

NEW TINE JAVA GENERAL PURPOSE DIAGNOSTIC APPLICATIONS

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Abstract

One of the strengths of the TINE [1] control system is the ability to easily make ‘rich-client’ applications containing that programming and display logic which is designed to expedite and enhance the operator’s or physicist’s abilities to diagnose problems and correlate results. In particular there are a large number of ‘rich-client’, general purpose applications which offer extensive interactions with the TINE standard servers and subsystems. This includes the TINE archive system, alarm system, post-mortem system, and video system, as well as scope trace analysis, multi-channel analysis and general configuration management. Available now for many years, these diagnostic applications have recently been realized as pure Java applications using ACOP [2] beans. All applications have been honed and refined based on extensive feedback from the application users. We offer here a description of these applications, some of the novel techniques used and focus on those ‘rich-client’ aspects which cannot be achieved by configuring ‘simple-clients’ based on displayer widgets.

ARCHIVE SYSTEM

TINE offers three different ways for archiving data [3]: event-driven archiving, local archiving with tolerance filtering, and central archiving with adjustable state and tolerance filtering.

Event Archive System

The event-driven archives are archive snapshots, which are based on scripts specifically targeting the event in question. In particular, post-mortem data frozen in the hardware, which is normally not found in the machine parameter archive can be collected. This is typically a set of transient data sampled on a very fine time raster centred at the time of the event. In a similar vein, data kept in short-term storage in a server's local history repository at a much higher sampling rate than on the central archiver can be retrieved and stored in association with an event [4].

All such events can be post processed using one of two designated Java applications: the Event Archive Viewer (EAV) and the Transient Recorder Viewer (TRV). The EAV enables the operator to explicitly select a device property from the naming service for which the available events will be displayed, while the TRV properties are based on predefined configurations read from the TINE archive server. The selected event data are shown on an ACOP chart, which offers numerous features, such as zooming, axis scaling etc. in order to inspect the data and look for the details that one is interested in.

Local and Central Archive System

Central archiving offers more standard way of data archiving. It consists of acquiring the specified data, passing it through the relevant filters and writing it to disk if warranted. Local archiving is in many ways similar to central archiving. The difference between the two options is that local archiving takes place at the server, which can be configured to maintain an archive of properties both on a short-term basis (in main memory) or on a long-term basis (on disk). The local archive normally stores a greater amount of data (rate of stored values is typically greater), however in contrast to the central system, the data on the local system are not permanently stored. There are several Java applications which make use of these two archive system.

The Archive Viewer (AV) is a powerful tool for inspecting data in the standard archive. One starts by selecting the appropriate properties one wishes to explore. There are several ways how to select them but we can basically narrow them down to two different aspects: explicitly selecting a property from the naming service (restricted to browsing only among archived properties) or selecting a predefined configuration from a list. These configurations prove to be useful in case we want to define a common set of properties which the machine operator wants to inspect on regular basis and does not want to waste time by searching the naming service in order to select them individually.

All selected properties are visible on the same trend chart as seen in Figure 1 and are available for further analysis. Analysis and inspection are made easy by providing a vast set of features to visually adjust the appearance of the graphs and charts, axis scale etc. For instance, one can even show two completely different properties on the same trend (eg. energy and vacuum pressure) despite the fact that one property has values several order of magnitude higher than the other. For such cases AV offers a “normalized mode” in which all visible properties are scaled to show percentage of their maximum value. Such features becomes useful when the AV is used to show the accelerator overview. If necessary logarithmic scaling of all or just some of the graphs can also be applied.

If during the analysis one finds out that a higher resolution is required to examine the properties the user can zoom in the chart and the graphs in the selected timespan will be refined with new values read from the TINE archive. Similarly one can also zoom out or select any other timespan in the past. Each zoom operation can be regarded as an ‘optical zoom’, where archive data are re-acquired on the relevant raster, as opposed to ‘digital’ zoom, which would only redraw the last acquired data on a different scale.

Furthermore, the AV also allows the correlation between any two selected channels. The channels will be plotted one against the other and if time stamps of the channels do not match, the values will be interpolated to show the proper correlation.

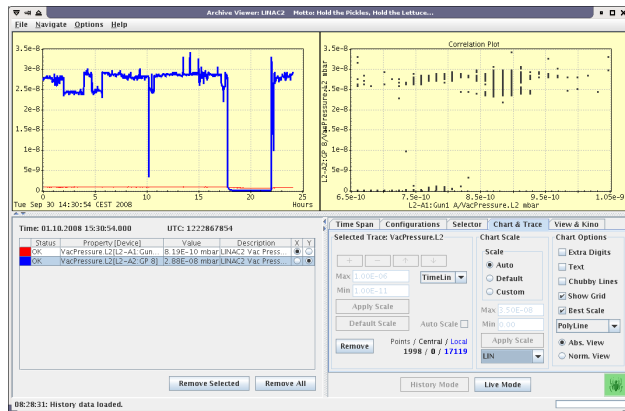


Figure 1: Archive Viewer. The left chart represents history trends of two vacuum pressure channels and the right chart presents the correlation between the two channels.

In TINE, channels can be defined as multi-channels, which means that there can be several devices, all having the same property and settings, which are dealt with as a vector object. All common properties of these devices can be arranged into an array, where each index in the array represents a single device. The AV allows the inspection of such multi-channels using the array history chart. For each time stamp in the past one can request a snapshot from the archive for the whole multi-channel array and show the values on the array chart. It is even possible to cycle through the history trend chart of a single property and while doing so to display the multi-channel that that property belongs too. In this case the snapshot is loaded for each selected time stamp in the trend chart.

Another application based on the archiving system, called the Multi-Channel Analyser (MCA) was developed with the purpose of inspecting the multi-channel arrays. It offers similar features as the Archive Viewer but its primary use is based on multi-channel history inspection. The application can show several multi-channels combined into a single one. The rules for combining channels together are defined by configuration files, which keep the application generic and independent of the system. The MCA also offers tools for comparison of individual device traces and other features employed also by the AV.

Both the Archive Viewer and the Multi-Channel Analyser can work in two different modes: the history mode (default for the AV) where all data are loaded from the archive system and the live mode (default for the MCA) where live data are acquired from the device servers. In fact, the live mode combines both the history and live data acquisition. One can decide to show live data and at the same time select a timespan defining how far back into history the data should be visible. The

history of the property will be loaded from the archive servers.

ALARM SYSTEM

Another important component for diagnosing problems in the control system is the alarm system, which notifies the operator about any irregularities in the operation of the machine. TINE alarms are processed at two levels. The first level is located directly at the front end and is known as the Local Alarm Server (LAS). The LAS is mostly responsible for generation of the alarms, determining oscillations, heartbeats etc. The second level of processing occurs at a dedicated middle layer TINE server known as the Central Alarm Server (CAS). Here, alarms are collected, filtered, sorted, and made available for client-side review. The CAS also performs several additional tasks more appropriate to central level processing. It can determine whether 'server-down' alarms need to be issued in the case of a non-responsive server. It can also take actions following the receipt of particular alarms. For instance, it can issue post-mortem triggers, send e-mails, or write reports, etc. [5]

The TINE Alarm Viewer retrieves data primarily from the central alarm server and only a small portion, such as alarm description and references are retrieved from the individual servers.

There are two diagnostic applications which are based on the TINE alarm system:

- a system dedicated Alarm Message Viewer,
- a general purpose Alarm Viewer.

The Alarm Message Viewer is a simple client which monitors a particular system and shows the alarms in that system as they occur. The application offers only the most important information and does not allow any user interactions with the alarm system once it has been started. Its main purpose is the on-going monitoring of the system and offering a quick glance over the status of the machine. For any further analysis and inspection one has to use the Alarm Viewer.

The Alarm Viewer is a powerful application replete with different features implemented in collaboration with the operators to make the alarm system as useful as possible.

The Alarm Viewer works in several modes or views in order to fulfil the requirements proposed by the machine operators. It was designed in a way that it shows only the most important data required by the operators and hide the information which is not required at a particular level. One can of course expand the view at any time to match his requirements.

The Alarm Viewer works primarily as a live alarm monitor. It monitors the systems of a particular machine and shows the quantity and severity of the alarms as they occur (it is even possible to turn on sound notification). Once an alarm is registered by the CAS it will appear in the viewer under the designated alarm system. By selecting the appropriate view the user can inspect the details of the alarm, such as the device and server of

origin, as well as the start time and duration. It is even possible to inspect the history of a give alarm – this will show all occurrences of the alarm (heartbeats, data change termination, reappearances) in the recent past (two hour window considered to represent live or non-archived data).

Furthermore, the alarm viewer offers the ability to suspend the entire view or acknowledge those alarms, which the operator is not interested in. Suspending the view means that the alarm tables will not be updated (allowing easier inspection when alarms occur rapidly), while the latter option means that all currently selected alarms will be suppressed and rendered invisible until the next occurrence/heartbeat of the particular alarm or the user decide to un-acknowledge them.

In addition, the Alarm Viewer also offers the possibility examining the archived alarms. By specifying the time frame in the past all archived alarms from that window will be loaded and the user has the same features at his disposal as when monitoring live alarms.

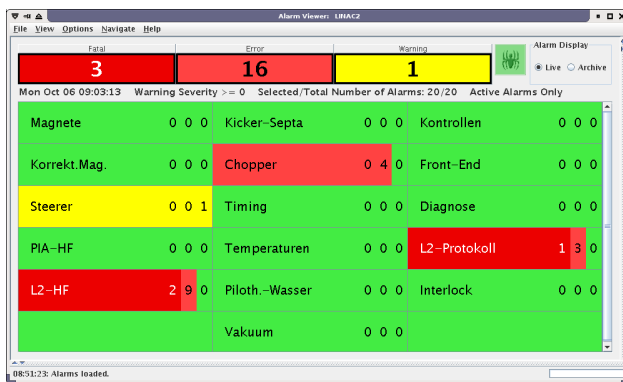


Figure 2: The most basic view of Alarm Viewer shows the alarms of all systems of the selected machine.

SPECIAL PURPOSE TOOLS

We have already mentioned that the Archive Viewer and Multi-Channel Analyser can also act as tools for monitoring live data. Both of them can be used for displaying numerous sets of properties and therefore, can be used as multiple displays.

However, there are also other applications, tailored to examine particular types of data. The Trend Viewer is more or less a stripped down Archive Viewer. It allows the selection of numerous properties and presenting their values in the trend chart together with their history as we already mentioned in the Archive Viewer section.

The Scope Trace Viewer is oriented in displaying the scope traces, which are special TINE properties. They consist of several hundreds or even thousands of points, which have to be presented in a chart (similar to oscilloscope traces). As with other applications which use ACOP beans, the Scope Trace Viewer also offers numerous tools for data visualization as well as some specific features which are usually employed by oscilloscope (eg. trace persistence).

Another special type of property in the TINE control system is the video type. The TINE Video Application is

capable of displaying a live feed from a designated camera integrated into the control system. By using the Huffman Compression methods [6] TINE employs fast transfer rates between the server and client. The drawing of the image is implemented in pure Java and can be realized with refresh rates of a few hertz.

Beside the aforementioned applications TINE also offers a set of tools for statistical analysis of the machine history and availability. The Operation History application gathers data from both the alarm and archive servers and performs various calculations (defined by specific configurations) to present the machine operation history. The user has the option to examine the running, standby and other states of the machine operation during any specified time frame, rendered at the top most level as a pie chart.

ADMINISTRATION TOOLS

Furthermore, there are several applications designed for monitoring front end computers as well as configuring the TINE control system

The FEC Remote Control Panel is intended to monitor the Front End Controllers (FEC) as well as the device servers on those computers. The user is allowed to monitor the processes on the FECs, inspect the alarm data, log files etc. The application also allows logins and process control on such computer.

The ENS Administration tool is used for administering the naming service, such as registering new device servers or front-ends as well as removing them from the system or simply grouping them in a particular way.

The Archive Database Manager allows one to create and maintain the archive system configuration files, which are loaded onto archive servers and define how certain properties should be archived. The application takes care of all the logic behind the structure of the files and notifies the user if any irregularities were introduced to the database.

CONCLUSION

When it comes to diagnostics the operators require reliable applications for analysis of the data. Together with some other applications TINE now offers a comprehensive set of tools for live and post-mortem analysis of the control system operation, thus making the analysis and operation overview much easier and more fun. In the end they allow one to focus on solving the problem itself rather than on trying to make the appropriate applications to work properly.

REFERENCES

- [1] <http://tine.desy.de>
- [2] <http://cosylib.cosylab.com/pub/acop/site>
- [3] P. Duval and M. Lomperski, "TINE Archive System (DAQ-Lite)"
- [4] P. Duval and M. Lomperski, "TINE Event Archive System"
- [5] P. Duval and M. Lomperski, "TINE Alarm System"
- [6] <http://en.wikipedia.org/wiki/Huffman>