DATA LOGGING SYSTEM UPGRADE FOR INDUS ACCELERATOR

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Abstract

An accelerator has various subsystems like Magnet Power Supply, Beam Diagnostics and Vacuum etc. which are required to work in a stable manner to ensure required machine performance. Logging of system parameters at a faster rate plays a crucial role in analysing and understanding machine behaviour. Logging all the machine parameters consistently at the rate of typically more than 1 Hz has been the aim of a recent data logging system upgrade.

Nearly ten thousand parameters are being logged at varying intervals of one second to one minute in Indus accelerator complex. The present logging scheme is augmented to log all these parameters at a rate equal to or more than 1 Hz. The database schema is designed according to the data type of the parameter. The data is distributed into historical table and intermediate table which comprises of recent data. Machine control applications read the parameter values from the control system and store them into the text files of finite time duration for each sub-system. The logging application of each sub-system passes these text files to database for bulk insertion. The detail design of database, logging scheme and its architecture is presented in the paper.

INTRODUCTION

Indus-1 and Indus-2 Synchrotron Radiation Sources (SRS) housed in Indus complex are cyclic particle accelerators that accelerate electrons up to 450 MeV and 2.5 GeV respectively [1]. These are supported by Microtron injector, Booster Synchrotron and various transport lines. In a multi accelerator complex like this, involving various complex subsystems, an effective system for comprehensive parameter data logging is considered essential.

Ideally, data logging system should contain all the information necessary to provide an accurate representation of the state of system parameters at any given time. The existing data logging system acquires and stores all the subsystem parameters at varying time interval of one second to one minute. Although this strategy has worked satisfactorily but this data logging scheme does not scale well as the number of control parameters grow and it begins to strain network and storage capabilities. This becomes a bottleneck in efficient operational diagnosis of all sub-systems in Indus accelerator. So an up gradation is aimed to design a data logging scheme that can provide a platform to log all the machine parameters at the same rate at which all the parameters are acquired from the field i.e. at 1Hz.

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Hence, a new data logging approach of gathering the time series data in text files in the form of strings with delimiters along with the timestamp is adopted [2]. Besides this some major modification at software level has been introduced to achieve fast data logging of all the parameters at 1 Hz.

HARDWARE AND SOFTWARE ARCHITECTURE

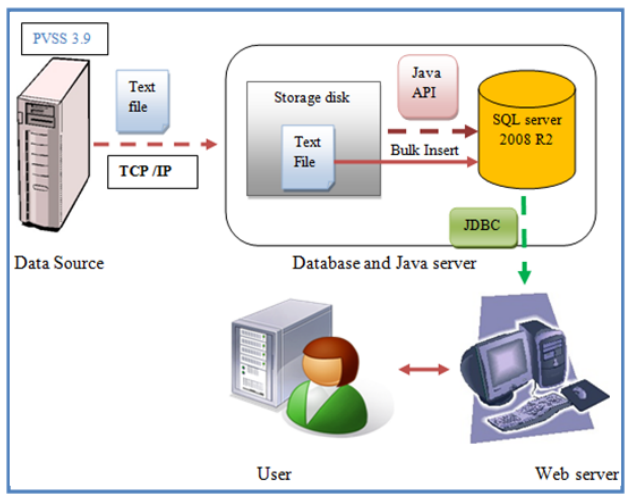

Figure 1: High level layout of data logging architecture.

The data collection process of Indus SRS machine is based on three tier architecture. The top layer architecture is shown in Figure 1. In the Indus control systems, middleware collects and processes the data from the field devices and sends it to the Indus control server based on the PVSS [3] industrial SCADA system. The PVSS control server continously puts the data into text files with the timestamp for time span of five minutes and copies the text files (data files) to Java application server over TCP/IP. This process is repeated with time for each subsystem. It also deletes the previous text files only on receiving the successful acknowledgement of copy operation from Java server. Hence the control application running on PVSS control server also prevents the data loss in critical situations of logging failure by retaining the data in text files.

For each sub-system of Indus-2, Java application interface exists between PVSS control server and database server.The Java application peridocally checks for recently received data file from the PVSS server and pass on the data file name to database server through a stored procedure call.These stored procedures after recieving the the data file information, perform the bulk insert operation into corresponding subsystem database

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table. The Java application also manage temporal synchronization and serve as watchdog for any application failure.

Table 1: Hardware Specifications

Hardware Resource	Specification
Database Server	HP Proliant DL 360 G7
Processor	Intel(R) Xeon(R) CPU E5630 @2.52 GHz (dual processor)
Disk	6G DP 10K SAS, 4x146 GB
Memory	8.00 GB

Table 2: Software

Software Category	Description
System Software	Windows Server 2008 R2®
Application Software	MSSQL Server 2008 R2® (Enterprise edition)
Application Software	Java(TM) SE Development Kit 6 Update 26 (Oracle Product version:1.6.0.260)
Application Software	PVSS 3.9® (ETM professional Control GmbH Product version:3.9)

DATABASE DESIGN

Separate databases are created for each subsystem of Indus-1 and Indus-2 and database schema pattern followed in this upgraded data logging scheme is based on '*data table per data type'* approach [4] i.e. same data-type parameters values are stored in a single table.The main advantage of this approach is its scalibility.The collected data is distributed into two categories of tables: main table and intermediate table on the basis of timestamp associated with the particular data .

Main table holds all the past available data except data residing in intermediate table. The intermediate table holds the most recent available data (in case of Indus database,intermediate table holds last one hour available data).Table partitioning feature [5], supported by MSSQL server 2008 R2 ®, has been implemented on the intermediate table for achieving better performance in data loading operation.

There is one main configuration table created in each subsystem database.This table comprises of metadata or configuration information of each parameter associated with the subsystem.Besides this, there are two staging tables in each subsystem database which support the efficient flow of data at the time of switching of table partition using sliding window scenario concept [5].

Data Flow Cycle

There are certain prerequisites that are essential for realizing data flow for implementing sliding window model of table partitioning [5].To comply with the prerequisites, the schema design of tables are kept same among staging, intermediate and main tables i.e. table schema for storing analog data type parameters and table schema for storing status data type parameters are same in all three tables categories.

Figure 2 shows the data flow cycle for analog data type parameters inside SQL server database. A similar data flow cycle is followed for table carrying status parameters.

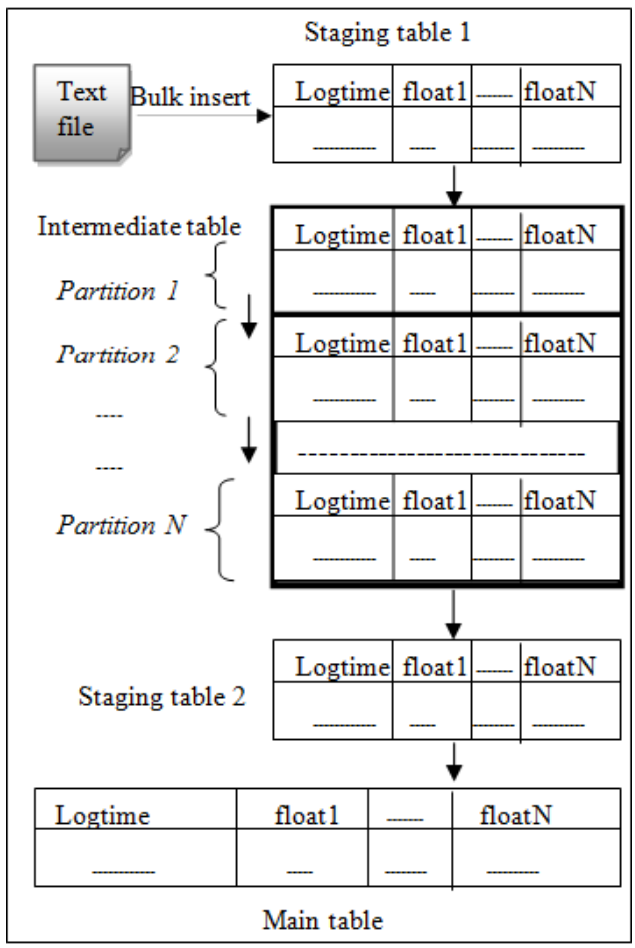

Figure 2: Data flow cycle for analog parameters.

Diagnostics and Error Handling

In order to diagnose and monitor the data logging system, a status panel is designed in PVSS. The Java application edits the status information in the log file at every five minute logging interval. The control scripts at PVSS server reads the information in the log file and subsequently reflect any undesired behaviour in the whole logging system on the status panel. Error is reported if required data files are not found or if bulk insertion operation is not successful.

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RESULT AND CONCLUSION

A new upgraded data logging system has been designed which is tested at the experimental server machine.It has been demostrated that the scheme has successfully logged approximately 1 GB of data per day. Almost 8000 parameters are logged at the rate of one hertz without any loss of data at any time instant.Thus this logging system is more suitable in terms of performance & scalibility and it is being deployed in Indus control system architecture.

SUMMARY AND FUTURE PLAN

In comparison to previous data logging system of Indus, this new logging system has enhanced the reliability and data availability of the time critical data of Indus systems.It improves the data logging rate by the use of advanced features like table partitioning and modifying the internal database schema.

Although the development phase of the data logging system has been accomplished as per our requirements but there still exists scope of improvements in the database performance from database administrative and maintenance aspect.

REFERENCES

[1] R. K. Agrawal et al., "Software Scenario for Control System of Indus-2", 10th ICALEPCS Int. Conf. On Accelerator & Large Expt. Physics Control Systems. Geneva, 10 - 14 Oct 2005, WE3B.3-70 (2005).

[2] E. Goman, S. Karnaev, O. Plotnikova, E. Simonov, "The database of the VEPP-4 Accelerating facility parameters, Proceedings of PCaPAC08, Ljubljana, Slovenia.

[3] PVSS-II is a SCADA package from ETM, Austria.

[4] R. Billen, C. Roderick, "The LHC Logging Service," Paper presented at the UKOUG Conference 2006 14-17 November 2006, Birmingham, UK.

[5] "Partitioned Tables and Indexes in SQL Server 2005" *http://msdn.microsoft.com/enus/library/ms190787(v=SQL.90).aspx*

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