Human Computer Interface for the Computerised Control of Electron-Cyclotron Resonance Ion Source (ECRIS) at Calcutta

Tapas Samanta, C. D. Datta and D. Sarkar
Variable Energy Cyclotron Centre, 1/AF, Bidhan Nagar
Calcutta - 700064, India

Abstract

Variable Energy Cyclotron Centre (VECC) at Calcutta has developed a compact room temperature Electron Cyclotron Resonance Ion Source (ECRIS) for various heavy ion beams. A PC-based control system for the ECR Ion Source is under development. A user-friendly Human Computer Interface (HCI) is a vital requirement of the control system of any modern and sophisticated experimental physics setup. This paper describes the HCI of the control system of the ECR Ion Source at Calcutta.

1 Introduction

Electron-Cyclotron Resonance Ion Source (ECRIS) becomes the most frequently used heavy-ion source for cyclotrons. To facilitate atomic and nuclear physics research in Variable Energy Cyclotron Centre (VECC), Calcutta, a compact room temperature ECR type ion source has been indegeneously developed for production of varities of heavy ion beams viz. N^{5+}, O^{7+}, Ne^{7+} etc. The details of this ECRIS are found in [1]. A PC-based control system for the ECR Ion Source is under development. This paper describes the Human-Computer Interface (HCI) of the control system of the ECRIS.

2 Development

A man-machine interface is an essential component of the control system of any modern day sophisticated experimental physics setup. An ECR of this kind consists of not less than 12 numbers of pumps, 11 numbers of valves, 28 numbers of *highly stable* power supplies of various specifications, 8 numbers of gauges and others. Some of the equipment controls (e.g. pumps and valves) are on-off, some are of continuous in nature (e.g. power supplies) and so on.

The starting form displays the overall system (block diagram) of ECRIS at a glance (figure 1). Detailed *mimic* of each of the subsystems with all necessary process parameters are displayed for monitor and control purposes, at a click of a mouse button. The current status of each of the subsystems are displayed as a scrolling text menu and the visual effect is also provided by changing colour and other attributes.

The Operation sequence starts at a mouse-click at *P11 or P12*. After starting the diffusion pumping sub-systems, the system waits for a few minutes to get the vacuum level of 0.01 Tor and then the Turbo pumpimg systems are switched on. Again the system waits for reaching the ultra high vacuum. Then it gives a ready signal to the operator audio-visually. The operator starts selecting the current profile and the specific Ion by clicking over any of the eight solinoid coils. On completion the system starts up automatically and tunes the Glazers (G11,G12) and the analysing magnet (M1) with the help of the Faraday's Cup (FC21) as shown in (figure 2). Once the particular beam is available at FC21, the system gives ready signal to the operator to proceed. Then the Beam Guiding (BG) section becomes active and the operator takes up to switch on the BG section step by step.

The operator can choose from a varities of heavy ion beams viz. N^{5+}, O^{7+}, Ne^{7+} as a recipe of earlier operations completed with necessary user satisfaction. The recipe may be modified to suit the special requirement if necessary. On successful operation, the same can be stored as a new recipe for use in future. Optional pumping sequence may be initiated to incorporate breakdown maintenance.

The interlocking parameters of various subsystems have been implemented. An auto-start and auto-stop mode of operation have been kept for automatic start up and shut down of the overall system. Operator override on "auto" with all safety interlocks valid, is incorporated for special override operation in auto mode.

Special security arrangements have been employed in the system to prevent unauthorized entry of operators into the control system. A super-user with all the access rights, is there to create and restrict the user access and permission. A simulation mode has been provided for training of the operator and other personnel.

An on-line alarming system has been incorporated to alert the operator much earlier than a possible breakdown. It will also store an alarm listing of all the incoming alarms attended, or unattended with acknowledgment time. A graphic window for monitoring and logging on-line process parameters of operator's choice, has been provided to track the critical parameters visually. All the details of the parameters are stored in the disk in case of any abnormal situations for possible post-analysis.

The database of the subsystem parameters for a particular ion beam energy and other details on the equipment are under preparation with FOXPRO as local RDBMS and ORACLE for centralised information. A periodic log of parameters will be maintained to provide a snapshot of parameter values.

The Human Computer Interface has been developed through Visual Basic version 3.0 on Pentium PC @100 MHz hardware platform.

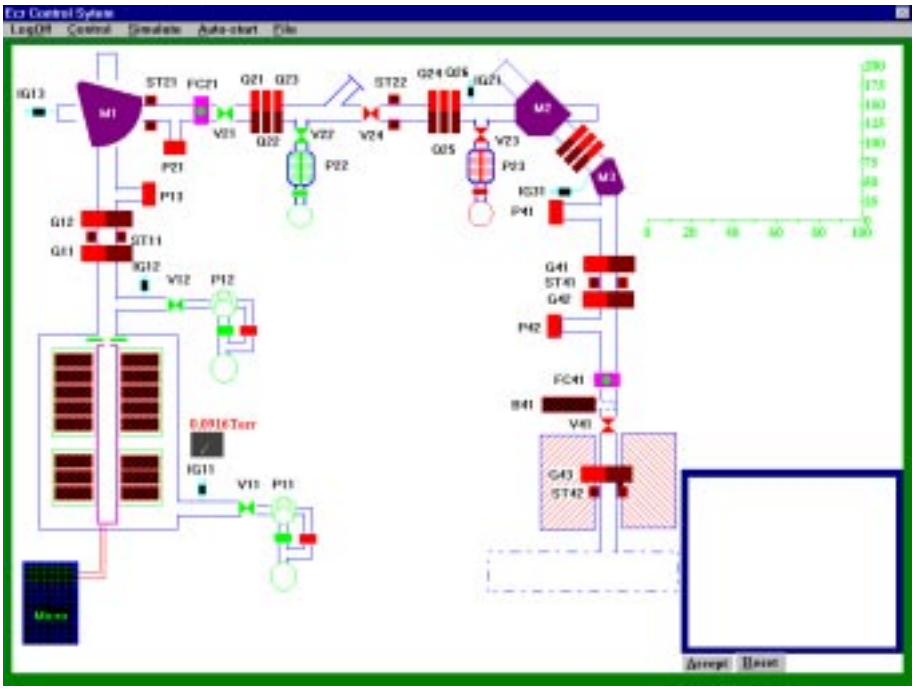

Figure 1: Initial stage of simulated operation with the diffusion pumping system and turbo pumping system on.

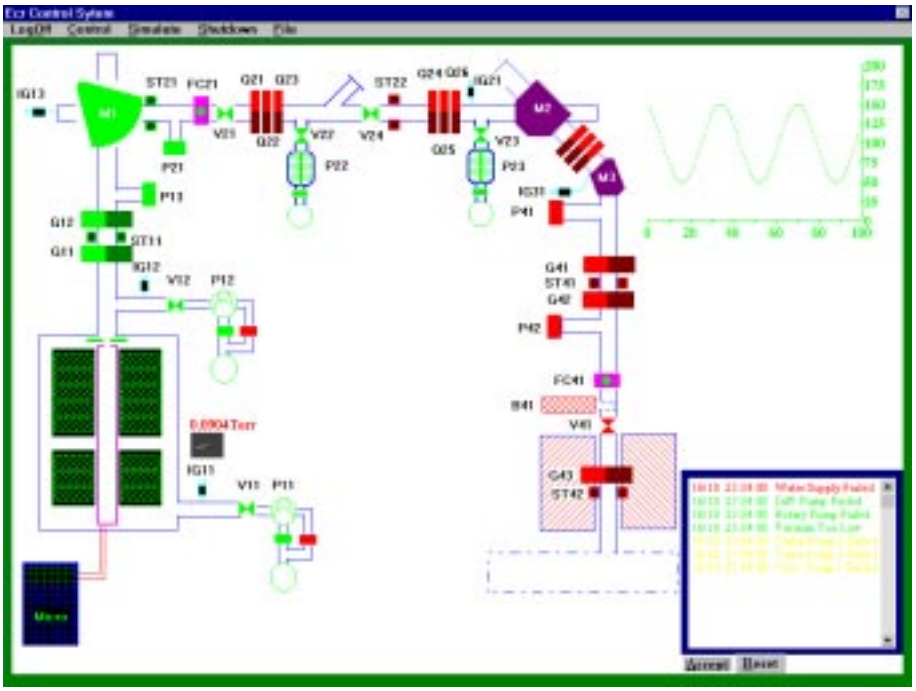

Figure 2: Simulated operation of beam analysis and tuning.

3 Future development

Critical Control Parameter's PID algorithms are being developed under C++. Tuning algorithm will be developed using Fuzzy Logic. Interface between the C++ and Visual Basic has been test developed and to be implemented in detail object level to minimize the code size in Visual Basic. Dynamic Data exchange feature is used as the medium between the two. Server/Client DDE model with little access-restriction is tested. Further access restriction is to be implemented. An online context-based help is under development to guide the operator to make faster decision in case an emergency. Beam analysis & filtering is to be developed to automatically scale the magnetic current and to identify the peaks for operator selection on a mouse click. Post-Operation analysis and report generation will soon be implemented.

4 Concluding remarks

Visual Basic is one of the Rapid Application Development Tools available for the developemnt of Human Computer Interface for the Control System Applications. Visual C++, Power Builder etc. are also available. We had experience on Visual Basic for such applications and this is one of the major reasons to stick to Visual Basic for such development. We find Visual Basic as an easier tool for such development compared to Visual C++. The man-machine interface for monitor and control of power supplies (Danphysik make) has already been developed [2], which will be integrated to the Control Console of ECRIS. The Interface software with the equipment level components is being developed in C++.

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