# LOGGING ACTIONS OF OPERATORS IN THE IHEP U-70 ACCELERATOR COMPLEX CONTROL SYSTEM

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## Abstract

The control system (CS) of the U-70 accelerator complex supports distributed control rooms environment which are equipped by unified consoles. Using any console it is possible to request any action on any accelerator complex equipment in accordance with user's rights to access it. There are situations requiring knowledge of actions, was performed on some peace of equipment during defined time slot. To solve this problem the CS logs all operators' actions initialized from any consoles such as open/close session, change settings of accelerator parameters, restore settings from archives, etc.

The paper describes a logging software organization and functionalities, contents of the log files and information visualization tools.

## LOGGING REASONS

The basic software architecture and organization of the CS was presented in [1]. The last steps of modernization towards homogenization of CS were discussed in [2]. As a result at present the control system supports a number of control rooms equipped with unified consoles on base of PC-compatible computers. The control rooms are distributed over different buildings and GUI is a separate software package dealing, on one side, with humans and, on other side, with descriptions in the data bases. That is why any changes and additions in the 'user–control system' interaction are made inside this package without influence on other CS software components, e. g. data processing.

Due to distribution of equal in rights consoles over number of control rooms there are necessities from time to time to know what actions on some accelerator equipment took place during the certain time slot. The knowledge helps significantly to understand complex difficult situations during simultaneous work of operators in a different control rooms with interconnected subsystems, e.g. ejection system of one accelerator and injection system of other.

We saw an acceptable decision of the problem in logging significant operator's actions with possibility of efficient visualization the information by any console of the CS. Control system users interact with it by the same unified GUI, realized as the data driven package of programs, which supports three main steps of actions:

1. User identification.
2. Menu tree - to select predefined set of parameters for observation and editing.
3. Tabular presentation of selected parameters values.

A password identifies the user and his rights to modify setting values.

'User – control system' dialogue session starts from root point of the menu tree and ends by closing the menu tree.

On selection of menu tree leaf the window with corresponding table of parameters' current values is opened. Current values of each parameter are presented by a row of a table. An operator may do next modifications on the values:

- Set new value to individual table cell.
- Set new value, add/subtract/multiply/divide all current values of selected rows or selected columns with some entered constant.
- Set new value, add/subtract/multiply/divide all current values of intersection cells of selected rows and columns with some entered constant.

So, it is possible to log most significant operator actions by modifying GUI programs only.

## LOG FILES

Log files are placed in the fixed directory on the control system file server (Figure 1) and are accessed using NFS protocol inside of the CS.
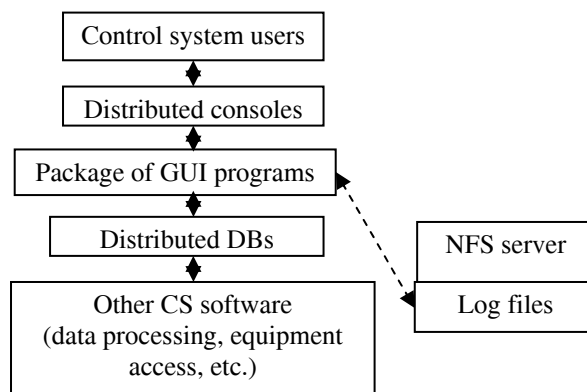


Figure 1: Location of the log files in the CS layout

There is a separate log file for each control system user containing descriptions of actins were performed by him. A log file is plane text file in Russian. A description of single action consists of two or three text lines and includes: consol computer name, date, time, menu tree path and concrete action.

A concrete action may be: open/close table corresponding to the menu tree path, restore settings from archive, one of modifications of values were listed in previous section. A table cells are addressed by row and column numbers. So, a value modification may be described like this:

pcstvn01.oku.ihep.su 09:38:40 Sat 24 Apr 2010
Table:
U1.5/ControlSystems/TimingSystem/Control/InjectionTimer/Reg.1:U-70High Intensity/Timing Delays

Set value 3900 to row = 3 column = 12

## VISUALIZATION TOOLS

The GUI tools of the control system include some facilities to output contents of a log files to a separate window of consol computer. But it is too primitive and do not give a chance to find interesting operators actions and to analyze the current situation fast enough.

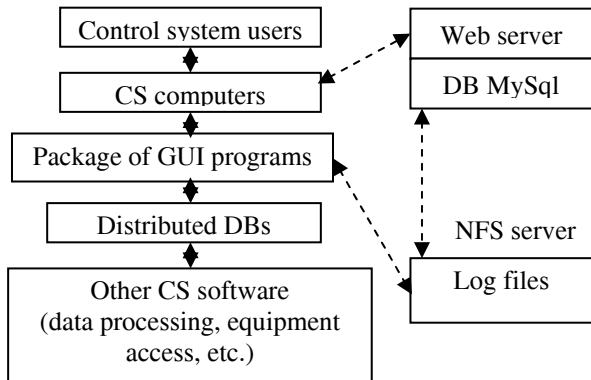So, more suitable visualization tool was developed (Figure 2).



Figure 2: Layout of the logs visualization tools

First of all we decided to give any CS computer opportunity to access log files information using standard web browsers since a control system users used to work with it. More over the tool should to provide selection of desired log records by some criterions. There are next criterions one may use for events selection:

1. Consol computer name an operator used to perform actions.
2. User name.
3. Start/end date and time of interesting time slot.
4. Data table a modifications were performed on (menu tree path).

A web-browser supports the visualization window combining dialog, menu tree, comments and text areas. The dialog area of a visualization window is used to define criterions 1-3. The data table may be defined by using interactive menu tree area. The shown menu tree of this area is restored from log files contents and includes paths were really used by operators (Figure 3).

In accordance with indicated criterions the descriptions of operators' actions are showing in the text area of a visualization window. It gives sufficient easily understandable information in Russian about actions were taken on corresponding accelerator complex equipment. The comments area is used to show full path of selected data table.

To meet the requirements of log files visualization the functionalities of the control system internal web-server were broaden. To solve the problem PHP-scripts, Java-applet, HTTP and JSON protocols are used.

Between web-server and log files there is data base of MySQL. Contents of the data base are formed by processing the log files information. It corresponds to the current state of a log files always.

06 Instrumentation, Controls, Feedback and Operational Aspects

Data base is used to comply with users requests to get information in accordance with defined criterions. When user requests to show log information, the web-browser get access to descriptions of all actions were performed up to request moment.
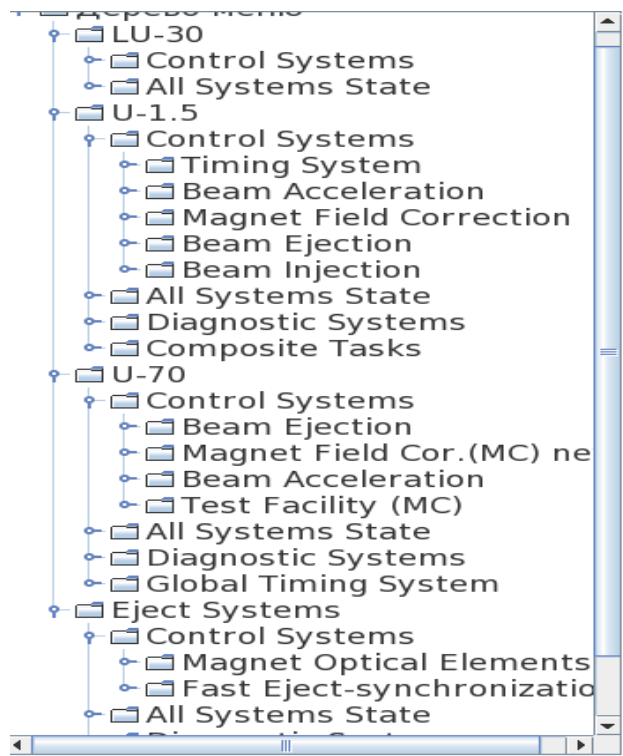


Figure 3: Menu tree is restored from log files texts

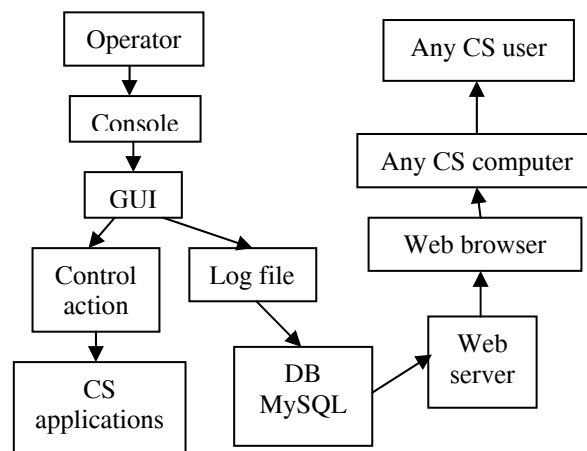So, the control system supports the next data flow scheme (Figure 4).



Figure 4: Data flow scheme

## CONCLUSIONS

Today users of the IHEP U-70 accelerator complex control system have new very helpful tool. It is used to analyze operators' activities, to discover and understand unexpected behavior of an accelerator due to remote slightly incorrect actions of some operator.

The control system web-site is internal and log information may be seen inside of the CS only.

## ACKNOWLEDGMENTS

The author would like to thank the students of the "Protvino" branch of the "Dubna" university, who participated to realization of the web visualization tool.

## REFERENCES

[1] V.Voevodin, "Software Architecture of the U-70 Accelerator Complex New Control System", Proceedings of the ICALEPCS'99, Trieste, Italy, 1999, p.457.

[2] V.Voevodin, "Information technologies in the IHEP U-70 accelerator complex control system", Proceedings of the RuPAC 2008, Zvenigorod, Russia, 2008, p.270.