Case Study

tenAsys®
Embedded Virtualization Solutions

INtime® Software Lets Biesse Combine Real-time Processing with Microsoft* Windows* Applications

Decreasing the number of computing platforms has improved the reliability of system.

INtime® for Windows

"By working with TenAsys, we will automatically be able to take advantage of processor hardware developments from Intel* as well as Microsoft's OS* evolution."

Figure 1: Biesse's Rover Gantry 512 installed at Simard Cuisine et Salle de Bains in Quebec City, Canada.

Figure 2: The Biesse Rover Gantry machine's HMI runs on Microsoft Windows.

When the team at woodworking machinery manufacturer Biesse considered how to update their CNC system, they looked for a real-time OS solution that would meet the timing requirements of their application, without requiring the investment of any additional effort in operating system development or compromising the performance of Biesse's Windows* application software. They selected INtime® for Windows.

Overview

Computer numerical control (CNC) machines are some of the most complex systems in the manufacturing world. Even the simplest CNC machines may have four motors driving motion axes that must all move synchronously, at high speed, with very high precision in order to maximize the machine's productivity and quality of output. The controllers that orchestrate the motion typically must make new decisions on how the motion axes must move and establish a new target position every one or two milliseconds.

Challenge

"The loss of a single control cycle is a mission critical failure," said Giuseppe Guerrini, System Software Chief Engineer of Biesse S.p.A., of Pesaro, Italy, one of the world's foremost providers of machinery for wood, glass, and stone processing and fabrication. "If one of our machines was to fail to update its target positions correctly for just a millisecond or two, inaccurate cuts could be made and the machine could jam or become unstable."

In order to guarantee that the machine's outputs are produced on time, the machine's inputs need to be sampled much faster – typically many times faster than output decisions need to be made. Controls engineers call the phenomenon of missed control loop times "jitter" because if one were to look at a graph of the motion produced by imprecise control loops, it would have jagged lines or small discontinuities. The results can be machine maintenance problems and poor quality output.

But even a one- or two-millisecond response time is not the fastest response that the system must make. Because of high precision timing and oversampling requirements of some fieldbus (machine network) interfaces (e.g. EtherCAT), the cycle times of control loops that manage these need to be as short as 100 microseconds. A human-directed operating system such as Microsoft Windows* can not manage all of these control tasks simultaneously and guarantee that they will be

processed with predictable timing (i.e., determinism), so most high-speed machines run their control loop software on real-time operating systems (RTOS).

The latest CNC machines also need to incorporate a full-featured OS such as Windows to run human-machine interface (HMI) software (see Figure 2) and to handle data logging, machine program development, and interfacing to enterprise networks. So the challenge for CNC machine developers is to combine both real-time and human-directed operating environments in the same system. Typically, this has been accomplished by including two separate computers in the machine, one running the RTOS and one running Windows.

Solution

A better solution, which Biesse implemented, was to host all of the real-time and non-real-time applications on a single processor. The key to combining these environments is embedded virtualization, the ability for the system to support a heterogeneous mix of operating environments, both real-time and human-directed, simultaneously.

After doing research on different real-time operating environments in magazines and on the web, Biesse engineers identified the INtime for Windows from TenAsys®, Corp. as the best solution for adding real-time functionality to a platform running Windows. Other "real-time Windows" products require modifications to be made to the Windows operating environment, or special drivers to be used with Windows in order to sidestep Windows' non-deterministic task scheduling. "INtime works with all standard Windows versions right out of the box," said Giuseppe Guerrini.

In Biesse's new Rover G machine (see block diagram in Figure 3), motion control cycles, I/O drivers, supervisory PLC logic and fieldbus drivers (EtherCAT, CANopen) are executed as real-time processes by TenAsys' INtime software, while the machine's HMI functions, including CAD/CAM system, and many third-party applications that its customers typically install, run as Windows processes and communicate with the real-time software using functions from INtime for Windows' NTX library.

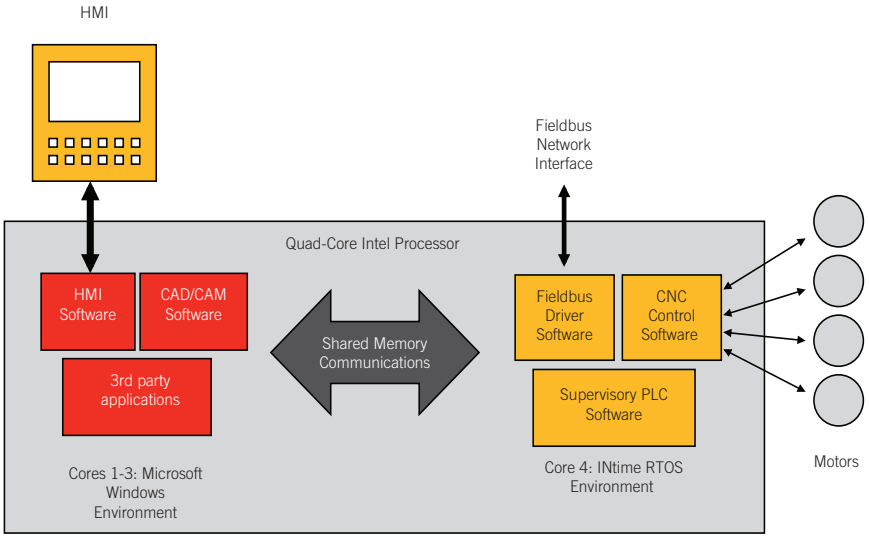

Figure 3. The quad-core I5 processor in the Biesse computer runs Windows on three cores and the INtime RTOS on the other core.

Results

At the most basic level, the decrease in the number of computing platforms by combining machine control and HMI functions on the same computer system has improved the reliability of system hardware. "As we now have about 50% of the hardware of a two-platform control system, our MTBF has doubled, and our service department saves costs by managing fewer spare parts." said Francesco Tabanelli, Biesse's Motion Control Chief Engineer. In addition, by using standard commercial desktop PCs, Biesse is able to change the model used about every year. "This always gives us the best price/performance ratio," said Francesco Tabanelli. "Currently, we use only one processor core for real-time tasks, but we can add INtime kernels on other cores, so we can tune our system depending on machine complexity."

One of Biesse's North American customers is Simard Cuisine et Salle de Bains, a manufacturer of kitchen and bathroom cabinetry in Quebec City. Simard used Biesse's Rover Gantry 512 (Figure 1) to replace a panel saw and a machining center. The Biesse machine precisely performs all drilling, boring, milling and cutting operations on a single panel in less time than was possible with Simard's previous machinery, while giving Simard more flexibility in the design of the company's cabinets than was previously possible.

Besides solving the performance and determinism problems for Biesse's current machine, another important factor for Biesse is the need to keep pace with evolving application requirements for the company's CNC products. "By working with TenAsys, we will automatically be able to take advantage of processor hardware developments from Intel as well as Microsoft's OS evolution," said Giuseppe Guerrini.