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The defining features of a 3D smart sensor

It seems everything is becoming smart these days – particularly in the manufacturing environment. But with the ever-increasing use of the term, it can sometimes be unclear what it really means. To help understand what smart means when referring to 3D sensors, MEPCA asked LMI Technologies to explain the key features offered by the technology.

Within the modern manufacturing environment, 3D smart sensors are used to improve production based on the principles of interconnectivity in Industry 4.0.

Production engineers use 3D smart sensors to increase productivity (build more widgets), eliminate manual error or inconsistency (creating better products), minimise waste (optimising input), and enable greater automation (using robots).

With that in mind, let's take a closer look at the features that define 3D smart sensors.

Figure 1

All-in-one design

All-in-one design is one of the key principles of 3D smart sensor technology. All-in-one means that everything is built-in to the sensor head itself – including scan, measurement, and control capability, as shown in Figure 1.

Where standard sensors require external controllers or PCs to process data, apply measurement tools, and communicate downstream control decisions, smart sensors offer this entire range of functionality within a single device. Plus, all-in-one design lowers total system cost and complexity on the production floor.

Ease-of-use

3D smart sensors make it easy for engineers to set up their systems and get results. Examples of this include a web-browser driven, point-and-click environment for rapid control and configuration; and rich I/O for communicating results to factory equipment.

Onboard data processing

Smart devices provide real-time, onboard measurement capabilities that minimise the lag between scan data acquisition and decision outputs, which means engineers can inspect a greater number of targets, and faster, without sacrificing measurement reliability or repeatability.

Interconnectivity

Smart design is about interconnectivity, which is one of the pillars of Industry 4.0. A 3D smart sensor achieves this by seamlessly connecting with factory infrastructure to report measurement results, allow the monitoring of trends from a web browser, the upgrade of sensor firmware over the internet, and to network with other factory machinery to exchange or combine data for the best optimisation results.

A 3D smart sensor has the flexibility to simultaneously output data and decisions to a wide variety of I/O. It also allows engineers to easily communicate with existing hardware using PLCs and robot controllers via Modbus TCP, EtherNet/IP, Profinet or custom ASCII strings.

Factory pre-calibrated

3D smart sensors are pre-calibrated by the manufacturer to output data in engineering units (as verified by a traceable calibration artefact). Without this ability, the sensor cannot perform dimensional analysis (metrology). And because a smart sensor is pre-calibrated, the user can power it up and immediately start scanning to generate optimal results – right out of the box – with no extra time, cost, or effort required.

Built-In 3D measurement tools

Standard sensors require you to purchase additional software (or write your own) to carry out measurement on your scan data. The dumb sensor transfers data to a PC where your application runs. This is not scalable in a factory environment where hundreds of sensors are deployed.

A 3D smart sensor, on the other hand, has built-in measurement tools that provide a drag-and-drop environment with full 3D visualisation and allows the user to add

measurements based on the specific feature that needs to be inspected. The tools execute on the sensor, and only pass/fail results are reported to the factory, effectively reducing the tremendous amount of 3D raw data down to a small decision set. This makes life much easier for production engineers, more cost-effective and leads to the simpler overall management of sensor technology.

Support for multi-sensor networking

The modern production line demands high-resolution scanning of individual parts and assemblies. Building these high-density scans of any single part often requires many sensors. Unfortunately, standard sensors do not normally provide an ability to align and stitch 3D data to build larger models.

3D smart sensors, on the other hand, offer built-in support for assigning multiple sensors in a flexible layout to create a single, dense 3D point cloud ready for measurement. This is very important in industrial applications where the target is larger than a single sensor's field of view, or when the engineer needs to generate a 360° scan of an object (e.g. in log scanning).

Customisable

Customisation of 3D smart sensors allows advanced users to develop and embed their own measurement algorithms directly into a sensor's firmware itself – delivering the same functionality and ease-of-use as native tools. This gives process engineers greater control over their unique inspection challenges to achieve the best possible results.

Acceleration enabled

Both PC-based and dedicated hardware sensor acceleration allows users to speed up inspection cycle times by adding more data-processing power to their systems. In applications where both high-data density and high-speed are required, acceleration can make all the difference.

Robot-friendly

3D smart sensors offer built-in support to work with robots directly and enable a fully functional multi-model production line to work at a much faster, more efficient rate than traditional single-model assembly lines.

Engineers can easily mount a 3D smart sensor on a robot end-effector and use built-in hand-eye calibration to determine the sensor coordinate transformation to robot coordinates. This allows the position and orientation of an object detected by the sensor to be communicated directly to the robot. Critical X-Y-Z and angle information is communicated to the robot for use in vision guidance, inspection, and pick-and-place applications.

So, in conclusion, 3D smart sensor design offers a powerful machine vision solution for modern industrial manufacturing. This approach provides an adaptive platform that connects to factory equipment to achieve the results engineers need for improved quality and productivity.

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