ENHANCEMENT OF VACUUM MONITORING SYSTEM OF KCSR ACCELERATOR FACILITY

Y. Krylov, K. Kuznetsov, L. Moseiko, N. Moseiko, Y. Yupinov
KCSRNT, RRC Kurchatov Institute, Moscow

Abstract

The vacuum monitoring system of Kurchatov Center of Synchrotron Radiation [1] is built on current measuring of sputter ion pumps mounted over vacuum chambers of accelerating units. Measuring hardware designed in INP SB RAS is using CAMAC standard [2] and has been operating for a decade now. Hardware upgrade is accomplished by installing a PC workstation, connected through CAN bus to an in-house crate controller. Developed software comprises three levels. Firstly, there is a low-level program running inside the crate controller under RTX-166 operational system. Secondly, we have SQL Server database with client program, whose function is to create the queries at workstation side. And finally there are high-level applications running over network needed to display a current facility status and a data processing.

NEW VACUUM MONITORING SYSTEM

Vacuum Monitoring is being implemented through current measuring of sputter ion pumps evenly mounted over accelerating units of KCSR facility [3]. This mechanism makes it possible to keep track of what is happening to vacuum system for as long as it takes, to locate point of bad vacuum and to get pressure value in case current was successfully calibrated using vacuum-gauge readings.

Until now it was CAMAC modules of IVA type which have been used to perform current measuring since their initial installation along with vacuum pumps 10 years ago. Vacuum Monitoring System was a part of Automatic Control System based on CAMAC-standard and built with "Odrenok" hardware [2].

After years passed it grew necessary to replace outdated hardware with a new one to keep system running continuously and be able to maintain control over vacuum, carry out tests on pump power supplies, write archives accessible over network and process data gathered from experiments [4].

Architecture

New system is schematically depicted in Figure 1. It can be logically divided into three tiers: front-end or client, back-end or server and hardware. Client applications of front-end tier are connected through network segment programmatically separated from LAN. This segment also incorporates server PC where database holding channel-related data resides. Server is linked to crate controllers by CAN bus.

PC Workstation

Operational staff can check status of vacuum system through p4-powered PC workstations working under XP Windows. At the time we have five of these, located inside the vacuum control room and facility's control room.

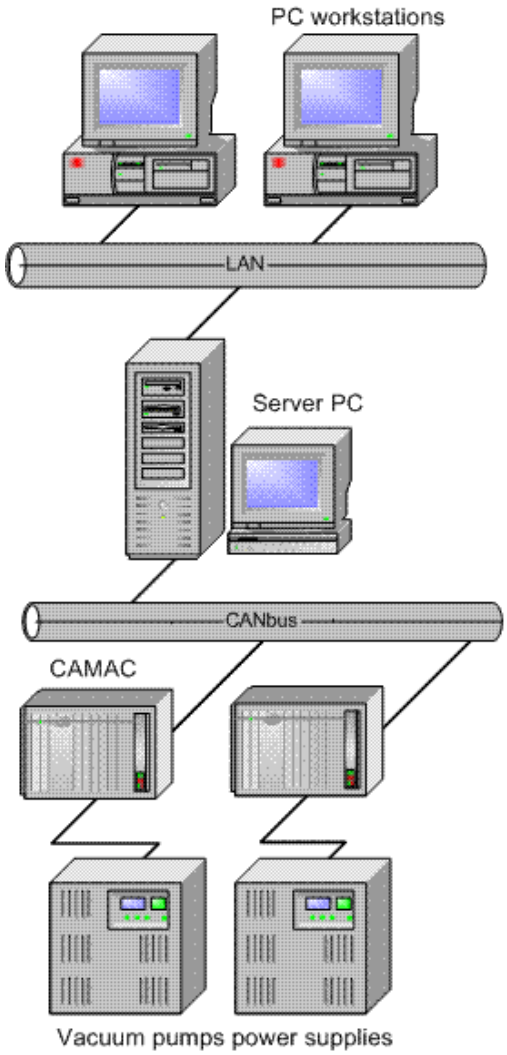

Figure 1. Vacuum Monitoring System.

Server

Server stands between low-level programs running into CAMAC controller and client applications which are supposed to execute primary analysis on data collected from sensors regarding vacuum system status.

The main task of server is to aggregate data, store it and make available to the end user by request. For this

purpose we picked up MS SQL Server 2000 as it proved to be simple and reliable RDBMS.

Crate Controller

Each of two crates used have four 16-channel IVA modules installed. Every module is able to measure current and voltage of power supplies automatically. Time needed to perform one measurement cycle is limited to 0.2 sec per channel. Values can be read from memory unit through K167 controller with C program stored in flash chip. Program runs under RTX-166 operating system and gets started once a command from the server is received. Connection via CAN-bus between the program and K167 controller is being established with interface driver of PCAN-PCI card.

Practical testing revealed that it is possible for enhanced system to get values of 128 current and 128 voltage channels.

SOFTWARE

Three-tier software architecture strongly relates to the vacuum system hardware.

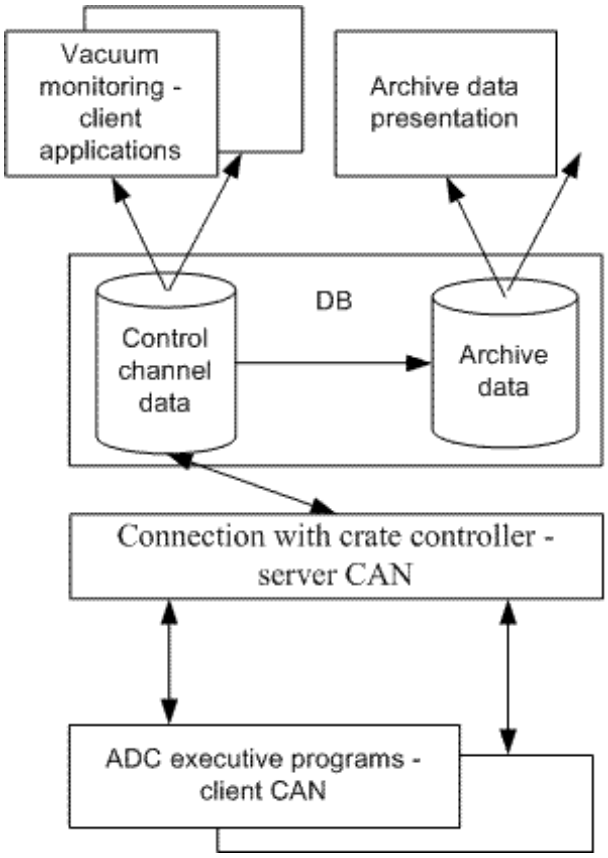

Figure 2. Software scheme.

There are low-level programs inside the crate controller to operate CAMAC hardware in the real-time mode.

Server has RDBMS installed so that it can provide access to control channel data stored in tables. Also there are front-end applications running under Windows XP which allow users to request data from RDBMS vie local area network.

We developed three kinds of client programs with Delphi and SQL that targeted at solving specific tasks. With first one user can read last measured values such as current or voltage of the chosen channels from the dynamically updated table.

After processing obtained data is being graphically rendered on a PC display to notify operational staff about vacuum status or hardware failures and warn them with color or sound signal in case of emergency.

The second one allows user to manipulate archived data representing pump current values for the set time period as a table or a graph.

There is unique program of a third kind loaded into server's memory whose main task is to get data from crate controller and put newly acquired values into the database table every 5 seconds.

Database

Database level has been introduced into the system framework because it was essential to have single data warehouse with standard interface and data management tools in place. Server uses SQL so that every application can send SQL request to this database to get value of the channel for the time period it is interested in.

The database of channels of the control consists of 3 kinds of tables: static, dynamic and archival. Static tables contain a full data set about channels of management, modules and crates. The key field is the unique name of the channel. This table are accessible to viewing and editing only by operator.

The dynamic table contain the data set for work on the channels accessible to management. It is created and filled by the special client at inclusion of the monitoring system.

Archival tables contain descriptions of created archives and archives. Archives are created and filled by means RDBMS. As soon as day dawns database server has new table created where it stores information received from CAMAC modules within next 24 hours. This data can be processed with standard DB routines and is accessible to any client. To preserve archived data integrity it is being replicated on a daily basis.

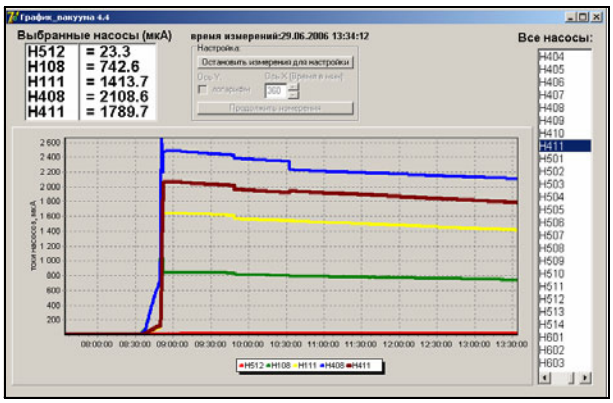

Figure 3. The screenshot of client applications.

Clients Applications

At the screenshot you can see chart with graphs showing current of chosen vacuum pumps during the storage ring is in an electron beam storing and ramping mode. Splash in currents on two orders, meaning corresponding increase in pressure of residual gas in the locations of pumps is precisely visible.

Vacuum Monitoring System is the first step in creation of up-to-date automatic control system that served as a training ground for hardware and software developing, introduced new means of connectivity and ways of data presentation. With new equipment replacing old one and CAMAC hardware having extended life-cycle system tends to be more fail-safe. This creates an excellent opportunity for us to accumulate and manipulate huge amounts of data that seems extremely useful from the perspective of facility management.

REFERENCE

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