HP VEE in Manufacturing

Manufacturing Systems Control and Data Reporting

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An HP Inkjet Business Unit pen manufacturing assembly line uses HP VEE for robotic and process control on all its intermediate assembly equipment.

The Hewlett-Packard series 800 Inkjet printers utilize a semiconductor chip attached to a flexible tab circuit for firing ink dots onto paper, forming text and images in color and black and white. This note describes the use of HP VEE for controlling one of the manufacturing steps in the sub-assembly of the tab. The assembly requires the precision placement of an interleaf material and the careful application of heat and pressure, all during synchronous process flow. A UNIX platform is used throughout due to its robust networking capabilities, multiuser features, and 2-way communications, allowing 2 engineers to modify and maintain over 30 different assembly machines. With the use of HP VEE, the technicians often make changes to, and maintain the control software.

The extensive input/output capabilities of HP VEE allow communication with a wide variety of vendor equipment.

Our applications simultaneously use: RS232, MXI-VXI, Digital I/O, DVM, HPIB, UNIX scripts, "PERL" scripts, sockets, mailx, and inputs via: mouse, keyboard, barcode reader, and panel button click. The application described in this note also monitors load cell pressures, processing temperatures, a laser cutting machine, and reel to reel status. All pneumatic and mechanical motion is monitored via sensors into digital I/O on the VXI bus which will allow HP VEE to stop the machine if any processes does not make or break in the correct sequence. Failure data is logged to a file along with cycle time and date/time codes, which are routinely uploaded into a desktop UNIX workstation or PC, where another HP VEE

application displays machine paretos. A 4-axis "PMAC" motion controller card installed in the VXI mainframe controls the movement of the flexible tab circuits as well as the interleaf materials through the laser cutter.

Real-time machine status and Data Reporting

Within the HP VEE control program several modules are dedicated to the monitoring the machine state and data control. Real-time SPC charts, machine state tracking controller, and lot incident reporting are all integrated into the HP VEE control software.

Real-time SPC is accomplished by sending machine data to a RQM database system. RQM accepts multiple data points per machine cycle and then generates SPC graphs based upon the data. Data is sent to RQM using Vee socket calls. The socket collector was designed not to block other Vee threads during execution and to automatically break out of the socket if the RQM server was determined to be down. Sockets are used to send data types and number of samples along with the actual data and a buffer to satisfy the RQM data structure. The modules are portable to any HP VEE control program.

Machine State tracking is achieved by monitoring the production tool and then sending machine transactions to an Informix database to display the results. This allows comparison of up-time/downtime data along with Repair reporting and Pareto chart generation. The machine state HP VEE modules collect information from graphical users interfaces and then use UNIX scripts to transfer the data to the proper database. Operators and Technicians can input comments related to repairs made on the tool by using the Vuepad editor. The comments are automatically put into the transaction data and then remote copied along with the machine state.

Lot incident reporting provides Operators, Technicians, or Managers the ability to create a Lot Incident Report for mailing to Process Engineers, Process Technicians, Managers and other resources connected with Production. The person filling out the LIR follows a sequence of GUI's which then creates an array of information that is mailed to selected individuals. The UNIX mailx utility is used to perform this operation. Additionally, the information is automatically sent to a local web server to provide access through standard Web browsers. UNIX rcp commands and scripts are used to accomplish this function.

Cycle time improvements and ease of maintenance come from simple migration to HP VEE version 4.0

The above processing machine achieved a 10% reduction in cycle time when we migrated to the newest HP VEE. Although we had to modify and simplify a few objects during the migration, the process took less than an hour. The compile feature made the buttons respond instantly, eliminated the short delays between processing steps, and made the machines run much more deliberately and smoothly.