SPECIAL REPORT

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TRANSFORMING PACKAGING, QUALITY & EFFICIENCY WITH MACHINE VISION

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INTRODUCTION

TRANSFORMING PHARMACEUTICAL PACKAGING, QUALITY & EFFICIENCY WITH MACHINE VISION

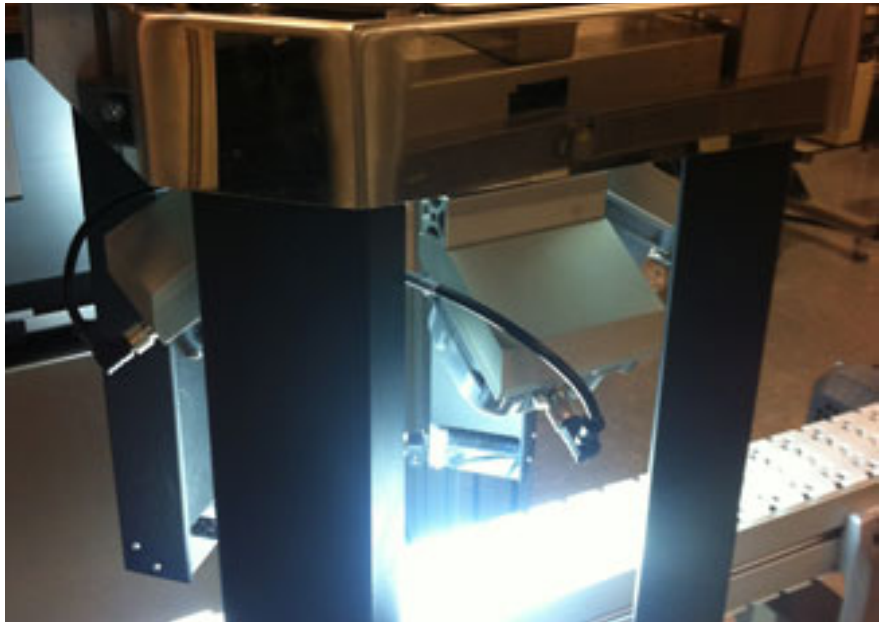
Imagine for a few moments the total number of pharmaceuticals being packaged every day, readied for patient consumption around the world. Perhaps too many to count accurately, and that is where machine vision comes in. Billions of doses are going out the door and for safety and quality's sake each bottle, blister pack, vial, syringe—you name it—should be examined for defects, flawed labeling, and other issues. For the most part however, no human or groups of humans have the capability to examine each and every package for flaws or errors.

Fortunately, machine vision technologies have advanced to the point where drug manufacturers and packagers have access increasingly smart vision-based technologies that can relieve humans of this impossible burden. With speed and accuracy machine vision systems can literally "see" every individual unit as it is makes its way through production and assure it meets all quality criteria. Applying machine vision solutions to attain these ends is both art and science. Cognex's experience in this area is world class; to help operations and manufacturing staff better understand the technology's risk management potential Cognex offers the following to shine a light on machine vision and its ability to transform Pharma's quality assurance from a statistical to an actual reality.

Pharmaceutical Serialization Vendor Uses Smart Cameras to Reduce Implementation and Validation Costs

Concern over the proliferation of counterfeit pharmaceuticals is prompting manufacturers to implement serialized packaging to support full traceability, product integrity, supply chain security and patient safety. Conventional serialization solutions multiplex with industrial cameras from an industrial computer (PC) to distribute vision at multiple points on the production line. Maintenance and validation of these systems can be expensive because of the need to deal with a complex operating system and custom software. Another challenge with existing systems is the cost and footprint required to serialize round, un-oriented bottles that frequently require labelers to position many cameras around the bottle in order to read the label.

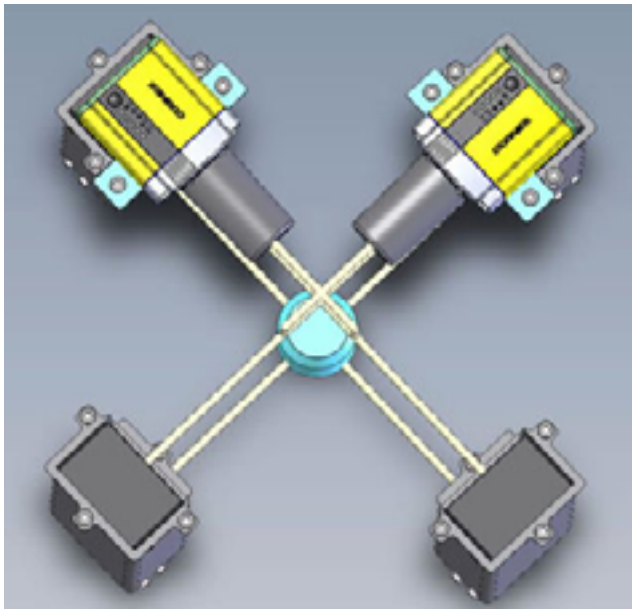
Körber Medipak's Seidenader subsidiary, one of the leading suppliers of pharmaceutical serialization solutions, has addressed these challenges by developing a serialization solution based on the use of smart cameras. Seidenader's Process Manager line-level serialization software is designed to configure and manage the Cognex smart camera technology, substantially reducing administration and validation expenses of the vision technology. Just a single industrial computer at the line-level provides the necessary recipe management, security and audit trailing for all camera stations on the packaging line.



Körber Medipak has also addressed the aggregation challenge of inspecting 2-D codes on round bottles. With Process Manager 360, bottles can be read on-the-fly, capturing a 360 degree view of an un-oriented bottle. Due to the small footprint of this solution, the inspection station can be integrated anywhere on the packaging line; including the out-feed of a labeler, or in-feed of a bundler or case packer at speeds up to 400 bottles per minute.

ADDRESSING THE DANGER OF COUNTERFEIT PHARMACEUTICALS

The World Health Organization estimates that 10% to 15% of the world's drug supply and probably on the order of 1% in the United States is counterfeit. Substances such as cement, talcum powder, sawdust, industrial solvents and paint have been substituted for the active ingredients of dozens of drugs. Robert Bate, author of Phake: The Deadly World of Falsified and Substandard Medicines, estimates that more than 100,000 people are killed worldwide by counterfeit and substandard drugs every year[1]. In a recent highly publicized incident, counterfeit versions of the anti-cancer drug Avastin entered the supply chain in the United States and reached the hands of dozens of doctors across the United States[2].



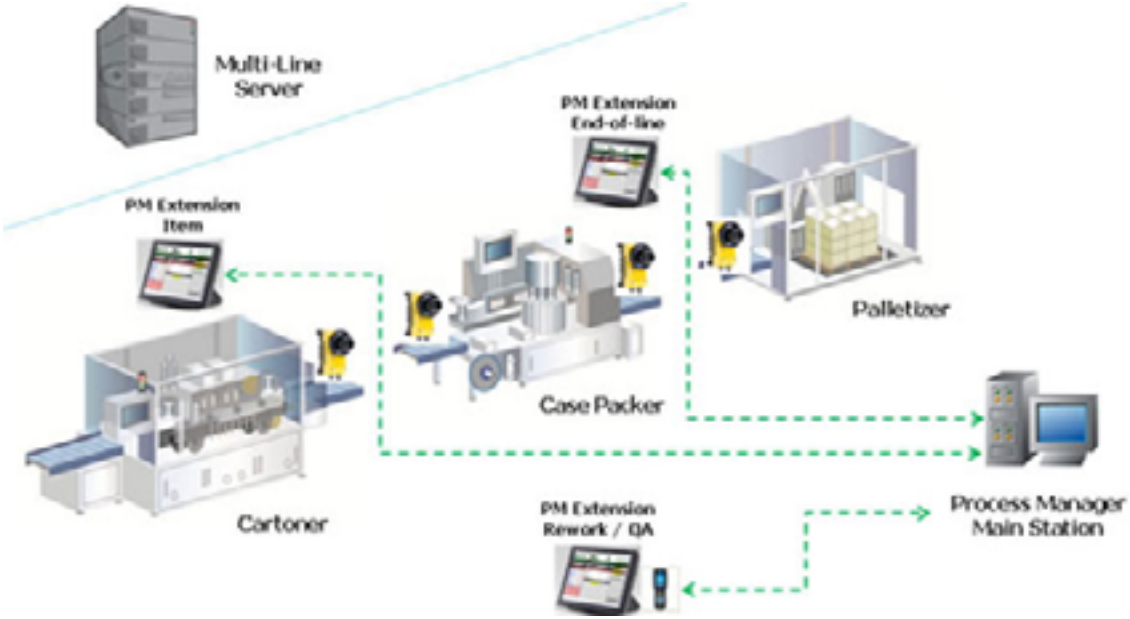
Regulators around the world have been working for years to develop a standard for a secure electronic chain-of-custody for pharmaceuticals, often called ePedigree. Within a few years, ePedigree requirements are expected to impact all pharmaceutical plants around the world. Even though all regions have not yet enacted ePedigree legislation, manufacturers exporting into regulated markets must adapt their packaging to conform to specific regulations even when the product is produced in jurisdictions that have not yet imposed traceability requirements.

Nearly all pharmaceutical manufacturers are addressing these challenges by working on implementing serialization solutions that will affix a unique and traceable serial number on every package, bundle, case and pallet. This approach to accomplish an ePedigree solution will provide an electronic record of the entire product cycle that provides accurate and complete information about each transaction within the supply chain, making it possible to easily and quickly verify the authenticity of each pharmaceutical product.

EARLIER GENERATION SOLUTIONS

Körber Medipak's Seidenader subsidiary is a leading global supplier of serialization solutions for pharmaceutical packaging lines. Körber Medipak's original serialization solutions utilized vision systems consisting of a camera, an image processing card and image processing software running on an industrial PC. Industrial PC-based vision systems require IT department oversight, service pack updates, and other items like virus protection software. In addition, PC technology changes rapidly so that in as little as one year after installation, it can be difficult to source and configure a new PC with the same specifications as those currently used on the line.

The PC based vision system used in the past took considerable time and effort to integrate because they required considerable vision expertise and possibly, knowledge of low-level programming languages. This can be very expensive in today's regulatory environment because the path to serialization compliance remains unclear with current data formats and marking standards varying from country to country and region to region. Furthermore, production changes require possible code rewrites to the technology, and costly equipment upgrades to the packaging lines. The overall application software, hardware, and operating system for each vision system always require to be validated to meet FDA requirements, which is an expensive process in itself.



BENEFITS OF SMART CAMERA BASED SOLUTIONS

Seidenader worked with Cognex to develop a new serialization software solution taking advantage of In-Sight® smart camera technology. The new line-level software requires only one industrial computer per line to manage the security and recipes for the smart cameras as well as audit trail all tool-set and threshold changes within the software itself. This smart camera-based solution provides pharmaceutical manufacturers with a lower cost of ownership because the vision operates independently of the computer operating system, is inherently much more stable over time and is not subject to yearly computer obsolescence issues. This approach makes it easy for the end-users to find "like for like" camera replacements for many years after initial installation, and to maintain consistent vision performance across multiple inspection points and packaging lines.

The new Seidenader serialization solution requires much less effort on the part of the customer's IT department when managing plant wide computer updates and virus protection. The Seidenader serialization solution is also less expensive to implement because the Process Manager vision interface provides access to the Cognex high level tools that reduce the time and expertise required to develop the vision application and customize the solution to meet specific customer needs.

SUPPORTING GLOBAL PHARMACEUTICAL MANUFACTURERS

Process Manager standard verification inspections are designed to parse the data matrix serial number in real-time, automatically populating the human readable toolset and provide verification and match functionality. The vision I/O

is managed via the Process Manager industrial computer platform, not a separate vision I/O board.

"We selected Cognex as our vision technology partner because Cognex is the technology leader in the vision industry," said Leonard Valeo, Serialization Solutions Sales Manager for Körber Medipak. "In fact Cognex spends more on research and development than many of their competitors have in sales. Cognex also can support their products around the world, which is important because the larger pharmaceutical companies are global in scope and they prefer to standardize on a single serialization solution, including a strong vision platform."

The Seidenader solution can provide item, bundle, case and/or pallet serialization throughout the packaging process. All serialization processes, equipment interfaces, printing stations, cameras and/or bar code readers are managed and controlled by Seidenader's Process Manager software; ultimately creating and documenting the proper parent-child aggregation relationship at the line-level. Process Manager controls and maintains parent to child relationships, while associating and documenting the alias of each serial number along the way. A localized repository manages the real-time allocation of numbers, associations, and status updates as related to the batch.

Seidenader also provides browser-based site-level serialization software that provides the proper gateway between the packaging lines and the end-users ERP/MES environments. This software, called MLS, interfaces with the L3 and L4 layers to manage client material master data and Production Orders automatically with the site-level serialization processes.

360 DEGREE INSPECTION WITH TWO BARCODE READERS

Seidenader has introduced a new 360 degree inspection station whose cost and complexity is reduced by using only two Cognex DataMan® ID readers utilizing the VSoC™ vision chip. VSoC technology enables DataMan to offer unprecedented speeds on 1-D barcode reading with up to 90 decodes per second and ultrafast image acquisition with auto-exposure, at up to 1,000 frames per second.

By using a simple bar code reading architecture, engineered with a proprietary LED lighting and mirroring design, Process Manager 360 can verify data matrix codes printed on round bottles at high speeds, with minimal to no false rejects.

Process Manager 360 is an affordable solution that is based on an "open-view" design, so operators and mechanics can actually see the inspection process occur. Process Manager 360 requires minimal adjustment based on bottle height and diameter and can be maintained without the need of machine vision expertise.

Seidenader is currently working with several global pharmaceutical manufacturers to implement their new serialization solution and expects to have their first customers up and running early in 2013. "Customers are excited about utilizing our smart camera technology approach to help reduce the cost of implementing and maintaining serialization solutions," Valeo said. "They are also excited about the dramatic reduction in cost and footprint for inspecting round bottles in complex aggregation applications. We are very pleased to be partnering with Cognex to deliver these benefits to the global pharmaceutical industry."

[1] Henry I. Miller, "Fake And Flawed Medicines Threaten Us All," Forbes Magazine, July 25, 2012.

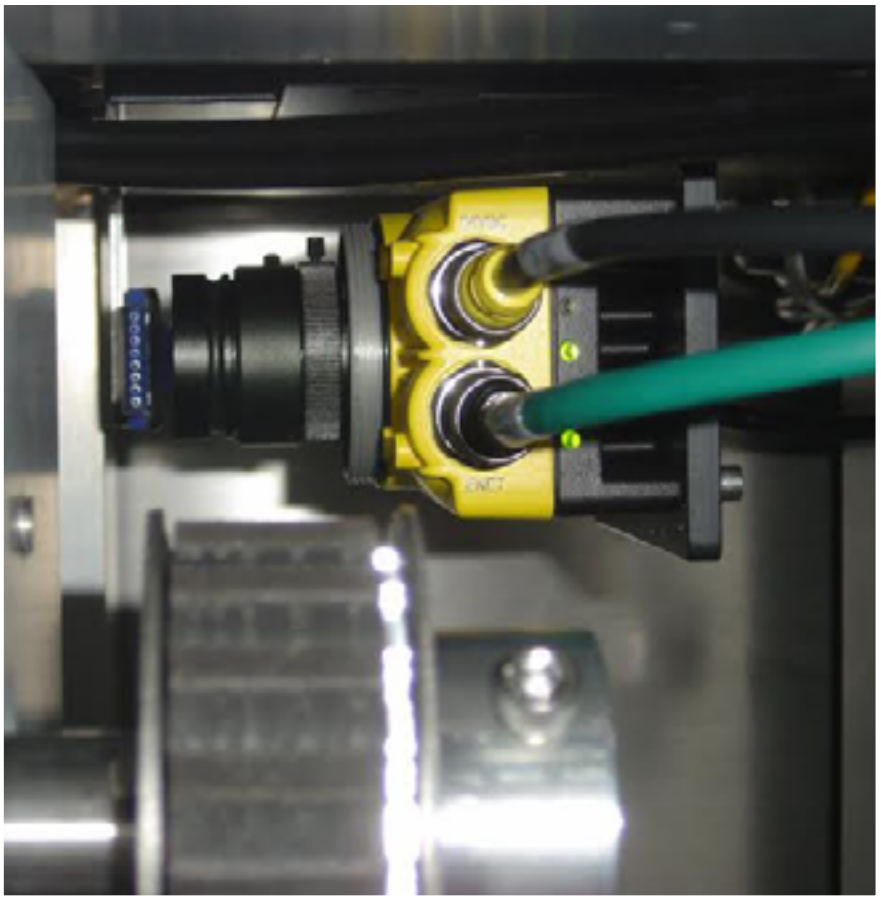
[2] Christopher Weaver and Jeanne Whalen, "How Fake Cancer Drugs Entered U.S.," Wall St. Journal, July 20, 2012.

Seeing the Value in Bright Stock Labeling

Vision technologies key to the robust QA/QC required by bright stock packaging strategies

BY JOHN LEWIS, MANAGER, MARKET DEVELOPMENT, COGNEX CORP.

In response to market forces and competitive imperatives, pharmaceutical manufacturers are consolidating manufacturing and packaging into fewer and fewer plants to reduce costs. At the same time, the number of unique packages required to meet market and regulatory requirements is increasing. These trends are rapidly rendering obsolete the traditional approach where pharmaceutical products are packaged and labeled at the time of production.



There is a more efficient approach to traditional labeling/packaging operations called bright stock manufacturing in which products are produced in large efficient batches and stored in unlabeled individual containers. These containers are then labeled just prior to shipment. The main challenge of implementing a bright stock manufacturing strategy is ensuring that the contents of every container are known with 100% certainty before applying the label and having the ability to demonstrate this fact via the pharmaceutical manufacturer's quality assurance, quality control (QA/QC) regime.

NEED FOR JUST-IN-TIME LABELING

The pharmaceutical industry's strategy of consolidating manufacturing operations into a smaller number of high-volume plants is challenged by the need for these plants to distribute its products effectively and reliably deliver shipments to meet the varying demand from local and global markets. To meet such market diversity and complexity, each product requires an increasing number of unique labels to

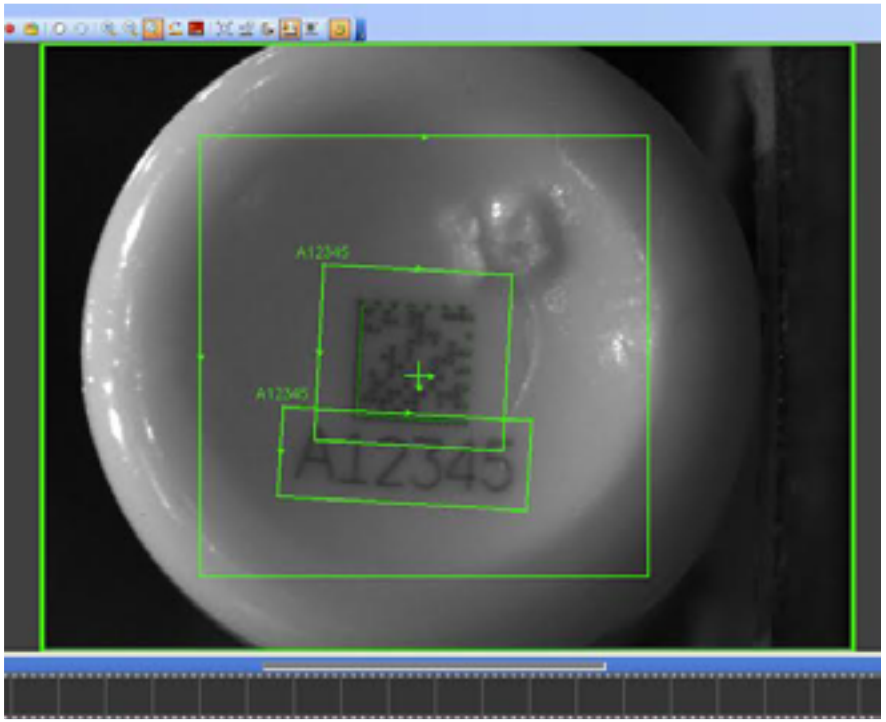
meet the regulatory and societal requirements of a given country or region.

The traditional approach of labeling and packaging the product at the time of production is becoming increasingly untenable because manufacturers are forced to estimate the demand for each of the different labels applied to its products. This approach usually requires that production be in relatively small batches, which is less efficient and more costly to produce than larger batches.

For example, when market demand doesn't match the forecast, product rapidly loses its value as it moves closer to its expiration date. Even while labeled product is losing value sitting on the shelf, a given manufacturer may be forced to produce and label the same drug to meet unexpectedly high demand for the same product with different labels.

Pharmaceutical manufacturers have long wanted to move to the more efficient approach of producing bright stock in large efficient quantities and labeling and packaging the product just prior to shipment—when demand is known for certain. But making certain that the contents of each and every bottle match its label on application is a significant technical challenge.

How can the manufacturer be certain that a handful of bottles containing a different product haven't been mixed together with the batch being labeled? Just a single bottle with the wrong contents could have enormous consequences including harm to a patient, damage to the manufacturer's reputation, a multimillion dollar recall and so on. This same concern, it should be noted, also applies to the increasingly large number of pharmaceutical manufacturers that due to plant consolidation are now making products in one facility and shipping them to another for labeling.



VALUE OF MARKING EACH CONTAINER

An obvious solution to this problem is to mark each container at the time of production to eliminate any doubt as to its contents. This code is then read just prior to applying the label and packaging in order to ensure that the bottle contains exactly what the label says it does. This raises the challenge of generating a mark on each bottle, often made of high density polyethylene (HDPE), recognizable with certainty during downstream processing. Traditional marking solutions such as CO2 and fiber lasers cannot generate much contrast on HDPE materials, rendering bar codes nearly unreadable.

Ultraviolet (UV) lasers can generate a darker mark, but it is still challenging to maintain the high read rates due to the many variables in the marking and reading process.

These unavoidable limitations in the marking process make machine vision critical to the success of just-in-time labeling. The traditional approach to machine vision involves the use of cameras controlled by personal computers (PCs). But PC-based vision systems take considerable time and effort to integrate because they require considerable vision expertise and in many cases knowledge of low-level programming languages. PC-based vision systems also require IT department oversight, service pack updates, and other items like virus protection software. PC-based systems can also be expensive in today's regulatory environment because each upgrade to the PC and vision code may require revalidation to meet FDA requirements.

ADVANTAGES OF VISION SYSTEMS

FP Developments Inc., a supplier of packaging machinery, recently provided a major pharmaceutical manufacturer with seven packaging lines. Each line deploys FP Model 1371 coding machines that mark a unique code on each bottle during the filling process and use a vision system to verify the code before the product is stored or transferred.

At the heart of this process are machine vision technologies engineered by Cognex, integrated with the coding machines and configured to read the relatively low contrast laser-marked 2D Data Matrix codes with near 100% read rates.

Controlled by internal microprocessors, Cognex's In-Sight vision systems operate independently of PCs. The security and recipes for the vision systems can be downloaded direct from the network or an industrial PC. Typically only one industrial computer per line is needed regardless of the number of vision systems to manage the security and recipes for the vision systems.

Vision systems are less expensive to implement because they can typically be developed without writing a line of code, a process replaced by a few prewritten functions called vision tools. The seven systems that FP Developments recently provided to a major pharmaceutical manufacturer use only two vision tools to read 2D Data Matrix codes marked with UV lasers on HDPE bottles. According to FP Developments Inc., Cognex vision systems are easily maintained by operators and easy to troubleshoot or perform routine maintenance. Operators can adjust the focus or lighting on the vision system either by plugging in a laptop or by operating the vision system in teach mode. Validation expenses are lower for vision systems because they are simpler and inherently more stable over time.

The vision system and laser are connected via Ethernet to a programmable logic controller (PLC). The PLC triggers the laser and vision system. The vision system compares the code on the bottle to the recipe and sends a pass or fail signal to the PLC. The system is currently operating at up to 250 bottles per minute with near 100% read rates and is capable of operating at substantially higher speeds.

PRODUCTION ADVANTAGES WITH ECONOMIC BENEFITS

FP Developments Inc. says its pharmaceutical customer is attaining the production targets and cost efficiencies set by its bright stock manufacturing strategy made possible by its new packaging lines. Now able to process larger batches, the company is experiencing cost savings and high service levels while reducing inventory and product obsolescence. Perhaps more importantly, the pharmaceutical manufacturer can prove that it has control of its labeling process and the means to virtually eliminate mis-packaging.

This approach also has the potential to provide a solution to other production problems. For example, another manufacturer had a minor problem with graphics in a small percentage of a batch. It ran the batch back through the packaging machine and used the vision system to scan each bottle and pull out the bad ones. In the event of a batch specific recall, the system could also be used to scan the recalled bottles to determine what percentage of the bad batch has been recovered and possibly to release the good bottles back into the supply chain.

CLARITY FOR COMPLIANCE

Regulators around the world have been working for years to develop a standard for a secure electronic record of the chain-of-custody of pharmaceuticals, often called ePedigree. The new packaging systems installed by FP Developments Inc. position its customer to achieve compliance with these upcoming regulations designed to prevent counterfeit drugs from making their way into the hands of consumers. The infrastructure needed to validate the origin of a unit package of pharmaceutical is not yet in place, however, pharmaceutical manufacturers that mark and read individual bottles have the ability to easily track the origin of each bottle. All in all, the new generation of serialization solutions based on vision systems can help pharmaceutical manufacturers reduce costs and improve the security of their supply chain.

Machine Vision Helps BI Achieve Quality Control

Tech is quicker than the eye, and for QA/QC on fast packaging lines that's a good thing

BY JOHN LEWIS, MARKET DEVELOPMENT MANAGER, COGNEX

Boehringer Ingelheim (BI), the world's largest family-owned pharmaceutical company, produces around 120 million blister packs a year. The prescription-only drug products in BI's blister packs are manufactured to reduce blood pressure, treat patients experiencing shortness of breath, and treat thrombosis.

These products get into patients' hands via pharmaceutical wholesalers and pharmacies. In the past, the company relied on human inspections to ensure the printing quality on their blister packs, even though regular random sampling did not allow for meaningful conclusions about quality to be drawn. Under normal circumstances, the human eye can usually see printing on a blister pack or folding pack of medication easily. However, when faced with the task of inspecting printing quality on a production line churning out around 300,000 blister packs and 100,000 folding packs every day, employing a "human sensor" to inspect products randomly cannot meet the demand of perfect quality control. At this level of production, BI now relies on the vision technology to achieve its quality control objectives.

In BI's production process, blister packs pass over a narrow belt at speeds impossible for the human eye to register

any more than the outline of the individual objects. Today, the vision technology that BI deploys to inspect blister pack printing ensures 100% error-free quality. Absolute transparency in the production process has replaced the unreliable statistical projections made by humans.

On the manufacturing floor, four stations inspect the blister pack printing. Another unit is on station for inspecting folding medication packs. Boehringer Ingelheim's objective is to assure every single product gets a quality inspection, operations enabled by Wesys-OCR vision software running on Cognex's VisionPro platform.

QUALITY UNDER PRESSURE

In principle it appears perfectly simple: a camera identifies a series of letters and numbers, rejects defective objects and moves accepted objects though the production process. On a pharma production line, there are two factors that make this process challenging: the enormous speed at which the blister packs transit the line and the accuracy of inkjet printing. Inkjet printing is very flexible and practical, but it can generate inaccuracies when it is tasked to print consistently clear images on foils with irregular surfaces such as those found on blister packs. To the untrained eye, inkjet printing may appear perfectly legible, but does not necessarily satisfy a customer's quality assurance standards. Small spots of ink not applied where they are supposed to be can be enough to cause a product to be rejected, an aspect of quality to which the pharmaceutical market in Asia is especially sensitive.

INTELLIGENCE SHOWS STRENGTH

BI achieves perfect quality control by deploying a commercially available industrial camera in each of the four blister pack inspection units, supported by LED ring light, which detects the printed undersides of the foil in fractions of a second. The information is transferred to the vision software at lightning speed so that it can perform a precise

sample comparison. Depending on the product type, particular examination is made of varying details which are applied — including lot number and expiry date — in addition to looking at pre-printed information.

The intelligent vision software knows and recognizes all the relevant symbols and letters and, on the basis of previously taught parameters and tolerance limits, assesses the quality of the printing. The system's OCR software is particularly characterized by its library of flexible, high-precision and easy-to-handle tools. It is possible to compile even complex product profiles which are accurate in every detail. It is particularly adept at reliable sample comparison — even reflections due to uneven surfaces and the changing foil colors of silver and white do not affect reliable inspection. The vision system reacts intelligently in these instances to fluctuations in print position and print quality.

FOLDING PACK FOIBLES

Dirt, pressure and sharp edges are the greatest deterrents to detecting unacceptable print quality on folding packs. In instances where these factors are present, the vision system prevents defective folding packs from reaching customers. Via white LED surface illumination, six industrial cameras examine the corresponding six sides of each individual pack — up to 80 per minute. Dirt, pressure, and sharp edges generally do not impact blister pack quality control but there can be exceptions. On the rare occasions a blister pack is tarnished by dirt or damage, incorrectly glued tabs or print errors, the vision system ensures that the products are handled appropriately.

The system can be operated via touchscreen or keypad. Employees feeding the packs into the inspection process by hand determine the proper product format. They select specified data from a clear list and start the inspection process at the touch of a button. The interaction between humans and the technology occurs swiftly and simply and ensures consistent quality.

ABOUT COGNEX

Cognex Corporation is the world's leading provider of vision systems, vision software, vision sensors and surface inspection systems used in manufacturing automation. Cognex is also a leader in industrial ID readers.

Cognex vision helps companies improve product quality, eliminate production errors, lower manufacturing costs, and exceed consumer expectations for high quality products at an affordable price.

Typical applications for machine vision include detecting defects, monitoring production lines, guiding assembly robots, and tracking, sorting and identifying parts.
Cognex serves an international customer base from offices located throughout North America, Europe, Japan, Asia and Latin America, and through a global network of integration and distribution partners. The company is headquartered close to Boston in Natick, Massachusetts, USA

Contact us by telephone: 1-844-222-1114

ADDITIONAL RESOURCES

Cognex Pharmaceutical Solutions
http://www.cognex.com/pharmaceuticals-ID-inspection-solutions.aspx

Pharmaceutical Application Demo Videos
http://www.cognex.com/explorelearn/products/?id=6148

Fundamentals Series Presentation: The Drug Supply Chain Security Act Explained
http://www.brainshark.com/pharmamanufacturing/vu?pi=zIBz18Ixe1z9Qtsz0

Fundamentals Series Presentation: Fundamentals of Successful Vision Applications and Implementation Considerations
http://www.brainshark.com/pharmamanufacturing/vu?pi=zIdzRMyuOz9Qtsz0

Cognex Corporation
One Vision Drive
Natick, MA 01760-2059
news@cognex.com