CONTOL SYSTEM FOR BARC-TIFR PELLETRON

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Abstract

BARC-TIFR Pelletron is a 14 MV tandem accelerator in operation from more than 20 years. It was having a DOS based control system software which was running on a 486 PC and it was not possible to port it on new PCs. It was based on serial highway and Uport adapter based CAMAC crate controller which are now not available and all spares were used. Hence We have changed CAMAC controller with in house developed Ethernet based CAMAC controller and new software has been developed. New Control system software is based on LINUX operating system with Graphical user interface developed using Trolltech's QT API,but can be easily ported on MS Windows.

INTRODUCTION

Pelletron is a 14 MV tandem accelerator located in TIFR, Colaba, Mumbai. It's an electrostatics accelerator which is further augmented by a superconducting booster. Both the facilities have their own control system and it was not possible to integrate both in older control system of pelletron. Control system is a tool to sense the status and to achieve the desired beam from the machine. It consists of control electronics hardware, control software and user interface. It also consists of databases to store system configuration and machine status.

Pelletron control system has been developed on LINUX operating system. LINUX is becoming very popular for particle accelerator control system, because of its stability and Open source nature [1].

SYSTEM ARCHITECTURE

A layered Architecture has been used in this system Figure 1. In a standard way control system can be partitioned in three layers presentation layer (operator interface), application layer (Server Layer/Device control unit) and resource layer (Equipment Interface Unit) [2], [3].

Equipment interface unit is the lowest level of control system which is interconnected to the accelerator equipment and sensors. In Pelletron CAMAC (Computer automated Measurement and control) is used.

Application Layer (Device control unit) provides different services to the other part of the control system like remote booting and configuration of Equipment layer and provides service to operator interface.

Operator interface unit is the layer which connects the accelerator with human and provides interaction with the machine. It consists of many displays (graphical screens, Scopes etc.) and knobs (Virtual panels and hardware knobs) for control and monitoring of the control system.

There is a communication link and communication protocol is the basis of multilayer system. Depending upon interaction between different layers it can be categorised as centralized system or distributed system. The Pelletron control system is a centralized control system. It has three CAMAC crates which are physically distributed at three different places (Ion source room, Bottom of accelerator tank and pelletron beam HALL) and are interconnected via Ethernet LAN communicating via TCP/IP protocol suit. Though the crates are distributed at different places but still it is a centralized control system as all communication between different crates and operator user interface are possible only via a centralized

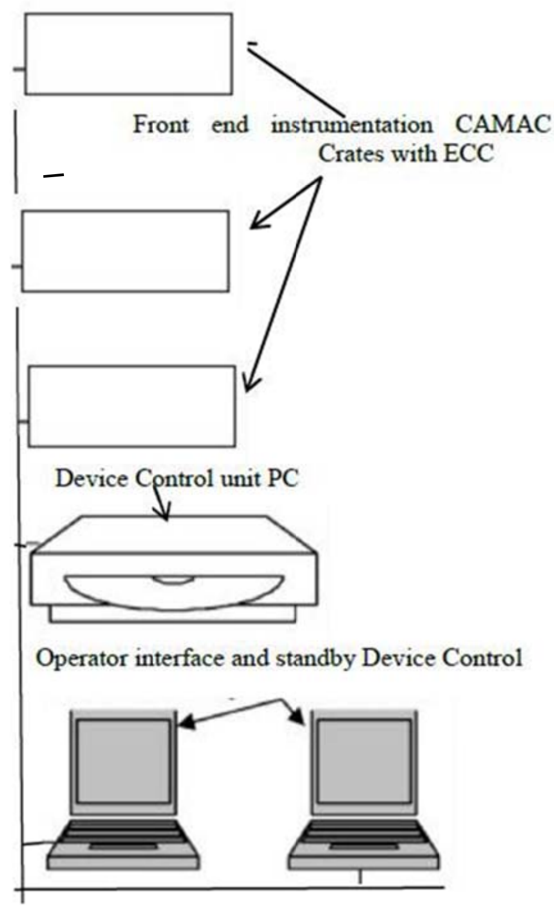

Figure 1: System Architecture.

Front End Equipment Interface Unit

CAMAC crates are the major constituent of this unit, with ADC, DAC and Digital input /output modules. Field instruments and sensors /actuators are connected to CAMAC cards. Crate Controller is having an embedded processor with CAMAC controller electronics which interacts with CAMAC modules and provides interface to the user (Device Control Unit) over 100 mbps Ethernet link. It provides connection oriented TCP server Socket interface to interact with the CAMAC system. It can be

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operated in two modes singles mode and list mode. In Singles mode channels from CAMAC modules can be read or written. In list mode a list of NAF can be uploaded and all the devices can be read in single shot. List mode has been used to read all the status and read backs from CAMAC modules and control parameters are operated in singles.

Device Control Unit

This unit consists of a PC running on LINUX. This unit interacts with the all CAMAC crates. It provides services to Operator interface units. Device control unit is responsible for safe and reliable operation of machine. Fault tolerance and redundancy is an important requirement for this unit. This system stores all field values in a fixed memory block, which is persistent till PC is powered off. Because of this persistent memory system can be restarted after any crash or with new configuration without disturbing the current status of the machine. The control system is a configurable system from a system database. Different data base files are created to store the CAMAC configuration, Device and signal Definition and operator interface page configuration are stored in Device control unit.

Device control unit has UPS backup to handle the sudden mains power outage.

Operator Interface Unit

This layer includes Operator interface soft panel running on a PC and hardware panel meters and scopes for monitoring and control of the accelerator subsystems. Different pages have been configured via page configuration database for different subsystems of the accelerator like vacuum page, ion source, beam line etc. Any new page can be created by adding entries in to page configuration database on Device control unit. Virtual panel consists of assignable multifunction slider control for analog control and assignable metres for for read backs. Multifunction sliders can be controlled via mouse or keyboard.

SOFTWARE ARCHITECTURE

Control system software [4] is a database driven system all system parameters and control parameters and their behaviour and look and colours are defined in ASCII database files. These files can be edited by using any spread sheet software or text editor. These database files are stored in password protected area and by default they have only read permission.

Front end instrumentation unit (CAMAC Controller) runs on real time operating system developed by electronics division BARC. It provides a TCP/IP connection at a fixed port.

Device control unit is developed on LINUX operating system following POSIX standard, so that it can be portable on any POSIX compliance operating systems. It is multi-threaded software which uses mutex for synchronization of critical sections. The overall software architecture is given in Figure 2.

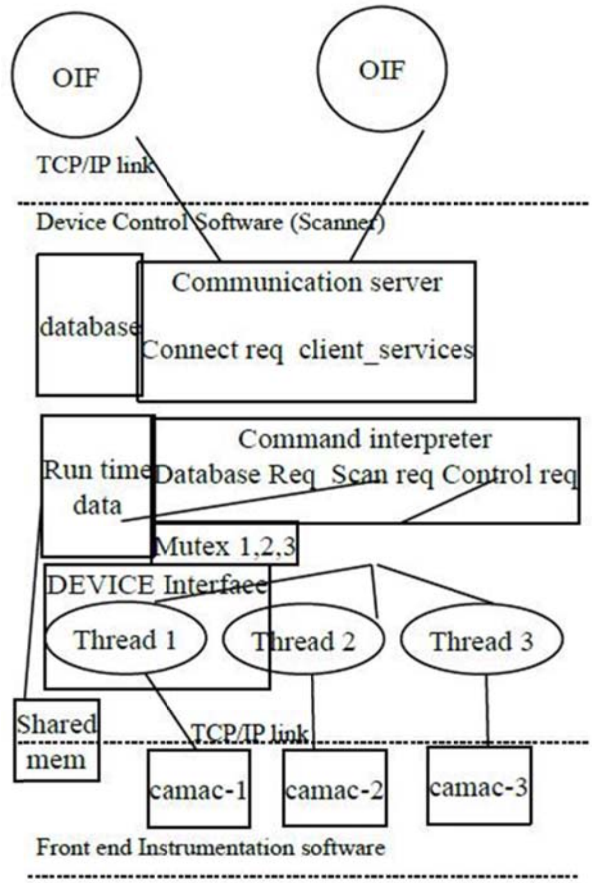

Figure 2: Software Architecture.

The Device control software named as scanner is divided in three layers lowest layer is Device interface layer which is a TCP/IP client for CAMAC crates. The no of threads and mutex are variable depending on database configuration. At present there are three crates hence three different threads and mutexes are launched. Each tread is responsible for connection and periodic scan of field data from individual CAMAC units. Command interpreter layer processes the request passed by communication layer and provides appropriate information to Operator interface unit. It communicates to device interface only for changing the values on field device via CAMAC DAC and Digital output units after acquiring the respective mutex.

The communication server layer is responsible for handling the connection request from OIF clients and passes messages and data through and from the OIF clients.

Operator interface is a GUI programme developed in Trolltech's Qt API version 3.0. Qt is a C++ based API which is source code portable between MS Windows and the Linux operating system.

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CONCLUSIONS

The System is in operation from past two years and working satisfactorily. It can be operated from existing LINAC control panel, hence providing integrability between Pelletron and LINAC control system.

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