

Color sensors can differentiate between cardboard boxes

On the right track in the Milky Way

A dairy producer uses a vision sensor to route the increasing numbers of different cardboard boxes in the final packaging area before they are palletized. In this case, color is used as a differentiating feature to reliably prevent incorrect sorting and to eliminate manual post-sorting.

With its Bärenmarke, Glücksklee and various-export products the Hochwald Nahrungsmittel plants in Polling, Germany, took the right track many years ago to ensure its global success. It is also important to efficiently set the right track when it comes to reliably sorting cardboard boxes containing condensed milk in the packaging station according to the destination country. In the Weiding plant, about 180 employees manually process approximately 200 million liters of milk to produce condensed milk, milk powder specialties and fresh products. A large proportion of the condensed milk is destined for export and is filled in 80, 170, 340 and 410-gram cans on five production lines. The cans that are then packed in cardboard boxes - in either one, two or four layers - move along a common conveyor belt to the central box distribution station. There, before palletizing, the boxes must be precisely sorted and distributed across five buffer tracks. This process means that each individual package must be absolutely clearly identified. They are less prone to damage or soiling. An additional factor is that with front loading of the channel, the identification of a barcode is significantly more time-consuming because of the distance to the scanner and the time taken for aiming.

Initially, the different heights and/or lengths of the cardboard boxes were identified using two light barriers located one after the other. However, with the growing number of different boxes – approximately 100 different versions in 18 sizes – it became increasingly more difficult to sort them by just using their dimensions as criteria. „In order to reliably distribute the cardboard boxes to the correct buffer tracks without having to manually intervene, we searched



Der Farbflächensensor Simatic MV220 integriert sämtliche Komponenten und Funktionalitäten für die elektronische Bildverarbeitung – von der Kamera über digitale Ein- und Ausgänge bis zur laserbasierten Ausrichthilfe.

The Simatic MV220 color sensor integrates all of the components and functions for electronic image processing – from the camera through digital inputs and outputs up to the laser-based alignment function.

for a system that was the simplest to set up and with the most favorable price that could additionally identify the boxes from their color as they passed on the conveyor belt“, explained Markus Werkstetter, head of the electrical engineering department with Hochwald.

Simple and compact

After several alternatives were compared, Vision Sensor Simatic MV220 from Siemens Automation and Drives (A&D) was selected. This innovative color sensor is the synthesis of high performance image processing technology and a simple, compact sensor system. It has degree of protection IP 65 and is therefore predestined for use in rugged industrial environments.

All of the elements required to simply differentiate between the colors are accommodated in an enclosure with the dimensions 113 x 35 x 90 millimeters. The first element is a digital camera with CMOS chip to evaluate the color images. It has a resolution of 640 x 480 pixels and has a continually adjustable lens with a variable image field from 40 x 30 to 200 x 150

millimeters (for object distances of between 50 and 250 millimeters). A white light illumination system, a laser-based alignment function as well as a simple operator control and display unit complement this. The control and display unit has keys, display and LED lamps. The integrated digital inputs and outputs are fed, just like the power supply, through M12 connectors. The vision sensor can „learn“ up to 16 different test models. It saves these and then in the automatic mode can reliably identify either stationary or moving objects.

Color identification without programming

To start, the system must be manually aligned. Two laser points that can be projected in the image window support this procedure. Templates supplied with the device help to calibrate the sensor – menu-prompted - to the prevailing ambient conditions. Learning specific test tasks is then reduced to placing one or several good objects in front of the device. Test operation can be started once the sensor



Five production lines output up to 40 cardboard boxes with different sizes and colors per minute that are reliably identified in the cardboard box distribution station and must be correctly routed.

minute pass through the station to be identified. The Vision Sensor MV220 is designed for a maximum of 30 exposures per second - which means, that as far this is concerned, it won't reach its limits any time fast.

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has been taught all of the models. To identify the color of a cardboard box or a printed logo, Hochwald uses the „matching“ test type for an average test density of 64 colors (16 and 2048 colors are also possible). A higher-level control gives the device the color pattern to be identified (model). „For our purpose, it is presently sufficient to just be able to identify one single color pattern and to link the result with the subsequent geometry scan“, explained Markus Werkstetter. From this information, the higher-level control - a Simatic S7-300 with CPU 315-2 DP – can determine the shape and color without any errors and therefore determine the destination of the cardboard box. The control is connected through the digital inputs and outputs of the vision sensor and distributed ET 200 I/O at the conveyor belt via Profibus.

TP 170B Touch Panel is used to locally control and monitor the box distributionstation. In the future, it is planned to network the autonomous control systems of the filling equipment and the cardboard box distribution station to make the associated operations even more transparent. Up until then, Hochwald checks the cardboard boxes as they pass by, whereby the exact instant in time that the image is recorded is triggered by a digital input. Each of the five upstream production lines has a capacity of between five and twelve cardboard boxes per minute. This results in the theoretical yield of one cardboard box per second. In practice, through clever production planning, it is ensured that as few cardboard boxes as possible are used that have the same shape and color. This means that a maximum of approx. 40 cardboard boxes per



The color of the cardboard box to be identified is entered on a Simatic TP 170B Touch Panel – from up to 16 previously learned patterns

Lights in the dark

Where there is much light, the shadows are deepest“. Goethe had already realized the duality in our world. In fact, in addition to writing poetry (and governing) he also involved himself with the science of colors. Back in the 18th century, he of course didn't know about color sensors – and their technical limits. Often, the sensitivity of conventional color sensors is not adequate for dark color tones or poorly reflecting surfaces.

Typical applications areas for the rugged device, which operate with switching fre-

quencies up to 1.5 kHz, include quality monitoring (for example, for internal fittings in vehicle production), but also in assembly, handling and packaging technology.

The operator control and parameterizing is extremely simple in-line with that requirement practice: The three-sensor output can be directly set and parameterized at the device using a teach-in technique. Up to ten tolerance stages can be defined and various evaluation algorithms selected.

And the matching software is even more user friendly and up to 20 reference values can be defined. In this case, for different test tasks, there are absolutely no re-equipping times



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