COGNEX ViDi

Deep Learning Image Analysis for Assembly Verification

COGNEX

THE GLOBAL LEADER
IN MACHINE VISION AND INDUSTRIAL BARCODE READING

Cognex,® the leading supplier of machine vision and industrial barcode reading solutions.

With over 2 million systems installed in facilities around the world and over thirty seven years of experience, Cognex is focused on industrial machine vision and image-based barcode reading technology. Deployed by the world's top manufacturers, suppliers and machine builders, Cognex products ensure that manufactured items meet the stringent quality requirements of each industry.

Cognex solutions help customers improve manufacturing quality and performance by eliminating defects, verifying assembly and tracking information at every stage of the production process. Smarter automation using Cognex vision and barcode reading systems means fewer production errors, which equates to lower manufacturing costs and higher customer satisfaction. With the widest range of solutions and largest network of global vision experts, Cognex is the best choice to help you **Build Your Vision.™**

$806 MILLION
2018 REVENUE

OVER 37
YEARS IN THE BUSINESS

500+
CHANNEL PARTNERS

GLOBAL OFFICES IN
20+ COUNTRIES

2,000,000+
SYSTEMS SHIPPED

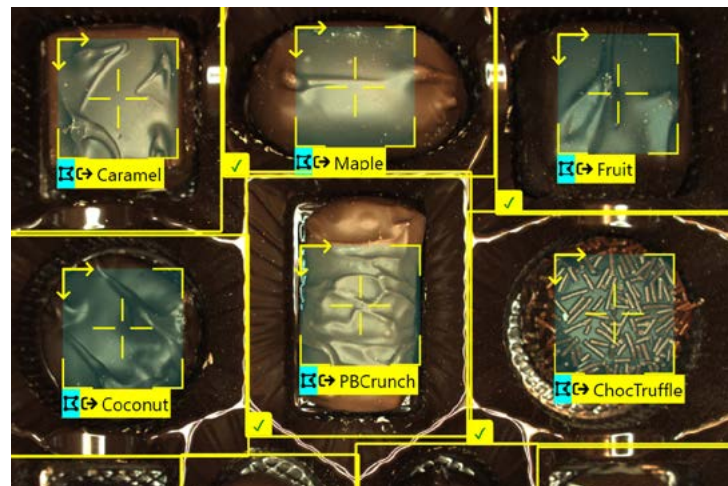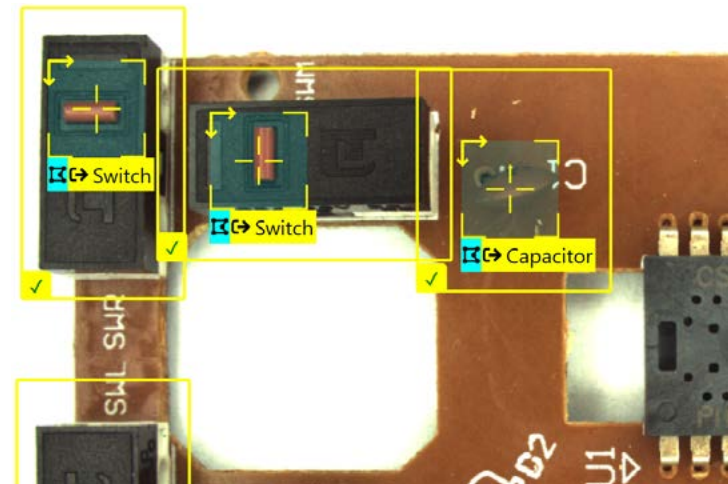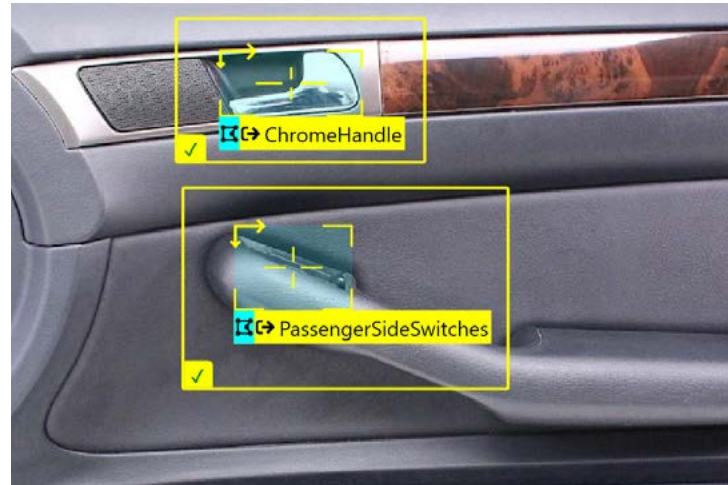# COGNEX ViDi: DEEP LEARNING IMAGE ANALYSIS
FOR ASSEMBLY VERIFICATION

Today's machine vision algorithms can distinguish parts by even the subtlest of differences in markings or features. And yet, limitations exist. It is very programming-intensive to develop rules for the hundreds or even thousands of variations that a single part can present to a camera. Even with the best-written rules, the highly complex scenes involved in assembly verification applications can be too difficult to control. In particular, part-to-part variation, large numbers of components, and configuration changes are difficult and time-consuming to program using traditional machine vision. Deep learning image analysis offers a breakthrough method to automate this class of inspection. Cognex ViDi™ can be trained to handle wide ranges of part-to-part variation in order to locate and confirm whether components are present and correct. Cognex ViDi can also recognize multiple types of components within varying layouts and configurations—no additional logic-building required.

AUTOMOTIVE
FINAL ASSEMBLY VERIFICATION

Ensure all automotive components are present and correctly assembled using deep learning software

Problem

Machine vision is used throughout the automotive component manufacturing process to rigorously monitor and catch quality defects. Final assembly verification has traditionally been done with human operators, as the various pieces of trim involved in final assembly introduce a high degree of complexity that challenges traditional machine vision inspections. Human inspectors verify that all parts, such as interior pieces like door trim, window switches, and door handles, are present and correctly assembled. Exterior checks for color, badges, headlights, and other components are also done at the final stage of car assembly. Human inspectors, though skilled at identifying varying parts as different models move down the line under changing lighting conditions, can be slow and inconsistent.

Solution

Cognex ViDi uses deep learning image analysis software to learn the finished appearance of the many car components to identify improperly placed parts. It is able to do this as accurately as a human inspector, but with the speed and reliability of an automated system. Using the ViDi Blue-Locate tool, a user can build up a component library of trained features. This library of components can contain a wide range of parts, from badges to door handles, for the tool to locate and identify within the image. By adding a verification step using the ViDi Blue-Locate tool, the software can provide a pass or fail result based on all of the components that must be assembled. Using this approach, final assembly verification can now be automated.

📍 Locate

PRINTED CIRCUIT BOARD
ASSEMBLY VERIFICATION

Identify and count PCB components to ensure correct assembly using deep learning software
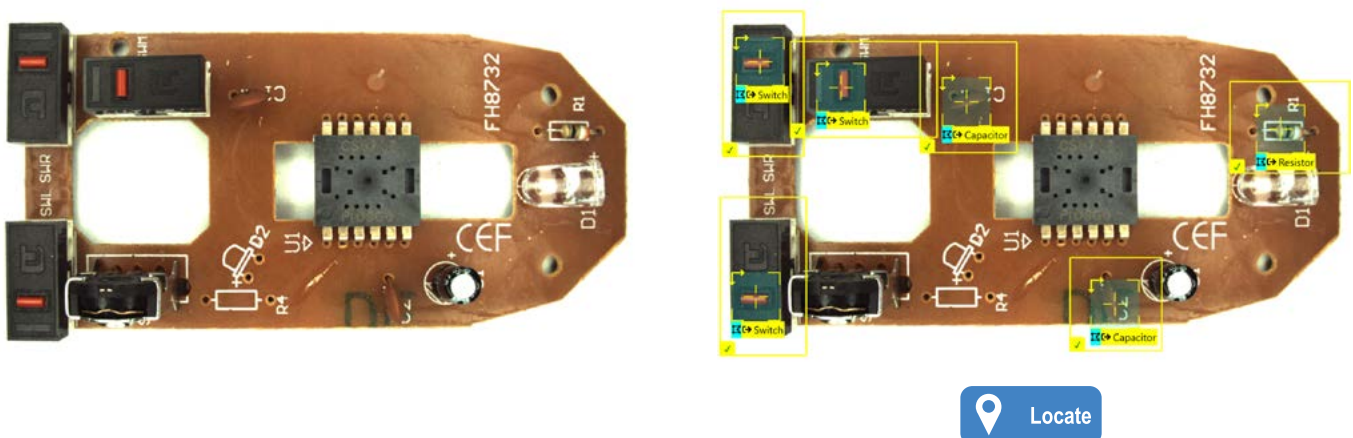
Problem

During final assembly verification, 2D and 3D machine vision systems traditionally inspect PCBs for the presence and correct placement of LEDs, microprocessors, and other surface mount devices. Wrongly positioned or missing components can impact a PCB's performance and lifespan. Manufacturers must be vigilant for scratched, twisted, bent, or missing pins. A chip has such low tolerances for error that any flaw, even the most superficial, is cause for rejection.

These errors must be caught before PCBs are assembled into devices or shipped to customers. Yet slight variations in appearance—whether due to subtle lighting contrasts, changes in perspective and orientation, or glare on metallic surfaces—can confuse an automated inspection system. Parts which are close together are difficult for a machine vision system to distinguish as independent components. Programming these inspections into a rules-based algorithm is time-consuming, prone to error, and challenging for a field engineer to maintain. Human inspectors, though capable of identifying these components, cannot meet the high-speed processing demands.

Solution

Cognex ViDi deep learning image analysis software offers a field-maintainable solution for PCB assembly inspection. The ViDi Blue-Locate tool learns to identify the components from images labeled with locations of each part type, building a reference model of each component within a single tool. This tool generalizes the distinguishing features of the parts based on their size, shape, and surface features and learns their normal appearance, as well as their general location on the board. The system is also optimized to work with images that are low-contrast or are poorly captured.

In production, ViDi Blue-Locate analyzes all the relevant areas of the board to locate and identify each component, despite changes in appearance. This solution is able to determine whether the components are present or absent and verifies that the correct component is being used. In this way, the tool can provide a reliable solution to automate complex PCB assembly inspection.

📍 Locate

CHOCOLATE
ASSEMBLY VERIFICATION

Identify, count, and verify chocolates based on their appearance for packaging and assembly verification using deep learning software
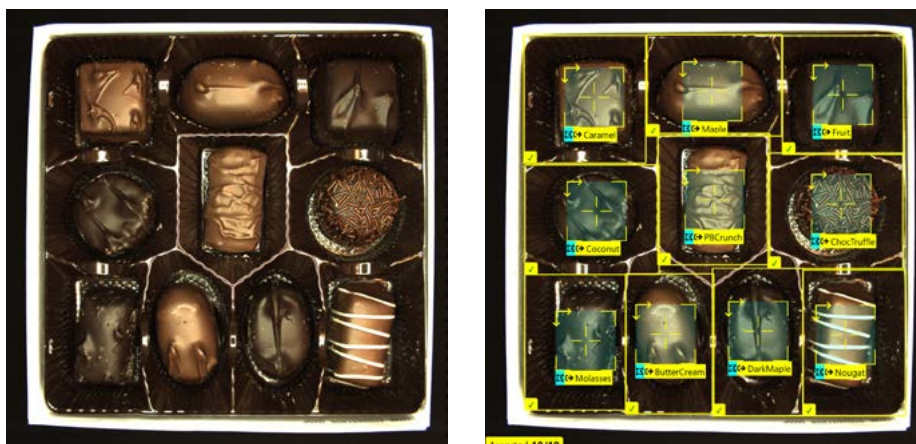
Problem

For certain food packaging applications, manufacturers must rely upon visual inspection to ensure the quality of the final assembly. Visual variations of food products can cause complications for an automated food and beverage inspection system. This is the case for chocolates, which arrive for packaging in differently configured boxes. The inspection system must successfully verify that each spot contains a piece of chocolate and that it is of the correct type.

Holiday-themed (i.e. Christmas or Valentine's Day) chocolate boxes present a particular challenge. The same chocolates may be present in the boxes, but their position may change based on the box's theme. The manufacturer must locate each chocolate and verify the correct type is in the correct position. Similarly, two chocolate boxes might use the same packaging (i.e. box of 6 chocolates) but be filled with different flavors (i.e. milk vs. dark chocolate selections). In this case, the manufacturer needs to count the chocolates and verify the correct chocolate selection is present.

Solution

Cognex ViDi uses deep learning image analysis software to automate the task of locating and identifying multiple features within a single image. Cognex ViDi can generalize the distinguishing features of various types of chocolate based on their size, shape, and surface features. With the ViDi Blue-Locate tool, a user can train the tool to locate each type of chocolate that will need to be found. Users can build a database of various types of chocolates for the Blue tool to find, which can then be used for packaging verification.

Once trained, the image can be split into different regions where the Blue-Locate tool will check for the presence of a chocolate as well as verify that it is of the correct type. Multiple configurations can also be created for situations where a single line may have variations in packaging. In this way, a user can automate the verification of chocolate packaging using just one tool.

📍 Locate

TRIM
FINAL ASSEMBLY INSPECTION

ViDi Red-Analyze Tool confirms the presence and placement of components on a confusing background

Problem

The various pieces of trim involved in final assembly verification introduce a high degree of complexity that challenges traditional machine vision inspections. Human inspectors verify that all parts, such as wire bands and metal housings, are present and correctly assembled. Subtle lighting variations make it difficult to tell whether the bands are in their correct housing. Human inspectors, though skilled at identifying wire bands, can be slow and inconsistent. Cognex ViDi uses deep learning image analysis to learn the finished appearance of a piece of trim and identify missing bands as accurately as a human inspector, but with the speed and reliability of an automated system.

Solution

Using the ViDi Red-Analyze Tool, a technician trains the system on "bad" images of trim where the wire is absent, as well as known "good" images where the wire is present, to create a reference model for a complete piece of trim. Using this model, Cognex ViDi identifies trim pieces with missing wire bands as anomalous and defective, failing them during final inspection.
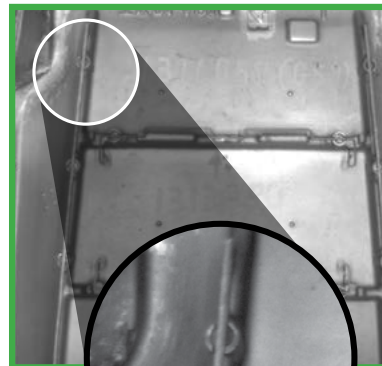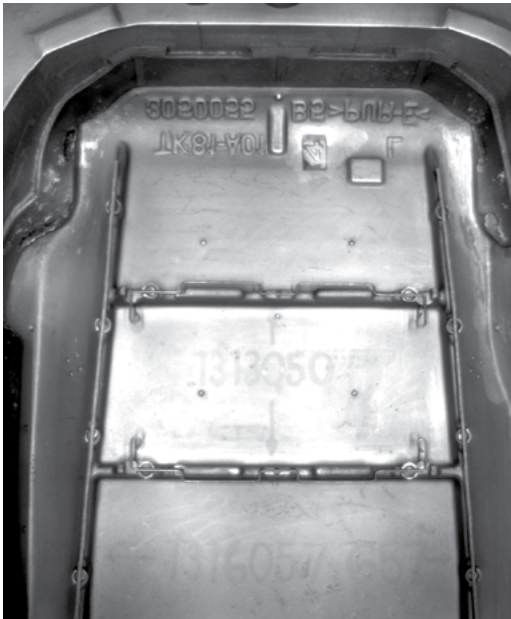
Wire present
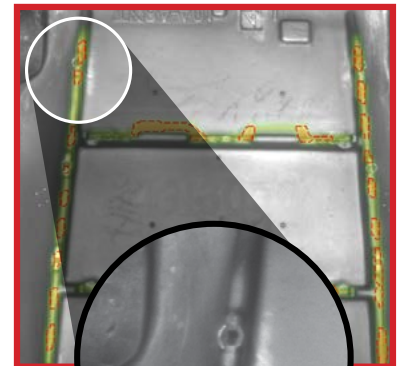
No wire

Analyze

COGNEX ViDi

Deep learning industrial image analysis

Cognex ViDi is the first deep learning image analysis software designed specifically for factory automation. 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, Cognex 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

Locate

ViDi Blue-Locate finds complex features and objects by learning from annotated images. Self-learning algorithms locate parts, count translucent glass medical vials on a tray, and perform assembly verification checks on kits and packages. To train the Blue-Locate tool, all you need to provide are images where the targeted features are marked. ViDi Blue-Locate also offers a reliable automated solution for assembly verification.

Segmentation & defect detection

Analyze

ViDi Red-Analyze is used to detect anomalies and aesthetic defects. Be it scratches on a decorated surface, incomplete or improper assemblies or even weaving problems in textiles; the red tool can identify all of these and many more problems simply by learning the normal appearance of an object including its significant but tolerable variations. The red tool is also used to segment specific regions such as defects or other areas of interest. Be it a specific foreign material on a medical fabric or the cutting zone on lace, the Red-Analyze tool can identify all of these regions of interest simply by learning the varying appearance of the targeted zone.

Object & scene classification

Classify

ViDi Green-Classify is used to classify an object or a complete scene. Be it the identification of products based on their packaging, the classification of welding seams or the separation of acceptable or inacceptable defects; the green tool learns to separate different classes based on a collection of labelled images. To train the Green-Classify tool, all you need to provide are images assigned to and labelled in accordance with the different classes.

Reads text & characters

Read

ViDi Blue-Read 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

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

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North America	+1 844-999-2469	Ireland	+44 121 29 65 163	China	+86 21 6208 1133	
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Germany	+49 721 958 8052	United Kingdom	+44 121 29 65 163	Vietnam	+84 2444 583358	**www.cognex.com**