

EXPERIENCE WITH VSYSTEM IN A WIDE VARIETY OF APPLICATIONS

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Abstract

Vsystem [1-3] has been developing rapidly with the demands of industrial and research users as well as with promising research into smart controls [4-8]. A significant development has been the fielding of V3.0 on VxWorks, Digital UNIX, Concurrent power/UX, and Solaris as well as our traditional platforms. One application running is with Vaccess on all three of VxWorks, VAX/OpenVMS, and Alpha/OpenVMS in one system. Other applications use Digital UNIX and Concurrent Power/UX. Our new version of the logger has been running in a power plant for over a year, acting as a black-box flight recorder, recording data at 33Hz and 100Hz. We are also installing a power-plant training system emulating the operator's home system with Vdraw and Vaccess running under Digital UNIX. For a new contract for an equipment vendor, we have finished the port of the full Vsystem package to Windows 95 and Windows NT. We made the first tests of charged-particle beam line automation and optimization with a generic automation package. This package has been developed against realistic models and exemplifies on-going research and development at our company.

1 VSYSTEM ARCHITECTURE

The Vsystem architecture is quite unlike any other product. It consists of a software bus/database, Vaccess, that connects all the computers in the system regardless of their architecture or operating system. Any computer can have 0-65,000 separate databases mapped in individual global sections; any process on any computer can access any field of any channel in the system. Vaccess is event-driven, which means that any process can request notification of changes of any field of any channel in any database. Equally, any field can be changed dynamically (except name, type, and array dimension). In V3.2, due late this year, dynamic channel creation will be supported. Figure 1 gives a picture of this software architecture and it can be seen that it is very much like plugging independent modules into a backplane of an I/O crate. This gives modularity and isolation through the operating system.

A key aspect in the use of this architecture is to use channels for calculated information so that it can easily be displayed and logged. An additional advantage of this architecture is that in place of the I/O connection, one can put a model of the accelerator and generate a training system or a log file playback utility and look at earlier operations. With the sophisticated database resolution

mechanism, the playback and training systems can coexist on the same network as the production system.

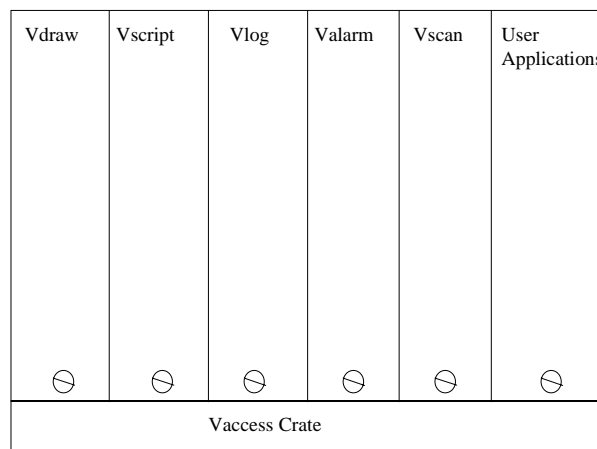


Figure 1: The Vsystem Architecture

2 INDUSTRIAL APPLICATIONS

2.1 Metal Casting and Rolling Mills

We have a number of applications in the metals industry where plants are being modernized with modern, fast controls in order to significantly improve efficiency and quality. These systems all use fast I/O, VME, VXI, and RTP Corp. as well as PLCs for the slower I/O. The fastest loops, controlling the roller pressure of the roller stands and the looper positions between the roller stands, run at one millisecond intervals in VME crates under either Digital VxWorks or Wind River VxWorks. In order to reduce unnecessary risk, the next level of computers are VAX's and Alphas running OpenVMS. All these systems have been in operation for some time and are performing well. Vsystem allows the implementers to map databases in all parts of the system. As a result, channels that relate mainly with activities in the OpenVMS computers, the less deterministic systems, can be placed in databases in these OpenVMS systems. This results in higher performance and less load on the highly deterministic VxWorks systems.

2.2 Power Plant Training Systems

Another client is a Power Plant Training School where they bring in operators for training from plants of several European countries. This training system has a super-computer running the plant model and communication with our system through reflective memory in a VME

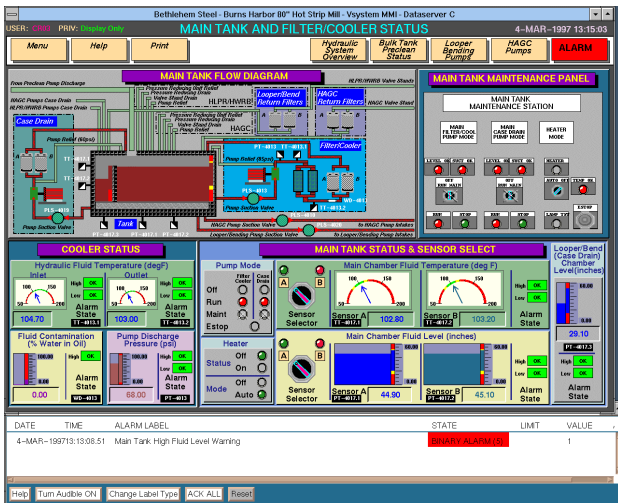


Figure 2: An Example Operator Window from a Hot Strip Mill.

crate. An Alpha single-board VME computer running Digital UNIX provides the second step of the link through to a Vaccess database in a workstation running Digital UNIX. Here also the operator interface emulation is implemented with Vdraw.

We used Vdraw to emulate older proprietary digital control systems from the student's home plant and added to Vdraw a few features to fully accomplish this. One new feature allows the operator to use a key to tab around the active areas on the screen. Another is the "picture-in-a-picture" (PIP) feature that makes it possible to include a portion of a Vdraw picture in a Vdraw window and to dynamically change this as the value of a channel changes. In this way, 12 segment files defining faceplates are used to create 15,000 screens through relationship tables, special Vaccess channels and handlers in the Vaccess database.

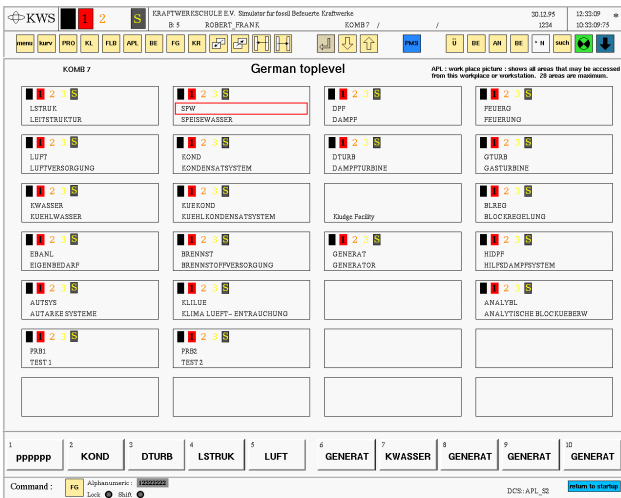


Figure 2: Example of a KWS Operator Window Constructed Automatically.

This saved the creation and maintenance of 15,000 individual pictures by hand. One of these pictures is

shown in figure 2. Thus, the whole operator interface system is automatically defined for this emulation, including window relationships, content, and so forth. In addition, a custom, industrial keyboard has been integrated into the system in addition to the regular keyboard, to better represent the systems being emulated.

2.3 Wafer Processing Machines

Semiconductor foundries use machines from several different vendors to process the silicon wafers. Until very recently, all the vendors had their own operator interface, which led to confusion for the operators moving from one machine to the next. Sematec, the US semiconductor industry consortium, generated a man-machine interface standard for these machines and we have implemented this for one of our customers to the Sematec Standard. This was done with the standard Vdraw with some minor additions to the package to support touch screens. Figure 3 shows one of the MMI screens.

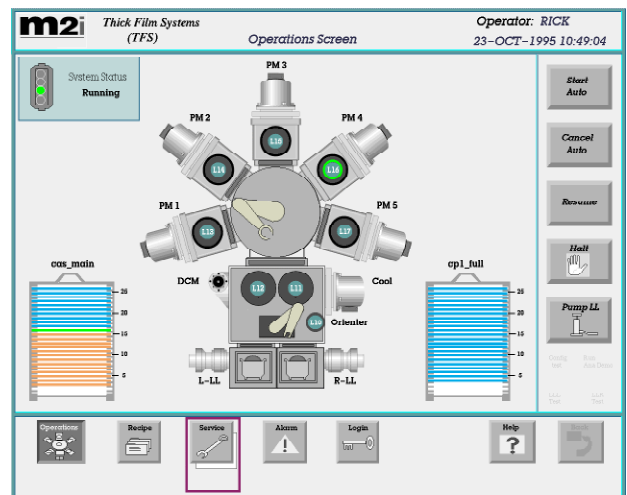


Figure 3: One of the Semiconductor Processing Machine Screens

2.4 Black Box Flight Recorder

Another application is the recording of plant operation data in a circular buffer on disk so that the engineers have high time resolution data to study. Such a system has been running at a European Nuclear Power Plant for over a year and two more systems are currently going into petrochemical plants.

These applications emphasize the performance of Vlogger. Logging over 13,000 values a second continuously into a 3-day long buffer makes the buffer large and thus the users needed search tools to find the point of interest and other tools to access and save this data. We have a full graphical user interface with an API for programming and an SQL interface for searching. Vtrend gives a graphical look at the data, as shown in Figure 4, and this can be started automatically at the point of the search.

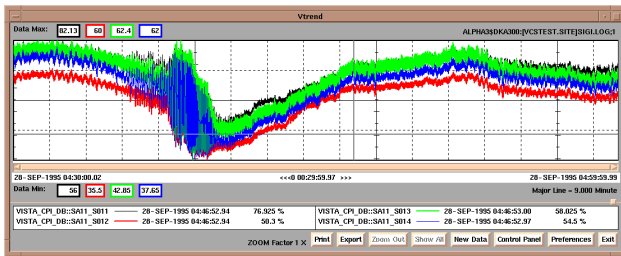


Figure 4: Vtrend Showing Some of the Power Plant Data

3 AUTOMATION

The architecture of Vsystem lends itself naturally to automate operations [4-8]. We are in the process of developing tools to tackle the control problems in an accelerator and apply solutions with the aim of complete automation and automatic optimization of an accelerator. These tools are not specific to one or a few control technologies but form a general framework within which to include appropriate control technologies. The goal is to improve on the performance of the operator and physicist. The first tests have now been carried out at the ATF accelerator in Brookhaven and the Atlas facility at Argonne. We expect that this work will lead to new members of the Vsystem family of products

4 IMPACTS ON VSYSTEM

All the examples given are industrial applications. This is not to ignore the research applications where Vsystem is used but rather to show the many common requirements between research and production environments. There are some important differences however.

In industrial production, productivity is easily measured and monitored by all layers of management. Imagine that the stock of all laboratories was quoted on some stock exchange and market analysts were monitoring performance in papers published and prizes won for outstanding research. This is essentially the case for industry. Profit, a combination of productivity, costs and sales, is the dominant measure of success. The only argument is whether one should take a long-term investment view or a short-term one. As a result, reliability is essential for any component of the plant. Here, perhaps, is one of the biggest impacts on Vsystem from the marketplace.

Another impact is the diversity of operating systems that customers demand support for. While many new applications are using OpenVMS because it is proven for continuous operations, some customers have migrated to UNIX. In addition, support is required for hard real-time

operating systems like VxWorks and other customers are using Windows 95 and Windows NT. Vsystem supports all these operating systems.

For larger applications, the PIP feature of Vdraw gives the basis for automated generation of operator screens through a data description of the machine. This saves considerable configuration and maintenance effort and thus cost.

5 CONCLUSION

It is clear from this short paper that Vsystem has found a market in industrial systems where the requirements are often more stringent than in typical accelerator control systems. Even so, Vsystem has not lost any functionality or performance and thus is an even better solution for accelerator control systems for accelerators of all sizes. A recent performance benchmark by a user measured 8.2×10^6 floating point numbers/second put to the Vsystem database on a Pentium Pro 200MHz running Windows NT.

Excellent documentation and support makes Vsystem especially suitable for small and medium sized projects with limited staff. All the evidence suggests that with similar resources, better and more comprehensive control systems result than with any other solution. Certainly, existing users benefit from the continual additions to the Vsystem package. For example, Vsystem now fully supports many operating systems on many computer architectures.

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