SMART CAMERA VISION SYSTEMS
The new approach to track and trace

White Paper

COGNEX
As pharmaceutical manufacturers confront increased margin pressure in the coming years, they will look for new ways to lower their costs to install and maintain production lines. Having the option to choose smart camera vision systems instead of being locked into PC-based vision systems at the machine level can be a tremendous advantage that often results in a solution that's less expensive to install, less complex to validate, and less costly to maintain.

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BACKGROUND

Increasing global regulations on healthcare products have many pharmaceutical manufacturers preparing to implement serialized packaging in support of full traceability and authentication requirements. However, the traditional approach of deploying turnkey serialization solutions that integrate PC-based vision can be expensive to install, validate, and maintain.

A new leaner, more cost-effective approach to track and trace demands new technology. That's why pharmaceutical manufacturers are increasingly opting for networked smart camera vision systems over PC-based inspection systems.

Due to miniaturization and advances in the power of digital signal processors (DSP), imaging sensors and decoding algorithms, traceability applications such as ID code reading, text verification, mark quality assessment, and label inspection can now be accomplished more economically using the latest generation of smart camera vision systems.

Compared to PC-based systems, smart camera vision systems are generally easier to configure, validate, and maintain. Because they are solid state, smart camera vision systems intrinsically provide a more stable platform than Microsoft® Windows®-based alternatives, requiring less maintenance, and fewer service pack updates and patches to install. Being configurable, rather than programmable, smart camera vision systems can also make it easier for manufacturers to accommodate future changes in regulations and standards.

The most advanced of these smart camera vision systems now offer advanced networking, communication capabilities and powerful factory integration tools. And with a standard operator interface for a common look and feel across all packaging lines and inspection points, many pharmaceutical manufacturers now consider smart camera vision systems an indispensable tool in their effort to build strategic information architectures more in line with corporate sustainability goals.
NOW IS THE TIME TO START SERIALIZATION

An increasing number of European countries are, or will be, adopting sophisticated tracking and ePedigree infrastructures throughout their supply chains. In the near term, Turkey and France will require item-level serialization starting in 2011. Other countries with regulatory deadlines include Brazil, the United States (California) and South Korea. Countries having entered regulatory negotiations to set a deadline include Spain, Germany, Italy, and Bosnia.

California, USA, has extended its ePedigree deadline to 2015, but for manufacturers that have yet to begin learning about serialization, now is the time to initiate a program or resume a stalled pilot project. Why? Because eventually these requirements will impact all pharmaceutical plants around the world.

As the pharmaceutical industry has consolidated, plants have become increasingly specialized, producing fewer products for an increasing number of markets. Therefore many producers manufacture one medication in a few or even a single location and then distribute that product globally.

Even though not all regions have enacted ePedigree legislation, it’s very important to know that manufacturers exporting into regulated markets must adapt their packaging to conform to specific regulations even at facilities located in countries that have not yet imposed legislative deadlines.

Of course, with compliance comes improved patient safety, product integrity, and supply chain security. However, beyond compliance, food and drug manufacturers have discovered real value in being able to stop counterfeiting, prevent parallel trade through unauthorized channels, and achieve greater visibility into how products are made, distributed, and used.

Implementing traceability for product safety and quality control not only helps firms isolate the source and extent of safety or quality control problems to minimize production and distribution of unsafe or poor quality products, but it also reduces the potential for bad publicity, liability, and recalls. And, in the event of a recall, the more granular the tracing system, the faster a producer can identify and resolve product safety or quality problems.

With the tremendous amount of work that will be required, it’s not too early for pharmaceutical producers to actively engage with equipment and software suppliers to map out their traceability requirements. Now is the time to learn about data carriers, coders and markers, labelers and printers, ID readers and vision systems, and to start planning to implement the software infrastructure required to support data sharing with trading partners.
NEW REQUIREMENTS DRIVE NEW TECHNOLOGY

Facing increased regulations in the coming years to fight counterfeiting and improve patient safety, major pharmaceutical manufacturers have put traceability at the top of their agenda. Today, all manufacturers uniquely code each lot or batch to identify time and location of production and make recalls more efficient and less costly. But this is not sufficient to meet the increased regulations of the future that will require full traceability to comply with product serialization and authentication requirements.

Whether implementing traceability at the batch level, or implementing serialized packaging to support full traceability for ePedigree, producers must deploy a broad range of technology and software platforms, spanning all levels, processes, and systems. At the highest levels, ERP (Enterprise Resource Planning) systems typically interface between the supply chain and plant-level systems such as MES (Manufacturing Execution Systems), line management, and serialization databases.

Here, PCs are an essential component of a traceability system, where they are a great tool for user access control, database management and enterprise level software applications. PCs are also generally required at the next level down where the line management and HMI (Human Machine Interface) software resides.

However, at the machine level, which includes packaging equipment, material handling, machine controls, ID readers and vision systems, Windows-based PCs are often unnecessarily costly to install and complex to validate when compared to smart camera vision systems. And thanks to the latest generation of smart camera vision systems, deploying PCs in machine level applications such as barcode reading, text verification, mark quality assessment, label inspection, and general machine vision applications is no longer necessary.

As a result, more and more manufacturers—as well as their equipment and materials suppliers—point to smart camera vision systems as key technology helping them to lower costs, improve supply chain security, and achieve product and package compliance in an increasingly regulatory and competitive environment.

PC-BASED VISION SYSTEMS VS. SMART CAMERA VISION SYSTEMS

Generally, today’s vision systems are divided into two groups: PC-based vision systems and smart camera vision systems. Key differentiators between these two types of vision systems include architecture, cost, and development environment. For purpose of this article, smart cameras are modular DSP-based vision systems that are self-contained and don’t require the use of a PC, VME, PCI, or similar architecture to run vision tools.
Centralized vs. distributed processing

The primary architectural difference between PC-based vision systems and smart camera vision systems is one of centralized vs. distributed processing. PC-based vision systems generally multiplex industrial cameras from a single processor in order to distribute vision at multiple points on the production line.

This centralized approach typically increases software complexity and integration costs to the point where the resulting system is not as easily scalable as a distributed smart camera architecture. PC-based vision systems also require more physical space on the machine, and can make centralizing the HMI a challenge when multiple stations are deployed.

In contrast, smart camera vision systems combine low-cost distributed processing with high-speed networking to provide infinite scalability. Smart camera vision systems generally have one or two processors per camera, and because they can be easily linked together and managed as a system over a network, the overall costs and complexities of implementing distributed vision are dramatically reduced.

Moreover, today's most advanced smart camera vision systems offer compatibility with low-cost, touch-screen displays that can be easily deployed wherever factory floor operators need more control over their vision applications and better insight into what is happening on the production floor.

Cost of ownership

In terms of cost, PC-based vision systems typically have a much higher cost of ownership because they often require more IT department oversight and management to deal with service pack updates and other items like virus protection software. Because smart cameras function independently of the Windows operating system, they don't require pharmaceutical manufacturers to repeatedly quarantine, test, and deploy patches.

PC performance increases with each boost in processor speed, which makes new PC-based vision systems well suited for the most complex or mathematically intensive applications. However, because PC technology changes so rapidly, it's not as easily replicated as standard off-the-shelf smart camera vision systems. In as little as one year after installation, for example, it's much more difficult to source and configure a new PC with identical specifications than it would be to replicate a smart camera.

Similarly, replacing failed PCs and/or expanding the line to include more PCs frequently results in many different PC models on the line. The end result is that some PC-based machine vision systems may offer the most sophisticated vision tools, and provide the fastest performance, because they rely on the latest CPU architectures, while others may not because they rely on older PC technology.
In contrast, smart camera vision system technology is inherently much more stable over time. As a result, it's much easier to find a commercial off-the-shelf replacement unit for many years after the initial installation. It's also less costly to stock spares and to maintain consistent vision system performance across multiple production lines and inspection points.

**Programmable vs. configurable development environment**

The development environment allows users to “build” (set up and program) vision applications to meet specific needs. While many PC-based systems have a programmable environment, most smart camera vision systems generally provide a configurable environment that's easier to use, integrate, and maintain.

Programmable PC systems are generally more costly and time consuming to integrate because they require more vision expertise and knowledge of low-level programming languages such as C++ or Visual Basic. Consequently, producers without in-house machine vision expertise in these low-level programming languages either incur the extra costs of contracting a specialist every time production requirements change or they pay for costly annual service and support arrangements with equipment suppliers.

This can be extremely expensive in today's regulatory environment because the path to compliance remains unclear with current data formats and marking standards varying from country to country and from region to region. In this uncertain environment, producers implementing programmable PC-based systems have limited ability to quickly and efficiently adapt. Every time production changes require code rewrites and costly line revalidations, programmable systems put profit at risk.

In contrast, the most advanced smart camera vision systems generally require no programming and provide more user-friendly interfaces that make it easy for pharmaceutical manufacturers to cost-effectively bring more of the machine-level integration for their packaging lines in house. Because they require no programming, these smart camera vision systems are much easier to adapt for compliance with emerging global standards as they evolve.

Consequently, producers implementing smart camera vision systems will have greater flexibility to quickly respond to new production requirements, and configurable software reduces the need for line revalidations because code rewrites are not required to accommodate production environment changes.
TURNKEY VS. BEST OF BREED SERIALIZATION SOLUTIONS

In a sprint to compliance with product serialization and authentication regulations, over the last few years many major pharmaceutical manufacturers have defined traceability requirements and initiated package serialization pilot programs. Some have standardized on integrated solution providers that offer turnkey serialization systems. Others are strategically leveraging multiple partners to design a best-of-breed serialization system at each level of the enterprise.

Many manufacturers that have standardized on a single turnkey vendor in an effort to reduce integration time are pausing to reassess best tools and practices. After rethinking their initial strategies, many have found that relying on one vendor to supply all equipment and software needed for serialization—from the machine and line levels up through the MES and enterprise levels—provides limited or no choice in component selection and technology choice.

Serialization success depends on not only selecting the right ERP, MES, and packaging line control software, but also choosing the right hardware for marking, coding, labeling, and especially for identification. Because companies with integrated serialization solutions must offer a variety of products and services beyond vision hardware and software, they generally have limited machine vision offerings.

In contrast, companies strictly focused on identification and machine vision offer a broad range of smart camera vision systems in a variety of form factors, resolutions, and processing speeds. These companies deliver the most accurate and reliable vision and ID tools for text verification, label inspection, barcode reading, and other general vision applications. In addition, companies with core competencies in machine vision and industrial ID generally provide both smart camera and PC-based vision system architectures for a price and performance-optimized solution at each application level.

CONCLUSION

Low cost, ease of deployment, and ease of maintenance remain the key attributes of smart camera vision systems, and over the last several years they have become more powerful. While PCs are required at the higher enterprise and production line levels, at the machine level smart camera vision systems can more cost effectively address ID code reading, text verification, mark quality assessment, label inspection, and general inspection applications.

Compared to PC-based systems, smart camera vision systems are easier to configure and validate. As a result, they are less costly to integrate and maintain. A distributed architecture allows manufacturers to more
easily reduce scrap, rework, and inventory problems by networking vision systems throughout production to catch defects at the source and potentially prevent errors altogether.

Smart camera vision systems intrinsically provide a more stable platform than Windows-based alternatives, without any service packs and patches to install. And, they readily handle all future changes in regulations and standards without costly code rewrites.

With built-in Ethernet, smart camera vision systems provide higher-level computing systems access to plant floor data. Ethernet also links enterprise level networks with production control and device networks, allows intelligent control devices to share information required for tasks such as automating production line changeovers, and offers high speed access to data generated by a broad range of plant floor devices for statistical process control.

As pharmaceutical manufacturers move from their current traceability initiatives toward compliance with future ePedigree requirements, those that opt to add smart camera vision systems at the machine level will achieve the best balance of price and performance at each application level. And because smart camera vision systems can be combined with a variety of third party products, producers have the flexibility to customize and scale their serialization solutions to best suit their budgets and needs.

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About the author

John Lewis is market development manager at Cognex. Formerly a technical editor for an engineering magazine, he has been writing about packaging technology, machine vision, factory automation, and other technology topics since 1996. He has published hundreds of articles in dozens of trade journals and holds a B.S. degree in chemical engineering from the University of Massachusetts at Lowell.