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Software-Based CNC Saves Machine Builders Cost

In recent years, the world of CNC controls has seen a trend toward more open, PC-based architectures. Many of these control concepts, however, still require manufacturer-specific hardware such as axis controllers with their own intelligence or external, proprietary modules for positioning control or input/output.

The dependence of machine builders and users on controls manufacturers has to date largely prevented greater cost reduction in control integration and maintenance. New control concepts in the form of open software CNCs based on standardized, market-ready embedded PC platforms provide relief here and offer potential savings of more than 30 percent.

The biggest cost benefits relative to total cost of ownership (TCO) are achieved by pure software CNCs because these do away with manufacturer-specific hardware. This reduces the dependence of machine builders and users on the control suppliers for integration, price and replacement-parts policy, system maintenance, and controls upgrades.

To connect drives and I/Os, software CNCs need only passive, commercial hardware which is available from various suppliers. With a software CNC, the position control loop is closed via the PC processor. A real-time software extension to the usual Windows operation systems ensures the necessary real-time performance to reliably close the velocity control loop every 500 µs for each axis.

The Next Step

As more machine builders reduce control costs with software CNCs as demanded by users, new savings potential emerge in the form of open software CNCs on embedded PC platforms. In the last few years, this concept has also experienced an enormous leap in development, so that now standardized platforms are available on the market in large quantities

Combined with the benefits of open software CNCs, machine builders can further reduce costs by assembling the controls. Compared with the usual industrial PCs, the embedded PC platforms are more compact, and cost less yet provide high levels of performance, such as HSC processing.

Software CNCs on embedded PC platforms

But the big key is the standardization and reliability of the components and the connectivity of the system. Modern embedded baseboards have standardized interfaces, such as PC104, Compact Flash, PCI bus, IDE, Ethernet, USB, RS 232, RS 485 and parallel port. This gives the boards a connectivity and upgradeability comparable to conventional industrial and office PCs. The Ethernet interface allows the embedded system to be integrated into the company network.

New processor technologies enable fan-free operation of the embedded systems at clock rates of up to one gigahertz. As there are also no built-in hard disks, there is no need for any moving components in the housing. This guarantees reliable operation, even under extreme conditions such as major fluctuations in temperature, large quantities of dust, or slight vibration.

The scale of the system essentially depends on the size of the built-in TFT touchscreen. A system with a 15-inch touchscreen roughly measures a compact 32x40x12 centimeters and, with its low weight, can easily be integrated into a movable operator console.

The operating systems used are Windows 2000 or Windows XP and Windows Embedded XP. With the latter, there is no need for a hard disk or other movable parts. The operating system and the software CNC run on a Compact Flash card with currently up to 512 MB storage capacity. If users rely on larger local storage media for applications such as workshop-oriented programming of a CAD/CAM solution or visualization software (viewers) and a communication program on the control, the normal Windows XP operating system is used. In this case, for example, a 2.5-inch hard disk, as used in notebooks, is connected to the internal IDE port of the baseboard and integrated into the system.

As the industry standard, the Microsoft Windows XP and Windows XP Embedded operating systems are rugged, future-proof, and offer users investment protection as well as high compatibility with other applications and future extensions.

Ideal Total Cost of Ownership

While the use of embedded PC platforms offers considerable potential as far as the integration is concerned, machine builders are also benefiting from the advantages of software CNCs on these platforms. With machine lifecycles of often well over ten years, taking into account the TCO, software CNCs cannot be surpassed, even by low-cost controls. For example, the software cannot break, so manufacturers can keep fewer spare parts in stock, thus freeing up storage capacity.

Software CNCs are also gentler on the users' budget. Windows operating systems reduce training requirements, so companies can go into production more quickly. Users also save a lot of money that would otherwise be spent rectifying hardware defects, which can never be completely ruled out. Instead of being dependent on support from the manufacturer, in most cases they can solve the problem themselves by purchasing from their nearest specialist dealer.

Always Up-to-Date

Unlike classic controls, software CNCs can also be constantly and inexpensively kept state-of-the-art in the long term, even when used on embedded PC platforms. For example, many users use machine tools for up to 20 years. Even high-quality processing centers do not become quicker over this period with classic controls – if anything, they become more susceptible.

Software CNCs allow the user to continually upgrade control performance to the current level of technology by installing a new embedded baseboard with the latest gigahertz CPU. This is a large advantage over most PC-based platforms which are based on an x86 processor concept, an idea that for more than 20 years has symbolized software continuity and future compatibility. Because they are upgradeable, it is possible that software CNCs will also be portable onto different and more up-to-date PC platforms in the future, which safeguards investment in software development. The software CNC benefits directly from more powerful yet cheaper

hardware components. At the same time, the use of open software CNCs allows the easy and regular installation of software updates, even via the Internet if necessary.

By virtue of the pure and open software architecture, machine builders can get directly onto the CNC core if necessary via an API. Once one is familiar with a software CNC, the control allows unequalled flexibility for one's own application. The software CNC can be optimized independently again and again according to the relevant requirements. Machine builders and users thus save a great deal of money on manual adjustments by control suppliers

Ready for the Market

Because of the demand by machine builders and users for further cost benefits, responsive vendors have developed software CNCs on standard embedded PC platforms. *MDSI, with the FlashCNC™, offers a market-ready system. The* company has ported its open software CNC, called OpenCNC, onto an embedded PC EBX platform. It is connected to the drives via PC 104-based, commercially available interface cards for the serial drive interfaces SERCOS or Yaskawa Mechatrolink 1 and 2. In the case of SERCOS, machine builders can choose from a variety of servo amplifiers from different manufacturers. In the SERCOS variant, the velocity position control is closed via the software-based SoftSERCANS driver.

The I/O system is connected most cost-effectively via one of the two Ethernet interfaces on the embedded board. This interface is addressed on a real-time basis via a software driver and thus allows fast and deterministic communication with the decentralized I/Os. The second Ethernet interface remains open for external communication and the integration of the control, and thus the machine, into networks. Alternatively, other standard interface cards based on PC 104 are available for other field buses such as Profibus or CAN.

Simplified Integration

The embedded system also reduces the complexity as well as the installation and wiring overhead. If the I/Os and servo amplifiers can be integrated directly into the machine, the complete control cabinet can be dispensed with if necessary, thanks to the serial and decentralized connection. The compact housing and the serial

connections mean that fewer cable feeds and less electrical power are required, the latter at around 120 watts.

Suppliers such as MDSI manufacture and pre-configure the systems according to customer requirements such as screen size, memory, processor performance, and interfaces. The desired version of the software CNC with all the necessary drivers is preinstalled and tested, which greatly reduces the integration overhead of the machine builders.

FlashCNC is based on the highly efficient MDSI OpenCNC motion core, the RTX real-time extension from VenturCom, PLC software as per DIN 61131/3, and a configurable operator interface. The completely open system does away with manufacturer-specific hardware and allows independent adjustments by the machine builders, who can use standard commercial hardware and offer the systems in different variations.

FlashCNC from MDSI can be used just like OpenCNC for controlling turning, milling, grinding, polishing, drilling and other cutting operations. Other possible areas of application include die casting, pick-and-place devices, (wafer) handling and assembly systems, gantries, simple robots, wire-bonding machines, and special-purpose machines.

Summary

For many machine builders, the emergence of open software CNCs on standardized embedded PC platforms provide three important advantages: minimized dependence on manufacturers and time and cost savings on integration and assembly – all without having to accept reduced control performance. Software CNCs on embedded PC platforms also satisfy high standardization and reliability requirements. The systems offer both machine builders and users flexibility in both hardware and software. Through the integration of the two worlds, users can achieve cost benefits of more than 30 percent.