

"The software's robustness allows us to meet customers' needs while allowing just about any Intel processor to be used."*

INtime® for Windows* Enables PCs in Advanced Deterministic Motion Control

Aerotech selects INtime® software for rigid deterministic control in its A3200 Digital Automation Platform

PCs grant industrial operators multicore processor performance, application flexibility, and an open architecture for integrating capabilities. However, PC GPOSs like Windows* do not provide the determinism real-time applications need. Motion control company Aerotech faced this tradeoff when developing the A3200 Automation Platform. To avoid compromising, they leveraged the TenAsys® INtime® RTOS.

tenAsys®

Overview

Aerotech, Inc.* of Pittsburgh, Pennsylvania is a leading provider of motion control systems to industrial end users, integrators, and OEMs. Their systems serve applications that demand high precision, high repeatability, and high throughput in markets such as medical device manufacturing, laser-based measurement and control systems, military equipment, semiconductor processing, test & measurement, R&D, and general automation (Figure 1).

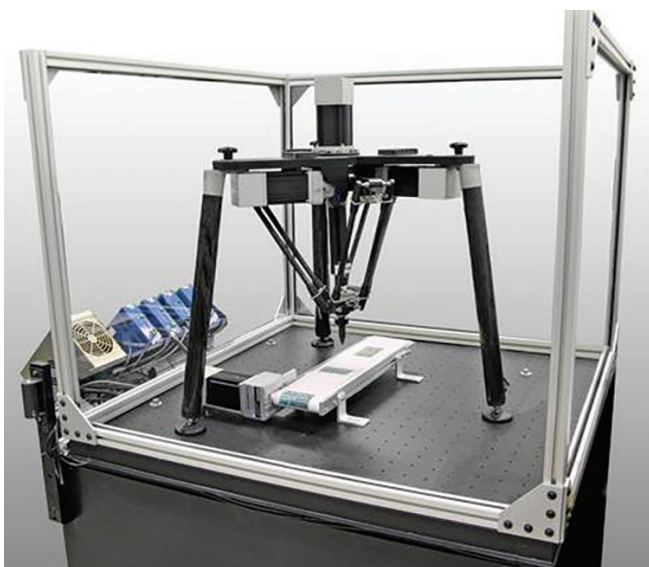


Figure 1. Delta robot demonstration system

In some of its motion products, Aerotech leverages a PC software platform as the main computing engine, with system integrators tailoring the hardware configuration to meet the specific needs of each customer.

Challenge

To keep pace with customer demand, Aerotech needed to capitalize on the openness and flexibility of modern PC platforms that allows end users to integrate hardware and software capabilities with motion control systems like its A3200 Digital Automation Platform. However, this flexibility cannot come at the expense of the strict determinism required for motion control tasks.

Typically, this has required multiple hardware platforms or a custom design because there are limitations to what a PC can do with Windows* as the only OS. By itself, a PC platform with Windows is not able to control many time-critical processes since Windows is not a deterministic operating system. Without determinism, there's no guarantee that the system will respond predictably to stimuli in exactly the same way each machine cycle, and hence the machine may not perform reliably.

Windows' standard task scheduler optimizes for processor usage and has no way of preventing housekeeping functions from disrupting the processing of time-critical tasks. At power-on, when Windows loads, it takes control of all the I/O resources of the processor, making physical I/O devices compete with other system hardware such as disk drives, timers, etc. for CPU cycles.

To leverage the performance and flexibility of a PC platform in control applications and not compromise the ability to run the huge base of PC-compatible software without modification, a software solution is needed that allows hard-real-time task processing to coexist alongside the Windows application environment.

Aerotech faced this challenge as they looked for operating environments to support their A3200 Digital Automation Platform.

Solution

The optimal solution is to support deterministic tasks communicating directly with I/O devices without involving Windows' tasking mechanism. After a search of available real-time operating systems (RTOSs), Aerotech selected INtime® for Windows.

INtime brings deterministic processing to Windows systems using a technique called embedded virtualization. With embedded virtualization, the I/O resources of the processor are partitioned at system startup so that Windows is restricted from controlling the I/O devices required by the RTOS (Figure 2). No modifications to Windows or any Windows applications are required.

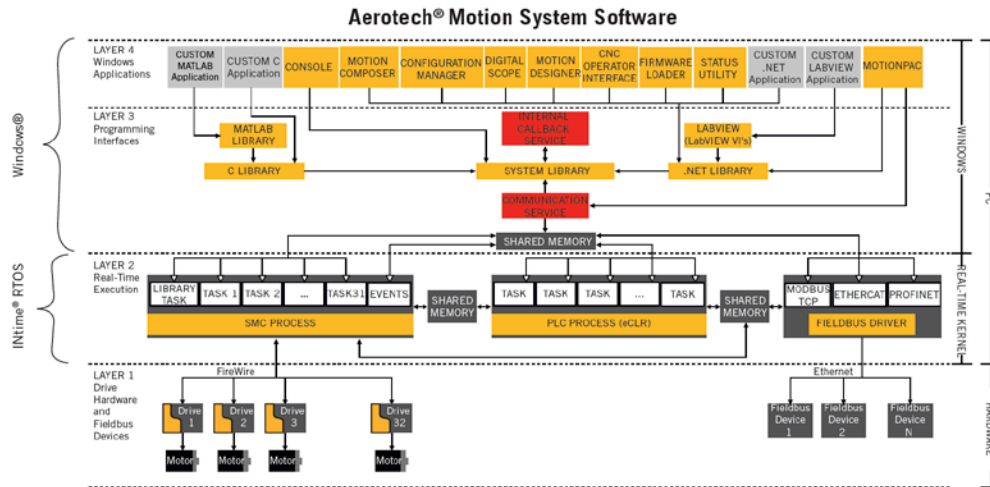


Figure 2. Embedded virtualization technology in TenAsys® Intime® for Windows* partitions multicore processor resources to enable a deterministic RTOS environment and non-deterministic GPOS to run side-by-side on the same hardware platform without interference.

Figure 3 shows the software architecture of Aerotech’s A3200 Digital Automation Platform. In the A3200, Windows runs the motion programming environment and data acquisition software while INtime software supports all real-time motion control functions.

“Partitioning applications has made our customers feel more comfortable,” said Dr. Joseph Profeta, Aerotech Director of Control Systems. “They trust that their time-critical processing won’t be affected by Windows tasks.”

INtime software delivers this functionality on a wide range of PC-class multicore x86 processors. “The software’s robustness allows us to meet customers’ needs without being too restrictive about which Intel processor to use,” said Dr. Profeta.

Results

The combination of deterministic tasking with flexible Windows application processing makes Aerotech’s platform well-suited for new machine control applications. The A3200 is also well suited to machine control system retrofits that replace aging control systems with modern ones that are easier to use and may have more capabilities. The flexibility and openness of the PC provides users with the ability to integrate any other software or hardware into the machine control process. Users can also easily size the PC for their application computing needs.

One of Aerotech’s customers, Integrated Industrial Technologies (I2T) of Pittsburgh, Pennsylvania, is a value-added reseller and system integrator of the Aerotech A3200 software motion engine. I2T, with its software and industry expertise, has developed intuitive upgrades for many industrial applications including milling, grinding, and gantry robots.

“By using a Windows-based solution we are able to use common development tools to create a rich user experience that can be customized to each solution we provide,” said Mike Joyce, President of I2T. “With the A3200 software environment, the motion control application has access to all of the computer’s resources, allowing the control software to be tightly integrated with file access, databases, communication networks, or any other peripheral that is installed into the PC.”

“The amount of processing power today on a PC has made our controller so much more powerful,” concluded Profeta. “The standard PC’s continuous improvements in cost and performance help us respond to customers’ needs for best-fit solutions, cost-effectively and in the shortest amount of time, but we need a real-time environment that works with it. And for that, TenAsys® INtime for Windows has met our needs.”

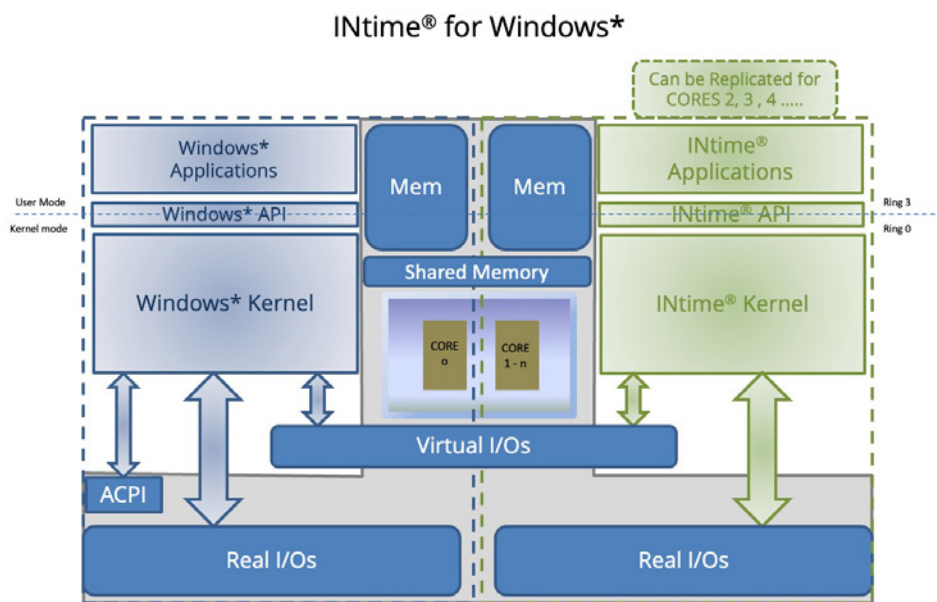


Figure 3. The Aerotech, Inc.* A3200 software architecture isolates Windows* and real-time applications to provide full Windows functionality while ensuring determinism in control operations. All the necessary interfaces to design, diagnose, optimize, and set up a motion control system application are run under Windows, while the resultant control code—including the machine interfaces—is run in real-time under TenAsys INtime® for Windows.

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