

Application Software for New BEPC Interlock System

S.M.Tang X.Y. Na J.S. Chen Y.L. Yu J.X. Yan
J.M.Wu T.H.Li H.J.Cheng
Institute of High Energy Physics(IHEP)
P.O. Box 918, Post code 100039, Beijing, China

Abstract

New BEPC (Beijing Electron Positron collider) interlock system has been built in order to improve the reliability of personnel safety and interlock functions. Moreover, the interlock system updates BEPC operation message once 6 seconds, which are displayed on TV sets at the major entrances. Since March of 1996, the interlock system has been in operation normally. This paper describes mainly the design idea and the structure of the application software for the interlock system.

1 Introduction

The hardware of new BEPC interlock system is based on OMRON C200H-series Programmable Logic Controllers (PLC). One multimedia IBM/PC-Pentium as the host computer, monitors the PLC system via serial port COM2. It communicates with the central computer VAX-4500 of BEPC control system via serial port COM3 and gets current operation message on the storage ring, such as beam energy, beam current intensity and life time, luminosity, operation mode etc.

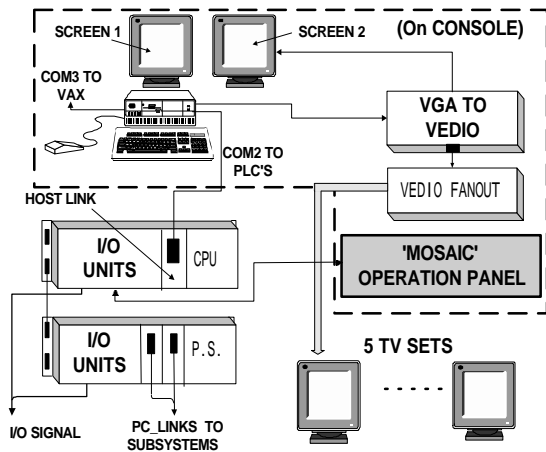


Fig.1 Central Interlock System

The central interlock system, located in the BEPC control room, is shown in Fig.1. There are two PLC racks of the system, the I/O units connect cardinal I/O signals to subsystems and the operation panel on the console. One HOST_LINK unit with an RS-232C port is mounted in the CPU rack and is connected to COM2 port of the host computer. Two PC_LINK units, which are mounted in the expansion rack, link all PC_LINK units of subsystems with

RS-485 port, so that BEPC interlock system is a distributed PLC system. Using an automatic polling method, the '0' level PC_LINK unit exchanges data with the subsystems in the storage ring area, the '1' level PC_LINK unit exchanges data with the subsystems in the LINAC and Transport area. These data are kept in LR (Link Relay) area of the CPU unit.

The host computer PC is equipped with a Multi-Screen interface card which connects two color monitors. One is used to show BEPC interlock information and another is used to display the BEPC operation message. One VGA/Video converter converts the latter signal to video and is sent to five TV sets at the major entrances via the video fan-out box.

2 Software features

MS-Window Chinese V3.2 is selected as the operating system, because it provides several major programming capabilities. These include standardized graphics user interface, a multitasking capability, an object oriented programming (OOP) approach, memory control, and the use of dynamic link libraries (DLLs). To display Chinese characters on screen is also an important reason for this selection. The application software has been developed on the Microsoft Visual C++ 1.51 workbench. The Visual C++ workbench is an integrated environment that allows user to develop window's applications easily. It provides advanced programming tools such as APP STUDIO a graphic editor, APP WIZARD an application template generator, MFC, CLASS WIZARD a class generator and Debugger etc, therefore the software development process can be simplified.

Easy operation and friendly Man-Machine Interface is design idea of the application program. The block diagram of the application program is shown in Fig.2. It consists of following five tasks:

COM2_PLC Communication is used to fetch the interlock data from central interlock system via serial port COM2 and update common data pool once per second.

COM3_VAX Communication gets current beam parameters and operation mode of the Storage Ring from the central computer VAX-4500 of the BEPC control system.

Update Display fetches the data from the common data pool and updates two screens.

The initial View on the first screen for the interlock application is shown on Fig. 3. Every row of the left column, representing a control of child window, is composed of one color icon, one button and one rectangular indicator. Each icon reminds the operator that

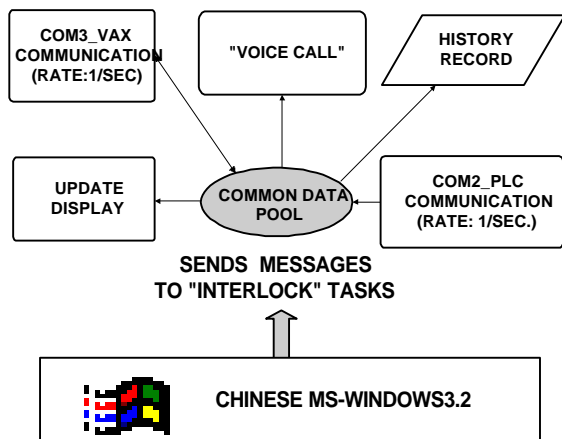


Fig2. Block Diagram of the application

one child window is pop-up by clicking the mouse on the right button and will show the message of assigned subsystem. Each indicator displays one subsystem's status. The green, red and yellow colors of the indicator indicate fatal failure, secondary failure and normal respectively.



Fig. 3 Initial View on First Screen

The second screen is used to display current BEPC operation message and time as shown in Fig.4. In order to put some short notice on TVs, a edit child window can be opened at the bottom of the screen. History Record records failure status of devices and the failure time.

Voice Call In case a event or hardware trouble occurs, in addition to the alarm message is displayed on the screens, the 'Voice Call' task plays a waveform sound of the *.wav file which is related to the event. It makes the operator to pay attention.

In order to prevent the application from 'dead lock', error tolerance is taken into consideration. For example, If the host computer gets some trouble on its serial port COM2, time-out of communication between the host and PLC is caused, the program should pause the communication and

the error message should be displayed on screen 1.



Fig.4 BEPC Operation Message on Second Screen

3 Small database

A small database RUN_BASE for the application is created and modified by means of a dedicated program RUN_DB.C off-line. When the interlock application is running, RUN_BASE file is loaded to the memory. All of the I/O signals in BEPC interlock system are logical signals, but not analog signals. For convenience of serial communication and data manipulation, the database RUN_BASE as a text file is stored on the hard disc.

RUN_BASE file holds a maximum of 1024 records. According to the features of the PLC and the specific condition of BEPC interlock system, 32-byte is selected as the record length. The data structure of RUN_BASE is shown in Fig. 5.

Every record describes one signal. The PLC address field consists of 5 characters, explains the I/O location of the signal in the PLC of central interlock system. The ID field is a signal name, includes 8 characters. The ST1, ST2 are desired and current status. If the signal is a Link Relay (LR) signal, the LINK_No. and LINK address should be filled. The remark occupies 10 letters and helps the programmer to know the implication of the signal.

4 Conclusion

The BEPC new interlock system was completed by the Control & Instrumentation division and Radiation Protection division before the end of 1995. Since March 1996, the system has been operational normally. PLC products are very applicable to accelerator's interlock system, due to their reliability, flexibility as well as ease of maintenance. As a result of providing multimedia technology to accelerator control, the operators run the machine easier than before.

As software products are developed at high speed, software tools are becoming increasingly automated, easy-to-use and suitable for customer applications. Besides Visual

