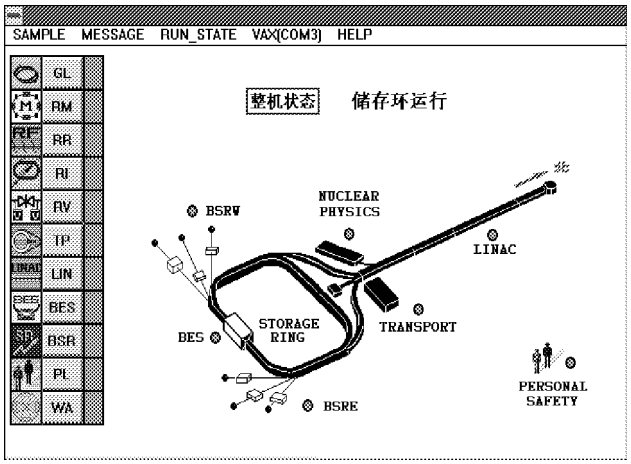

Fig. 4 Screen 1 on The Console

The icons in the first left column present the systems and subsystems. One of the buttons in the second column is selected by the mouse, a child_window is pulled up and the more detail message of the subsystem is displayed on the child_window. The indicators of the third column show the status of the system or subsystems. The red, yellow and green colors illustrate fatal failure, secondary failure and normal state.

6 CONCLUSION

The BEPC new interlock system was completed by the Contrl & Instrumentation division and Radiation Protection division last year. Since this BEPC running period (March 1996), the system has been ope-rational normally. The PLC products not only apply to industrial process control, but also apply to accele-rator’s interlock systems.

7 ACKNOWLEDGEMENTS

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REFERENCES

[1] The General BEPC Interlock System, by S.Y.Chen, etc. (Internal File of The IHEP)

[2] The LEP Alarm System, by M.W.Tyrrell CERN Proceedings of Conference on Accelerator and Large Experimental Physics Control System, p254, KEK, Thukuba, Japan. (1991.11).

[3] Interfacing Industrial Process Control System to LEP/LHC, by Michel RaBany CERN, The Same Proceedings as above, P269.