# 3D SMART SENSORS IN VISION-GUIDED ROBOTIC SYSTEMS

## VISION-GUIDED 3D MACHINE VISION

# INTRODUCTION

## 3D smart sensors give the power of "sight" to robotic quality inspection systems.

**Robots On The Rise**

The use of industrial robots in mass production environments has many proven benefits. Most importantly, robots automate tasks that previously were done manually. Robots are able to work for extended periods of time with a high level of speed and repeatability, which significantly increases product quality and productivity while minimizing costs.

*Bluewrist Robotic Inspection System*

**Vision-Guided Robotic Systems**

A Vision-Guided Robot (VGR) System is a robot fitted with one or more machine vision sensors. Sensors guide the robot to move to a variable target position and then perform a predetermined function like picking objects from a bin and placing them in another location. VGR systems are rapidly transforming production processes by making robots highly adaptable and easy to implement, while dramatically reducing the cost and complexity previously associated with the design and setup of fixed robotic cells.

Vision-guided robotic technologies deliver **speed, repeatability,** and **flexibility** to meet rising production demand for high-quality manufactured goods.

# INDUSTRY APPLICATIONS

**3D vision-guided robots are revolutionizing traditionally manual industrial applications.**

### Pick & Place

Pick and place is very common in today's factory. In this application, robots have to pick up parts presented one at a time and place them in a preset order and location, even when the exact location and 3D orientation of the part is variable. By using 3D smart sensors with onboard software, an industrial robot can perform this task autonomously—something that could previously only be done by a skilled worker.

### Discrete Part Assembly & Inspection

In industries such as automotive, robots are mounted with 3D smart sensors in order to pick up and guide parts to critical locations for insertion (e.g., doors and windshields). VGR systems are also used in the inspection of finished assembly features such as verifying panel gap and flush tolerances.

If manual inspection and 2D scanning systems can't achieve the required results, what solution can?

**The answer: 3D smart sensors.**

# APPLICATION CHALLENGES

## 3D smart sensor technology solves the limitations of legacy 2D solutions.

### Object Recognition

For the majority of VGR applications, a 3D smart sensor is not only responsible for guiding the robot to its correct position, it also detects and inspects discrete objects and executes real-time control decisions based on the acquired data—all from inside the sensor.

### Object Reflectivity and Low Contrast

Object reflectivity and low contrast have typically tested the limits of 2D-based vision systems. The emergence of 3D scanning technologies, however, has provided robotic systems with the ability to identify and locate objects based on shape—enabling the reliable detection of objects with low contrast or complex geometries—especially in poor lighting conditions.

### 3D is The Difference-Maker

When a robot can "see" discrete objects in 3D at production speed, it allows the VGR system to perform its task without the need for custom tooling. This means that generic bins, racks and conveyor systems can be leverages with the robot adjusting dynamically to any variation in size or location. A 3D smart sensor's built-in measurement tools enables a robotic system to detect and manipulate objects of different geometries and sizes, contrasts and colors, and even touching and overlapping items. As a result, robot work cells are smarter and can support different products, short runs and quick changeovers.

## WHY 3D SMART SENSORS:

- Contrast invariant, ideal for inspecting low contrast objects

- Volumetric measurement provides shape and position related parameters

- Immunity to ambient light means it performs in variable lighting conditions

- Pre-calibrated to deliver measurements in standard units

- Built-in protocols to directly interoperate with robots

# HIGH SPEED, "SELF-AWARE" ROBOTS MADE POSSIBLE BY 3D SMART SENSORS

## 3D smart sensor technologies make robotic systems adaptable to their unique application environment.

**Random Bin Picking**

One of the main challenges in VGR today is random bin picking, which involves a robot equipped with a 3D sensor locating and picking randomly positioned parts from a bin. In the past, random bin picking was separated into stages. Parts were first isolated, then detected and retrieved, with dedicated systems for each stage.

**What's the Big Idea? Self-Aware Robots**

Now, 3D smart sensor technologies allow a robot to be "self-aware" and therefore react to its environment—dramatically speeding up the bin picking process. Robot self-awareness gives the sensor knowledge of kinematics, tool position, how to engage with the part, where the bin walls are located in relation to the sensor, and where the part is with six degrees of freedom. The most advanced 3D sensors can calculate all of these features and control robot motion directly.

# THE FUTURE OF VISION-GUIDED ROBOTIC SYSTEMS

**3D smart sensors will continue to drive the advancement of vision-guided robotic technologies.**

### More Companies Choosing VGR

As Vision-Guided robotic systems become more reliable and easier to use, these solutions are increasingly a cost-effective replacement for manual inspection, sorting and assembly. Many end users are finding the increased productivity and cost savings gained are substantial enough to warrant complete system upgrades.

### Mass Customization Driving VGR Demand

As demand for mass production grows globally, fast, flexible, error-proof assembly is the goal of many manufacturers. Applications where new product models are introduced frequently, where production runs are shorter, or where changeover is more common, will benefit the most from advanced VGR systems.

### New Markets for VGR

Industry insiders expect new markets to emerge for VGR. From agricultural applications with vision-guided robots working in the fields, harvesting, feeding, weeding and transporting produce and grain, to collaborative scenarios where robots are working alongside humans in manufacturing plants, or in logistics and packaging operations—the possibilities are endless.

## A 3D SMART SENSOR ADVANTAGE:

- Automates manual applications such as bin picking, pick and place, inspection and assembly

- Delivers higher speed and accuracy

- Improves quality and operator safety

- Minimizes cost to the user

# THE POWER OF MACHINES THAT SEE.

**3D smart sensors provide a faster, more precise and cost-effective solution to traditional 2D methods.**

### Easy-to-Use

Features such as web-browser driven point-and-click environment for rapid configuration, built-in measurement tools and rich I/O for communicating results make it easy for factory technicians to get the results they need.

### Low Latency

Real-time measurement capabilities minimize lag between data acquisition to decision outputs, which means factories can consistently meet their throughput targets.

### Built-In Measurement Tools

Built-in application-specific tools provide a drag and drop environment with full 3D visualization to support part detection and measurement and deliver highly accurate and repeatable results.

### Customizable

Sensor customization allows users to develop and embed their own custom measurement tools directly into the Firmware itself—with the same functionality and ease-of-use as built-in native tools.

### FactorySmart®

Today's 3D smart sensors connect seamlessly with networks to communicate results, display diagnostics and statistics over web browsers, access upgrades over Internet, and interface with factory equipment.

## "SEE" BETTER WITH 3D:

- Automatic exposure accurately measures regardless of color

- Compact sensors easily mount on robot end effectors

- Immune to robot movement and vibration

- Direct robot communication for closed loop guidance

# IT'S BETTER TO BE SMART
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**ABOUT LMI TECHNOLOGIES**

ADVANCING 3D MEASUREMENT WITH SMART SENSOR TECHNOLOGY

At LMI Technologies we work to advance 3D measurement with smart sensor technology. Our award-winning, FactorySmart® sensors improve the quality and efficiency of factory production by providing fast, accurate, reliable inspection solutions that leverage smart 3D technologies. Unlike contact based measurement or 2D vision, our products remove complexity and dramatically reduce implementation cost.

To learn more about how LMI's inspection solutions can benefit your business, we invite you to contact us at contact@lmi3d.com or visit us at www.lmi3d.com to explore the possibilities of smart 3D technology.

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