FIRST EXPERIENCES WITH CENTRAL WEB BASED FAULT INFORMATION SYSTEM

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Abstract

Indus Control System, which controls the Indus-1 and Indus-2 Synchrotron Radiation Sources at RRCAT, Indore, is a distributed computer system. It employs 8 VME Controllers, 300 interface modules, 7 Operator Computers for Indus-1 and approximately 100 Equipment Control VME stations, 10 Supervisory Controllers, 11 Operator Computers and 6 Server Machines for Indus-2. The machine is operated in shifts to provide synchrotron radiation from Indus-1 to users as well as carrying out commissioning experiments of Indus-2. To keep it up and running, the faults encountered during its operation are rectified at site and complete observations and rectifications of the faults are recorded electronically by the shift crewmembers in a central web based fault information system. This System is based on three tiers software architecture and has been developed using Java Servlets, HTML, JavaScript and SQL Database. Using relational database, facilities have been provided in the system for logging, e-mailing, acknowledging, exploring and analysing the fault information of various sub systems. This paper briefly describes experience, implementation aspects and functionalities provided by the system.

MOTIVATION

The main motivation of this project is to constantly monitor and improve the performance of Indus Control System. Indus-1 Control System Computers for different sub-systems are directly connected with their respective Equipment Controllers (ECs) through RS-232 serial link and these Equipment Controllers in turn are connected with different field devices e.g. Power Supplies, Vacuum Components, Radiation Monitors etc. Indus-2 Control System is based on three layer architecture for Controlling/Monitoring of various field devices. Operator Console Computers, which provide Graphical User Interface to operators, are connected with Supervisory Computers through 100 MBPS Ethernet link and Supervisory Computers are individually connected to EC Computers over RS-485 link. The EC Computers are finally interfaced to different field devices.

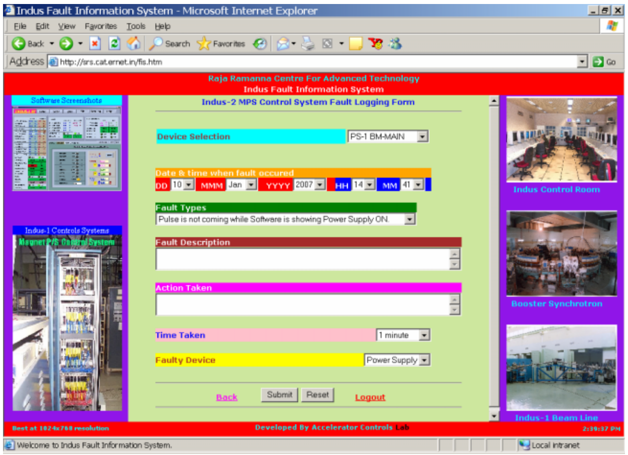
Seeing the complexities of different types of hardware and software involved in the control system, it was felt to have a system that would systematically track the information logged by machine crewmembers during operations of the machines.

REQUIREMENTS

Following basic requirements were considered before developing the system:

- It should be possible to use the system by multiple users simultaneously connected with CATNet (CAT Network).
- The system should be easy to use for especially non-computer experts.
- The information entered by the users should be precise and free of errors.
- It should be possible to send the entered information to concerned sub-system experts electronically.
- It should be possible to view the stored information in a structured way as per different search arguments e.g. system name, faulty device, time stamps, etc.
- It should be possible to acknowledge the stored faults by concerned sub-system persons.
- It should be possible to generate the system wise statistics of faults between a given periods of time.

It was realized that if web based system is designed then it would not only serve the above basic requirements but also offer many new features, which would not be possible with other non-web based systems. Thus this system was developed using Java, HTML, JavaScript and SQL Database. The first version of the system became operational in May 2004 and since then with various modifications and additions of new functionalities this system is being used continually by the crewmembers during operations of Indus-1 and Indus-2.



Address http://srs.cat.ernet.in/fis.htm

Raja Ramanna Centre For Advanced Technology
Indus Fault Information System
Indus-2 MPS Control System Fault Logging Form

Device Selection: PS-1 BM-MAIN

Date & time when fault occured: DD 10 MMM Jan YYYY 2007 HH 14 MM 41

Fault Types: Pulse is not coming while Software is showing Power Supply ON.

Fault Description

Action Taken

Time Taken: 1 minute

Faulty Device: Power Supply

Best at 1024x768 resolution
Developed By Accelerator Controls Lab
2:39:37 PM

Welcome to Indus Fault Information System.

Figure 1: Fault Logger.

[#] bsks@cat.ernet.in

SYSTEM IN ACTION

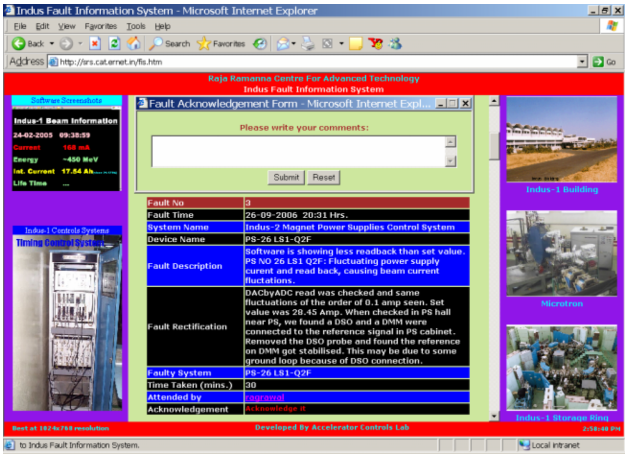
Access to fault information system has been protected with password so that only authenticated users only could use the system. User interface part of the system has three sections namely Indus-1, Transfer Line-3 and Indus-2. All of these three sections have been divided into five sub-sections namely Fault Logger, Fault Acknowledger, Fault Explorer, Fault Analyser and Expert Info Viewer.

Fault Logger

This section provides option to log the entire fault related information from one point. Entries to be logged include subsystem name, device name, time stamp, fault type, fault description, action taken, time taken and name of the faulty device (Figure 1). To avoid the misspelling and confusion almost all the fields contain the drop down lists and masked with preset data so that user has to just select the value from the list. After logging the fault entries into database, system also asks users to opt for sending by e-mail the logged information to concerned persons. Names of the concerned persons are automatically displayed according to data filled in 'faulty device' field.

Fault Acknowledger

This section is meant only for persons concerned with the systems for acknowledging the faults. Users can retrieve (Figure 2) the list of unacknowledged faults by filling the query form.


Indus Fault Information System - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://srs.cat.ernet.in/fis.htm
Go
Raja Ramanna Centre For Advanced Technology
Indus Fault Information System
Software Screenshots
Indus-1 Beam Information
24-02-2005 09:38:59
Current 168 mA
Energy ~450 MeV
Int. Current 17.54 Ah
Life Time ...
Indus-1 Controls Systems
Timing Control System
Fault Acknowledgement Form - Microsoft Internet Expl...
Please write your comments:
Submit
Reset
Indus-1 Building
Microtron
Indus-1 Storage Ring
Best at 1024x768 resolution
Developed By Accelerator Controls Lab
2:58:40 PM
to Indus Fault Information System.
Local intranet

Fault No	3
Fault Time	26-09-2006 20:31 Hrs.
System Name	Indus-2 Magnet Power Supplies Control System
Device Name	PS-26 LS1-Q2F
Fault Description	Software is showing less readback than set value. PS NO 26 LS1 Q2F: Fluctuating power supply curent and read back, causing beam current fluctations.
Fault Rectification	DACbyADC read was checked and same fluctuations of the order of 0.1 amp seen. Set value was 28.45 Amp. When checked in PS hall near PS, we found a DSO and a DMM were connected to the reference signal in PS cabinet. Removed the DSO probe and found the reference on DMM got stabilised. This may be due to some ground loop because of DSO connection.
Faulty System	PS-26 LS1-Q2F
Time Taken (mins.)	30
Attended by	ragrawal
Acknowledgement	Acknowledge it

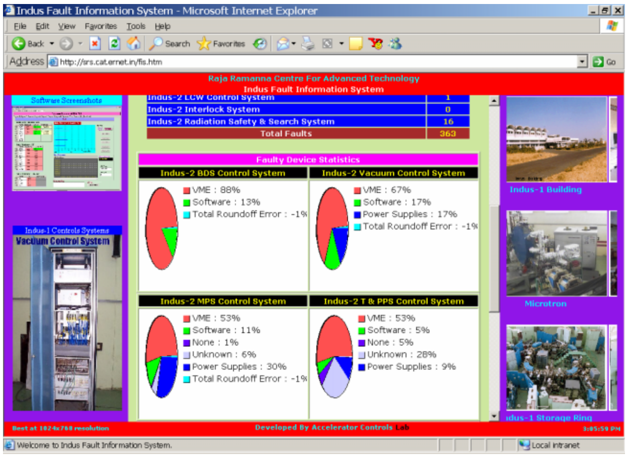
Figure 2: Fault Acknowledger.

Fault Explorer

This section provides facility to search the faults logged by crewmembers during operations of Indus-1 and Indus-2. By filling the query form user can search from the historical faults according to subsystem name, device name, faulty device and between given period of time. The historical faults are returned in a table, which contains the fault date & time, system name, device name, fault description, fault rectification, faulty system and logged by fields.

Fault Analyser

This section of the system (Figure 3) facilitates the users to view the statistics of devices found faulty out of any specific system in pie charts over a given period of time.


Indus Fault Information System - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://srs.cat.ernet.in/fis.htm
Go
Raja Ramanna Centre For Advanced Technology
Indus Fault Information System
Software Screenshots
Indus-1 Controls Systems
Vacuum Control System
Faulty Device Statistics
Indus-2 BDS Control System
VME : 88%
Software : 13%
Total Roundoff Error : -1%
Indus-2 Vacuum Control System
VME : 67%
Software : 17%
Power Supplies : 17%
Total Roundoff Error : -1%
Indus-2 MPS Control System
VME : 53%
Software : 11%
None : 1%
Unknown : 6%
Power Supplies : 30%
Total Roundoff Error : -1%
Indus-2 T & PPS Control System
VME : 53%
Software : 5%
None : 5%
Unknown : 28%
Power Supplies : 9%
Indus-1 Building
Microtron
Indus-1 Storage Ring
Best at 1024x768 resolution
Developed By Accelerator Controls Lab
3:05:59 PM
Welcome to Indus Fault Information System.
Local intranet

Indus-2 LCW Control System	1
Indus-2 Interlock System	0
Indus-2 Radiation Safety & Search System	16
Total Faults	363

Figure 3: Fault Analyser.

VME, Power Supplies, Software, Computer, etc may be some of the faulty devices in case of fault related to any sub system controls.

Expert Info Viewer

This section of the system was added later and facilitates the users to only view the names of devices and concerned persons. Concerned persons listed in this table can acknowledge the faults and logged fault information is also mailed electronically to these concerned persons only.

Shift Summary

This special section of the system was added recently for logging, e-mailing and exploring the main activities done during the operations of Indus-1 and Indus-2. This section is very useful for group leaders and system experts.

CONCEPT

The system follows the three-tier software architecture where Web Browser, Java Servlets and DBMS Server reside on client, middle and data tier respectively. Java Servlets in middle tier connect clients built using HTML or applets to back-end servers.

Client Tier

For interacting with the system, the client tier (user interface part) has been designed using HTML and java script. JavaScript codes have been incorporated in HTML query forms for validation of data filled by users at client end. A client communicates its requirements to the servlet, using HTTP and the business logic in the servlet handles the request by connecting to the DBMS Server.

Middle Tier

Java Servlets, which act between client and data tier were chosen to implement the middle tier that connects the client tier to data tier.

Java Applets were embedded in HTML pages (Figure 3) to plot the pie chart and bar chart for pictorially displaying the faults statistics of various sub systems.

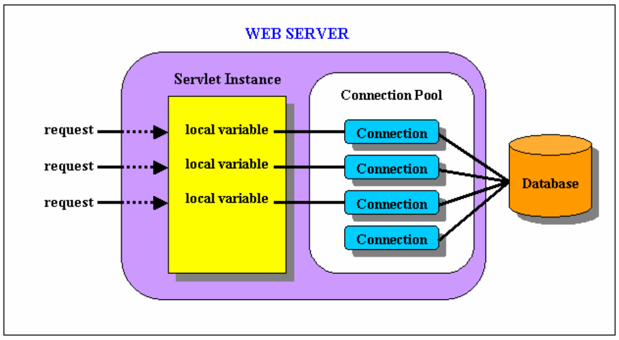


Figure 4: Servlets using a database connection pool.

Using JDBC Type4 Driver a database connection pool has been used to improve the performance. This servlet creates a pool of Connection objects in advance and hands them out as needed as shown in Figure 4. This servlet maintains a Hashtable, using Connection objects as keys and Boolean objects as stored values. The Boolean value indicates whether a connection is in use. If all the connections are in use, the class creates new one.

Data Tier

SQL Server 2000 based database was designed to implement the data tier, which stores the complete information in related tables. Device Information and concerned persons details were stored in the database so that logged fault information could be mailed electronically.

CONCLUSION

The first version of the system with only basic required functionalities was launched in May 2004. After that many new features were added as per the feedback from crewmembers, system experts and group leaders. The system is very useful for not only the accelerator crewmembers but also for machine/subsystem experts for improving the overall machine performance.

Presently, we are using Microsoft Windows 2000 based infrastructure and if we switch to Linux based infrastructure then very little modifications are required in codes of middle tier of the system during porting.