

LIFE SCIENCES SOLUTIONS GUIDE

Machine vision and deep learning to solve the toughest applications

COGNEX

THE GLOBAL LEADER

IN MACHINE VISION AND INDUSTRIAL BARCODE READING

Cognex®, the world's most trusted machine vision and industrial barcode reading company.

With over 2.3 million systems installed in facilities around the world and over thirty nine years of experience, Cognex is solely focused on industrial machine vision and image-based barcode reading technology. Deployed by the world's top original equipment manufacturers (OEMs), Cognex patented vision tools and hardware are suitable for both off-the-shelf builds and custom integration into in-vitro diagnostic and laboratory equipment. Today, life science OEMs use Cognex products to take their equipment performance to the next level.

**\$726
MILLION**
2019 REVENUE

OVER 39
YEARS IN THE BUSINESS

GLOBAL OFFICES IN
20+ COUNTRIES

2,300,000+
SYSTEMS SHIPPED



THE RIGHT CHOICE FOR LIFE SCIENCE OEMS

Solving Complex, Custom In-Vitro Diagnostics and Lab Automation Challenges with Industry-Leading Machine Vision and Automatic Identification Technology

With the largest investment in R&D and a global engineering support team, Cognex is the preferred machine vision supplier for the life sciences industry. Today, OEMs rely on Cognex for vision and automatic ID solutions to meet the demanding requirements of their customers and deliver accurate, reliable, and high-performance machines.

Global Support	4
In-Vitro Diagnostics Lab Automation	5
Vial Presence Check	5
Reagent Track & Trace	6
Pipette Alignment and Guidance.....	6
Liquid Level Measurement.....	7
Diagnostic Device Automation	7
Deck Inspection (ViDi).....	8
Sample Quality Management (ViDi).....	9
Microscopy	10
Cell Classification and Counting (ViDi)	10
Cell Pathology (ViDi)	11
Gleason Pattern Scoring (ViDi)	12
Medical Imaging	13
X-ray Organ Localization and Identification	13
X-ray Anomaly Segmentation and Defect Detection.....	14
Automatic Identification	15
Medical Device Track & Trace.....	15
Surgical Tool Tracking	16
Patient Identification	16
OCR on IV Bags (ViDi)	17
The Cognex Advantage	18
VisionPro ViDi	19



GLOBAL SUPPORT

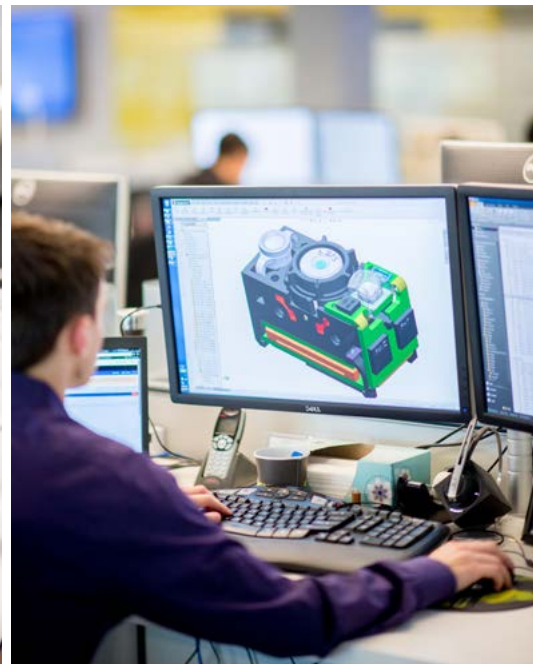
Local Expertise, Worldwide Reach

Cognex understands that responsive, expert service is an expectation all customers should have. Cognex serves an international customer base from offices located throughout the Americas, Europe, and Asia and through a global network of highly-trained partners, system integrators, and distributors. Original equipment manufacturers (OEMs) rely on Cognex's wide range of world class solutions, backed by expert application and technical support, to build advanced vision-enabled automation equipment.

With strong investment in R&D and a global engineering support team, Cognex helps OEMs stay on top of the latest advancements and meet their specific product development, integration, and lifecycle requirements.

With patented vision software, image engines, vision systems, and barcode readers that are designed for optimal integration into automated systems, Cognex has the capacity and resources available to support even the largest deployments. So whether you're considering machine vision for the first time or are already an expert user, Cognex global services provide the expertise to help your organization succeed.

From development to deployment, Cognex is there to help you design, implement, and install your vision systems.



IN-VITRO DIAGNOSTICS LAB AUTOMATION

AUTOMATE DEVICES AND TESTING

In devices performing everything from simple diagnostic tests to sophisticated DNA analysis, machine vision helps improve efficiency and increase throughput. Automating in-vitro diagnostic devices helps the healthcare industry to drastically reduce potential errors and more accurately help detect infection, diagnose medical conditions, prevent disease, and monitor drug therapies. This is why clinical diagnostic laboratories look to Cognex for solutions to help them increase throughput and improve quality. To solve their barcode reading and vision needs, Cognex offers both off-the-shelf and OEM systems that can be designed directly into products. Because Cognex vision systems are reliable, easy to set up, and operate at the highest efficiency levels, they can help the life science industry greatly reduce time to market. Cognex vision systems are easily configured to provide the necessary results with high reliability and low demand on additional infrastructures, such as CPU units or embedded PCs.

VIAL PRESENCE CHECK

Cognex robust vision solution identifies presence of vials

CHALLENGE

In-vitro diagnostics (IVD) laboratories with highly automated robotic systems encounter frequent failures resulting in misaligned or absent vials or caps. These automated systems need to integrate an error-proofing tool that not only can confirm the presence of a vial or cap but also can detect misalignments and other system failures.

SOLUTION

By providing robust tools to identify the presence of vials and detect system malfunctions, Cognex machine vision systems help IVD laboratories achieve quality goals. Machine vision systems also help laboratories avoid machine crashes and the reporting of bad or false diagnostics results.



REAGENT TRACK & TRACE

Image-based readers improve reagent barcode read rates and enable both 1D and 2D code reading

CHALLENGE

Modern diagnostics laboratories need to track every sample to ensure tests are linked to the correct patient. Ensuring process quality is critical as laboratory throughput increases. Laboratories demand higher 1D reagent barcode reading rates, and when they transition to serialization with 2D codes to track samples, they require solutions that are fast, reliable, and easy to set up.

SOLUTION

Image-based barcode readers improve read rates and enable both 1D and 2D code reading, which ensures quality in diagnostic laboratories and facilitates successful serialization to track samples more effectively. For the same reason high-speed factories and logistics customers use Cognex, laboratory automation customers use Cognex solutions to quickly and reliably read any code. Even if 2D codes are not yet necessary for certain applications, Cognex barcode readers can be quickly and cost-effectively upgraded to read 2D matrix codes when needed.



PIPETTE ALIGNMENT AND GUIDANCE

Machine vision precisely locates fixtures to align robotic arms



CHALLENGE

IVD systems use robotic arms to perform an ever-increasing number of tasks. As sample sizes get smaller, precision robotic arm guidance is required to avoid malfunction.

SOLUTION

Cognex PatMax® technology finds patterns and returns location data to a robotic arm system to calibrate the system and ensure proper alignment. Cognex machine vision technology precisely locates fixtures to align robotic arms to handle the smallest sample sizes and ensure optimal system functionality.

LIQUID LEVEL MEASUREMENT

Machine vision systems measure fill levels in liquid handling devices

CHALLENGE

IVD laboratory automation systems require 100% effective liquid handling functionality. In these systems, validating the volume of liquid is often critical to knowing the system is operating properly and ensuring the quality of the test result.

SOLUTION

Machine vision systems are able to reliably perform liquid level measurement because they have no moving parts or sensors that can wear out or fail. Machine vision is able to find the meniscus in a vial or the edge of liquid in a capillary tube even when measuring very small amounts. Outside a vessel, the measurement of the size of droplets or a liquid spot can aid in correlating the results of a test procedure. Machine vision systems can even measure the different levels of the separated phases of centrifuged blood and the thickness of the buffy coat.



DIAGNOSTIC DEVICE AUTOMATION

Machine vision automates testing and reduces errors



CHALLENGE

Diagnostic device manufacturers know that automation is critical to success. In devices performing everything from simple diagnostic tests to sophisticated DNA analysis, machine vision can help improve efficiency and increase throughput.

SOLUTION

Machine vision automates the diagnostic devices and accessories that perform tests on samples, such as blood, urine, and tissue. Automating diagnostic devices helps the healthcare industry to drastically reduce potential errors, and more accurately help detect infection, diagnose medical conditions, prevent disease, and monitor drug therapies.

DECK INSPECTION

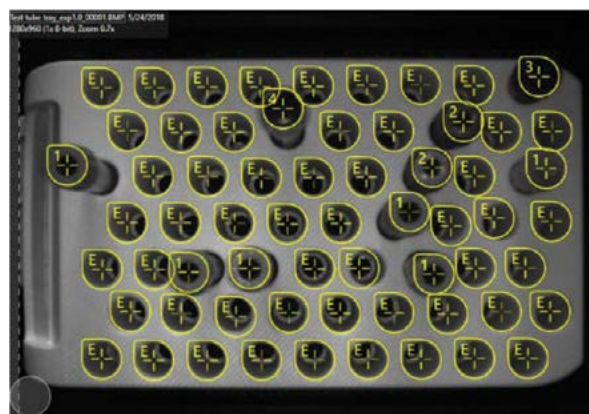
Deep learning-based software locates rack samples

CHALLENGE

Clinical diagnostic equipment manufacturers rely on machine vision for automated deck population assessment. Liquid handling systems, such as analyzers or IVD equipment, must detect the location and orientation of racks and their vessels in order to pipette and process samples properly. Incomplete racks can impair workflows and cause costly machine assists. These highly automated systems sometimes encounter failures resulting from misaligned or absent test tubes or caps that haven't been removed. Vessels and tubes vary in size, dimensions, and cap type by manufacturer, making it difficult for the machine handling system to predict the position of parts on their decks.

SOLUTION

Cognex ViDi™ self-learning algorithms excel at locating similar objects in bulk. With the ViDi Blue-Locate tool, any lab technician is able to fixture tray images, teaching the software to identify and count individual tubes based on their size, shape, and features. ViDi Blue-Locate detects the location and orientation of microtiterplates and other racks on the IVD's deck, as well as their sample tubes, despite their unpredictable and varying dimensions. Once ViDi has located the samples on the rack, traditional machine vision tools are used to align the samples and reagents for further processing.



BLOOD SAMPLE QUALITY MANAGEMENT

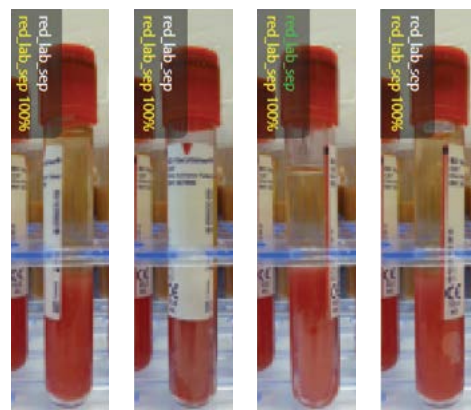
Cognex ViDi analyzes centrifuged blood for proper separation

CHALLENGE

Blood testing analyzers rely on accurately prepared samples and test setups. Centrifuged blood samples are ranked according to different indices (e.g. hemoglobin, bilirubin, and intralipid index levels) and receive quality scores based on turbidity and plasma color. All of these indices can vary in appearance based on how samples are loaded and oriented in the rack. Blood separation and the presence/absence of labels and caps are important factors in quality assessment, which is crucial for robust workflows in highly automated labs. Because there are so many judgment-based factors, this inspection often falls to humans.

SOLUTION

Deep learning-based image analysis can ascertain whether centrifuged blood has been effectively separated into distinct phases (plasma, buffy coat, and red blood cells) and classify samples by the criteria used in processing. The ViDi Green-Classify tool trains on annotated images of different classes until it successfully conceptualizes and generalizes the normal appearance of different phases. During runtime, ViDi sorts multiple classes within a single vial, extracting blood quality factors like plasma color and turbidity, buffy coat volume, and centrifugation status into distinct classes while ignoring irrelevant qualities like cap status and label presence. Based on the classes, it separates passing samples from failing samples. This information can also provide useful process control information about the samples being drawn and re-centrifuged.



MICROSCOPY



BREAKTHROUGH DEEP LEARNING-BASED SOLUTIONS

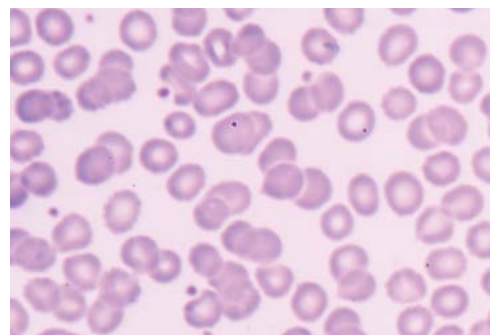
Be it for the detection of malaria parasites in blood smears or even the mitotic count on cancer tissues, Cognex now offers a breakthrough automated solution to clinical and research microscopy solutions that previously required human inspection. VisionPro® ViDi is the first deep learning-based image analysis software designed specifically for a wide range of life science applications including feature location and identification, defect detection and segmentation, object and scene classification, and optical character recognition (OCR). It is a field-tested, optimized, and reliable software solution based on a state-of-the-art set of machine-learning algorithms. Combining artificial intelligence (AI) with VisionPro and Cognex Designer™ software, VisionPro ViDi solves complex applications that are too difficult to program and maintain using traditional machine vision systems.

CELL CLASSIFICATION AND COUNTING

Deep learning-based algorithms separate cell types by their unique characteristics

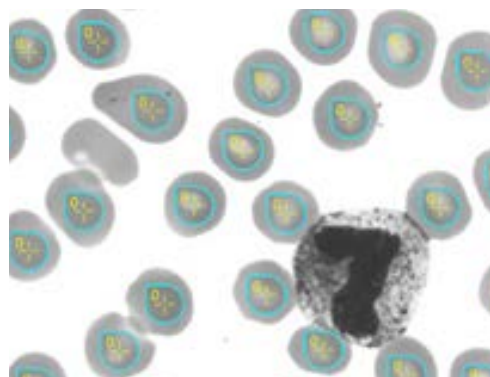
CHALLENGE

Cell classification and counting is a key task in clinical diagnosis (e.g. in blood smears or mitotic counts). Many processes require an accurate initial cell count to standardize their baseline inputs and measure outcomes. Because the appearance of cells can differ, machine vision can sometimes struggle to accurately locate them against confusing backgrounds or artifacts. Those cells which are close together can also be difficult for machine vision to distinguish as independent.



SOLUTION

The ViDi Blue-Locate tool accurately identifies cells by learning from annotated images of microscopic slides. The tool generalizes the normal appearance of cells based on their size, shape, and surface features as well as variable features. Self-learning algorithms learn to differentiate between intact and damaged cells (e.g., those which carry a malaria virus), even on noisy backgrounds, and provide a reliable count. The ViDi Green-Classify tool learns to sort different types of cells, classifying them by unique characteristics such as size and shape.



CELL PATHOLOGY

Cognex ViDi detects cell abnormalities on histologic slides

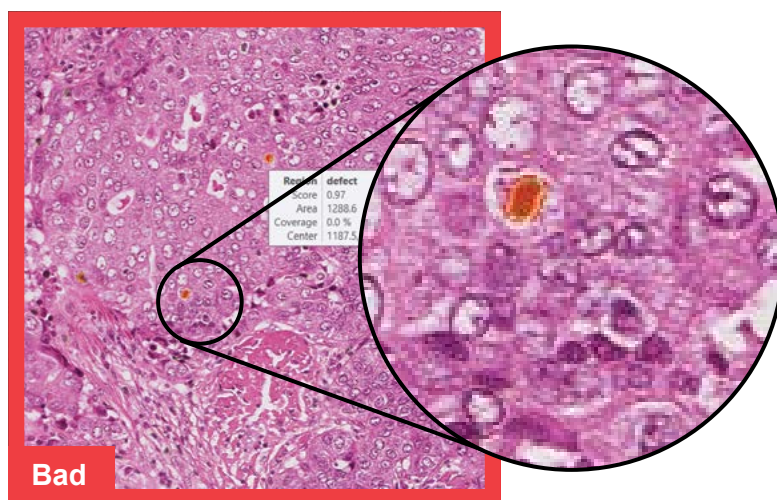
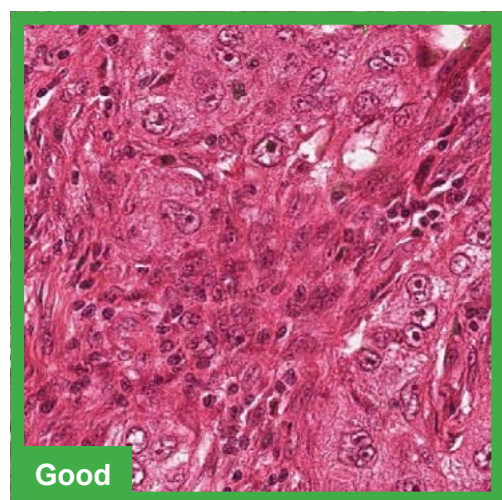
CHALLENGE

Histologic samples exhibit various forms of cell damage. Because the appearance of cell damage is highly unpredictable and involves many possible forms, it can be difficult for machine vision to identify all possible anomalies without extensive programming.

SOLUTION

The ViDi Red-Analyze tool detects cell abnormalities by learning the normal appearance of a cell, including its significant but tolerable variations (e.g. mitosis). The tool's deep learning model learns to account for natural deviation amongst cell clusters, while flagging significant changes in appearance as anomalous. Based on this initial training, Cognex ViDi can dynamically segment the regions of interest exhibiting cell damage for further histological analysis.

The Red-Analyze tool is also used to segment and identify specific regions of interest, such as a specific fixation medium on a microscopic slide (e.g. paraffin) or other artifacts due to improper staining, simply by learning the varying appearance of the targeted zone.



GLEASON PATTERN SCORING

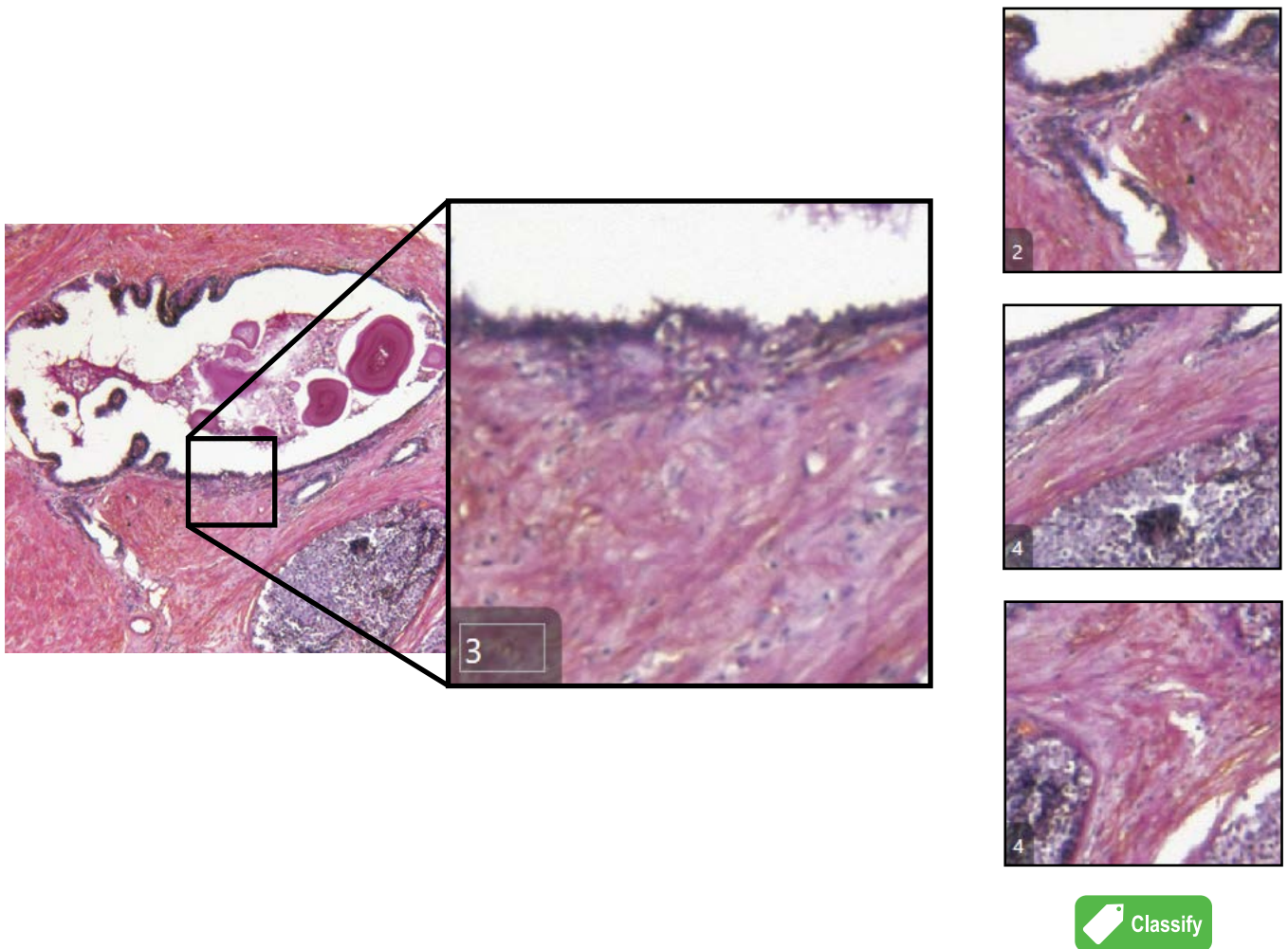
Deep learning-based software classifies cell morphologies

CHALLENGE

The Gleason pattern grading scale classifies prostate cancer cells by their glandular structure on a scale from 1–5. Gleason patterns range in their degree of differentiation, from small and uniform to highly irregular and distinct. Scoring a Gleason pattern can be challenging when there are multiple scenes—in this case cells—in a single slide.

SOLUTION

The ViDi Green-Classify tool categorizes different cell morphologies like the Gleason pattern based on a collection of labeled images. To train the Green-Classify tool, a technician or engineer provides all images labeled in accordance with the different classes. Cognex ViDi develops a model of Gleason patterns 1–5, then classifies cell tissues by their degree of differentiation and sorts them by grade.



MEDICAL IMAGING

DETECT BIOLOGICAL ABNORMALITIES

Medical imaging analysis has traditionally required the flexibility of a human inspector and the ability to make qualitative decisions about an unstructured scene. It can be time consuming and difficult to locate an object or region of interest with precision. Today, deep learning-based image analysis can automate the search for biological anomalies in radiological X-rays, ultrasounds, and NMRs.

X-RAY ORGAN LOCALIZATION AND IDENTIFICATION

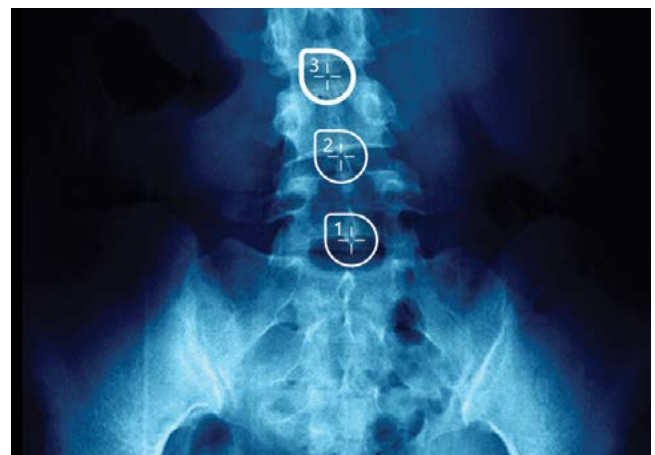
Deep learning-based tools locate the region of interest in an X-ray despite a visually confusing and poorly contrasted background

CHALLENGE

It can be difficult to locate a specific region of interest in an X-ray, such as a particular organ, due to a confusing and poorly contrasted background or other image quality issues. An automated system must be able to successfully identify the region of interest while ignoring irrelevant features. Deep learning-based image analysis combines the flexibility of a human inspector with the speed and robustness of a computerized system to solve this challenge.

SOLUTION

The Cognex ViDi Blue-Locate tool is able to locate a specific organ by learning the distinguishing features of that area while ignoring irrelevant features. ViDi Blue-Locate finds complex features and objects by learning from annotated images. Self-learning algorithms are able to locate different types of organs or implants on very noisy backgrounds of X-ray images or other complex objects in bulk.



X-RAY ANOMALY SEGMENTATION AND DEFECT DETECTION

Deep learning-based tools help detect and segment anomalies in X-ray images

CHALLENGE

The search for biological anomalies in radiological X-rays, ultrasounds, and NMRs has traditionally required the flexibility of a human inspector. Today, deep learning-based defect detection and segmentation tools can help identify anomalies in medical images quickly and accurately by successfully searching for any deviation from the body's normal appearance.

SOLUTION

The ViDi Red-Analyze tool can be used to inspect a medical X-ray image or detect defects on an ultrasonic image simply by learning the normal appearance of an object, including its significant but tolerable variations. The ViDi Red-Analyze tool develops a reference model of an organ's normal appearance, as well as specific types of anomalies, based on training on a set of sample images. Any anomalies which digress from the normal physiology of the targeted zone are flagged as defects for a CAD computer-aided diagnosis by an expert radiologist.



AUTOMATIC IDENTIFICATION

TRACK PATIENTS, SURGICAL TOOLS, AND MEDICAL DEVICES

Hospitals are working hard to improve quality, using automation to ensure patient safety. System builders are similarly using automation to improve quality at higher throughput, and implement track & trace systems for test samples, surgical rooms, medical devices, and patients in the healthcare system. Cognex image-based barcode readers read codes quickly and reliably, helping OEMs easily document inspection and code reading results to meet most regulatory requirements. In addition to breakthrough code reading, Cognex offers DataMan® products for every step of the traceability process, including quality verification and data validation. Easy-to-use and reliable DataMan products enable quality control solutions for applications that require the highest read rates for 2D DataMatrix codes—critical to product traceability. Verification solutions feature compliance with industry standards, certified calibration, and reliable and consistent results.

MEDICAL DEVICE TRACK & TRACE

Image-based barcode readers help track patients, surgical tools, and medical devices

CHALLENGE

Hospitals are turning to automation to improve quality and ensure patient safety. Liability for defective product, inconsistent quality, rapidly changing costs, increased global competition, and FDA regulation all challenge the profitability of medical device manufacturers.

SOLUTION

The Cognex AE2 Advantage® engine with DataMan software leverages the power of Cognex vision and barcode reading tools in an embedded product that is compact and flexible, but also cost-effective. It includes an easy-to-integrate form factor and open software architecture and interfaces. The Advantage engine delivers best-in-class 1D and 2D code reading for traceability, plus a full suite of industry-proven vision tools to locate, analyze, and inspect parts or features for embedded vision applications.



SURGICAL TOOL TRACKING

Image-based barcode readers reduce errors in operating theaters by tracking equipment

CHALLENGE

Hospitals are using automation to improve quality and ensure patient safety. One place this is especially crucial is in the operating theater. To avoid dangerous mistakes, best-in-class hospitals need to track every surgical tool and sponge entering and leaving surgery.

SOLUTION

Image-based barcode readers are designed specifically to read the 2D codes directly marked on tools and sponges. The speed and reliability of Cognex barcode readers help hospitals avoid the dangerous consequences associated with surgical tool misreads and no-reads.



PATIENT IDENTIFICATION

Image-based barcode readers help link patients to activities and equipment



CHALLENGE

To ensure patient safety, hospitals need to use 1D and 2D barcodes to reliably link patients to medications, instruments and other aspects of their activities during their hospital stay.

SOLUTION

Image-based barcode readers accurately read 1D and 2D codes to help link patients to activities and equipment. Fast, accurate barcode reading allows hospitals to ensure that patients are afforded the highest-quality care.

OPTICAL CHARACTER RECOGNITION ON IV BAGS

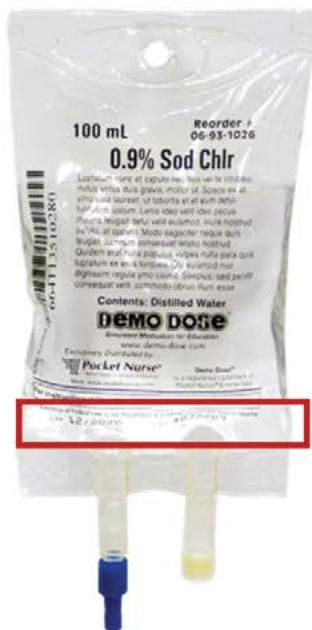
Cognex ViDi deciphers human-readable characters on flexible, shiny surfaces

CHALLENGE

Hospitals rely on machine vision to read and verify characters printed on hospital supplies like IV bags. When there is no standard font used in alphanumeric codes, this can require extensive training to teach the vision system to recognize the multiple fonts and styles it may encounter, especially on wrinkled surfaces like IV bags. Characters that are printed poorly, either on labels or directly onto packaging, can also cause OCR challenges.

SOLUTION

The ViDi Blue-Read tool deciphers badly deformed, skewed, and poorly etched characters using optical character recognition (OCR) and verification (OCV). The pretrained, omni-font library identifies most text out-of-the-box, without additional programming or font training. This makes for fast, easy implementation with limited development. This robust tool can be retrained to adjust to specific OCR application requirements or misread characters.



THE COGNEX ADVANTAGE

Cognex provides the tools and resources to support the most challenging life sciences applications, from the feasibility testing stage through prototyping, validation, and production support. Whatever the challenge, Cognex has the products and expertise to help you BUILD YOUR VISION.

➤ Leading machine vision and ID products

- Engines designed for tight integration into manufacturing equipment
- "Ready to deploy" solutions
- Options to design and build custom systems
- High-performance barcode reading

➤ Proven Cognex application software

- The flexible In-Sight Explorer™ EasyBuilder® user environment makes all inspection, defect detection, guidance, alignment and measurement applications easy to set up and deploy.
- Hotbars® image-analysis technology provides fast and reliable 1D barcode reading of even the most challenging or damaged codes.

➤ Flexibility for custom OEM requirements

- Interchangeable lenses and custom focus available
- Internal and add-on lighting options
- Preloaded OEM job file

➤ Compact and cost effective

- Small form factor enables maximum integration flexibility
- Delivers exceptional value to OEMs' given volume requirements



VISIONPRO ViDi

Deep learning-based industrial image analysis

VisionPro ViDi is the first deep learning-based image analysis software designed specifically for industrial applications. It is a field-tested, optimized, and reliable software solution based on a state-of-the-art set of algorithms in Machine Learning. Combining artificial intelligence (AI) with VisionPro and Cognex Designer software, VisionPro ViDi solves complex applications that are too difficult to program and maintain using traditional machine vision systems. ViDi deep learning technology consists of 4 different tools:



Feature localization & identification

The ViDi Blue-Locate tool finds complex features and objects by learning from annotated images. Self-learning algorithms locate, classify, and count objects in the image, such as blood sample tubes in a rack, cells on a microscopic slide, or organs on an X-ray image. To train the Blue-Locate tool, all you need to provide are images where the targeted features are marked.



Segmentation & defect detection

The ViDi Red-Analyze tool detects anomalies and/or defects. Be it contamination in blood samples (e.g. clot), incomplete or improper centrifugation, or even sample quality management based on scoring different indices (e.g. hemoglobin, bilirubin, intralipid etc.), the Red-Analyze tool can be trained to identify all of these and many more problems simply by learning the normal appearance of an object including its significant but tolerable variations. ViDi Red-Analyze is also used to segment specific regions such as defects or other areas of interest. The Red-Analyze tool can identify all of these regions of interest, including buffy coat inspection of a blood sample or defect inspections on sample vessels, simply by learning the varying appearance of the targeted zone.



Object & scene classification

The ViDi Green-Classify tool classifies objects or complete scenes. Be it the classification of different test tubes or the separation of acceptable or unacceptable defects, the Green-Classify tool learns to separate different classes based on a collection of labeled images. To train the Green-Classify tool, all you need to provide are images assigned to and labeled in accordance with the different classes.



Reads text & characters

The ViDi Blue-Read tool deciphers badly deformed, skewed, and poorly etched codes using optical character recognition (OCR). The pre-trained font library reads most text out of the box and minimizes training steps for fast, easy implementation. This robust tool can be retrained to adjust to specific OCR application requirements—no vision expertise required.

COGNEX VISION AND BARCODE READING OEM PRODUCTS FOR LIFE SCIENCES



Advantage Engines

The Advantage engine is a compact (14.5 mm x 29.1 mm x 20.5 mm, 10 g), flexible and cost-effective product that leverages the power of Cognex vision and barcode reading tools. It delivers best-in-class 1D and 2D code reading, plus a full suite of industry-proven vision tools to locate, analyze and inspect parts or features for embedded vision applications. The Advantage engine is designed for deep integration into OEM products.

Advantage 100 Series OEM Vision System

This vision system offers OEMs the ability to leverage the power of Cognex vision and barcode reading tools in an embedded product that is compact (23 mm x 44 mm x 54 mm, 78 g, including cable and connector) and flexible, but also cost-effective. In addition, the Advantage 100 series allows optics, lighting, and communications to be tailored for maximum flexibility to meet the specific requirements of a volume OEM integration.



DataMan 50 Fixed-Mount Barcode Reader

The DataMan 50 is the smallest (23.5 mm x 26.5 mm x 45.4 mm) high-performance, fixed-mount barcode reader. The upright design facilitates minimum optical depth and variable optics, while three adjustable focal distances deliver the widest range. The DataMan 50 has a solid-state design (IP65) with no moving parts that can wear out and require replacement.

COGNEX

Companies around the world rely on Cognex vision and barcode reading solutions to optimize quality, drive down costs and control traceability.

Corporate Headquarters One Vision Drive Natick, MA 01760 USA

Regional Sales Offices

Americas

North America +1 844-999-2469
Brazil +55 (11) 2626 7301
Mexico +01 800 733 4116

Europe

Austria +49 721 958 8052
Belgium +32 289 370 75
France +33 1 7654 9318
Germany +49 721 958 8052

Hungary +36 800 80291
Ireland +44 121 29 65 163
Italy +39 02 3057 8196
Netherlands +31 207 941 398
Poland +48 717 121 086
Spain +34 93 299 28 14
Sweden +46 21 14 55 88
Switzerland +41 445 788 877
Turkey +90 216 900 1696
United Kingdom +44 121 29 65 163

Asia

China +86 21 6208 1133
India +9120 4014 7840
Japan +81 3 5977 5400
Korea +82 2 530 9047
Malaysia +6019 916 5532
Singapore +65 632 55 700
Taiwan +886 3 578 0060
Thailand +66 88 7978924
Vietnam +84 2444 583358

© Copyright 2020, Cognex Corporation. All information in this document is subject to change without notice. Cognex, PatMax, VisionPro, DataMan, Advantage, Easybuilder, and Hotbars are registered trademarks of Cognex Corporation. VIDI, Cognex Designer, and In-Sight Explorer are trademarks of Cognex Corporation. All other trademarks are the property of their respective owners. Lit. No. LSSG-EN-0320

www.cognex.com