Dot by Dot to the Goal

Camera Systems in the intraplant Logistics

In the food industry, the production automation has come a long way. Especially regarding the outer packaging, strict customer requirements demand new approaches from the viewpoint of the manufacturers. If, for example, EAN codes on the outer packaging are not allowed to be used for the identification and control of the production facilities – since they would cause problems with the merchandise management system of the customers – matrix codes represent a convenient alternative to bar codes.

Many customers specify a two-dimensional data matrix code, which enables a more convenient identification of the packaged goods also at the manufacturer itself.

With about 1600 employees, Zentis in Aachen is not only one of the largest jam and marmalade producers in Germany, but also supplies cereals, raw marzipan, candy bars and marzipan eggs to retailers and processing companies. At the plant II in Aachen-Eilendorf, 190 employees make approximately 20,000 tons of candy per year.

To be able to definitively identify the origin and course of the products within the production as well as for retracing purposes, the intraplant logistics was reorganized at the beginning of 2005. In doing so, a special solution was called for at the end of the production lines, where the goods are packaged in automatically erected covering boxes and conveyed via various tracks to the "terminuses" – the palletizing stations. For the reliable identification of the cartons prior to the discharging to the proper station, the manufacturer decided on vision sensors Simatic VS130-2 from Siemens Automation & Drives.

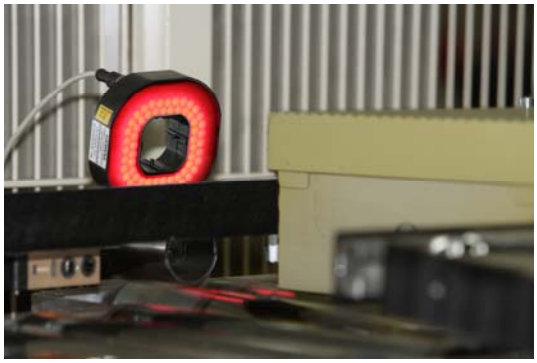
"Many of our customer, in particular discounters, demand nowadays that the outer packaging no longer is marked with conventional EAN or UPC codes, in order to avoid potential conflicts with the codes of the respective merchandise management system and corresponding problems at their scanner checkouts," explains Achim Minten, who as European maintenance manager at Zentis' plant II is responsible for the automation. "We therefore print a data matrix code onto the cartons, which is read/decoded and analyzed via camera systems."

This not only meets the requirements of the retail partners, but offers functional advantages as well, since the data matrix code (DMC) can very conveniently be adjusted in shape, content and size to the individual needs. Thus, at Zentis, the production line, palletizing station assignment and article number are accommodated in a dot matrix measuring just 12 x 12 mm.

Error-free Reading at 0.7 m/s

The decision for employing the vision sensors VS130-2 to detect the cartons prior to them being discharged to the terminal stations was backed by three major reasons: the convincing performance of the camera system at high throughput speeds, the support from Siemens in the development of an industry-suitable solution and its time-saving and cost-saving integration concerning compatibility with existing automation technology.

During the planning stage, special attention was paid to the interplay between DMC encoding and automatic reading station, since the system had to operate error-free at speeds of up to 0.7 m/s. On account of this basic requirement alone, several competitive systems were ruled out from the start, since they only could read the matrix code while it was stationary.



Optimally in the picture: The vision sensor Simatic VS130-2 brings along the required illumination.

View of the production jobs: Process and analysis are visualized via Simatic WinCC

The vision sensor VS130-2 also convinced with further performance advantages. Thus, the system detects DMCs on the most varied surfaces and – depending on the lens – offers variable reading distances from 75 to 3000 mm.
Add to this the availability of a VS130-2 version with C or CS mount sensor head, which opened up a flexible solution that passed the restrictive guidelines of the International Food Standards (IFS) with regard to the use of glass in the food production. In this case, the lens of the camera is covered by a protective housing with a front shield made of unbreakable plastic. The image field of the lens used with the VS130-2 can optimally be adjusted to the respective application.
Zentis has always preferred to employ automation technology from Siemens, and it has again proven itself: “We know most of the systems very well, and the required know-how can usually be attained with a single training course. The integrated Siemens approach with regard to configuration, data management and communication makes all areas of the work easier for our engineering department – from the setup and changes up to the quick error correction even without external help.”
The conveyor operation is controlled by a highly available Simatic S7-400H controller and visualized via a WinCC user interface.

Besides the data acquired by the camera, a status count is also displayed here, i.e. how many cartons of a palletizing job have already been detected. In doing so, the counting criteria can be user-defined.

“With the new system, we could improve our logistics and quality control equally, since a retracing of the products down to the individual machine and corresponding batch is possible via the DMC marking. Should complaints arise, the error cause and the path of the affected products can thus quickly be reconstructed.” Before the introduction of the new system, the carton data had to be acquired by hand and written down on a pallet label; for an integrated data acquisition, this was associated with correspondingly more work.

Perfect Interplay

The success of the automatic reading with the DMC encoding of 22 x 22 matrix dots employed at Zentis depends on the perfect interplay between all components. After all, the edge length of the dots amounts to only 0.54 mm. The Simatic VS130-2 compensates for all deviations of the DMC that might occur during its printing.

The CCD sensor of the camera with a resolution of 640 x 480 pixels provides a display area that is sufficient to optimally acquire the data matrix code to be read in spite of system-dependent fluctuations such as positioning and trigger inaccuracies or print position. The lens employed and the automatic adaptation of the read algorithms deliver a reliable read result even with the sharpness and size fluctuations.

The best possible illumination of the DMC is ensured by a ring light. The ring light is controlled by the analysis unit of the VS130-2, synchronous to the image taking. This enables an exposure time at maximum light intensity with a duration from 20 µs to 10 ms. The image taking and the illumination are triggered by a light barrier.
“A significant advantage of the image processing system is that the analysis device possesses Profibus as well as Ethernet interfaces,” adds Achim Minten. With them, typical interface problems caused by additional interface boxes or converters are ruled out from the beginning. Furthermore, the configuration technician can directly access the analysis device from any networked terminal for changing the parameterization or for calling and activating one of the 15 storable parameter records. For this, the analysis device receives a fixed IP address on the network. It goes without saying that the access can be password-protected.

Increased Reliability and Transparency in the Logistics

A special feature of the Simatic VS130-2 is also that it does not have to be programmed or parameterized like a conventional image processing system, since it automatically configures the illumination and learns the detection algorithms without user instructions by means of a code pattern. This self-parameterization can take place while the conveyor is running under real operating conditions, and either be started on-site at the device or remote-controlled via the integrated, Web-based user interface. It also activates automatically, if a read process fails while in operation. Thus, the system offers maximum reading reliability independent of operator inputs.
The VS130-2 is designed for the analysis of data matrix codes according to the ECC 200 (Error Correcting Code) and thus is reading its latest and most reliable version. Besides the model employed at Zentis, larger codes with up to 2334 ASCII characters (7-Bit), 1558 expanded ASCII characters (8-Bit) or 3116 digits are possible as well. Data matrix codes according to ECC 200 ensure a high reading reliability by means of the Reed-Solomon error correction: even if 25% of the code are destroyed, for example due to smearing of the print image, the data content remains reconstructible.
At the plant II in Aachen-Eilendorf, Zentis currently employs four vision sensors Simatic VS130-2, which have been operating to the full satisfaction of the customer since their commissioning. “The system optimally covers our requirements,” emphasizes Achim Minten. “For the future, we could envision to also read EAN codes with it and track our pallets in this way.”
Already planned is the use of additional systems in the area of the four carton erectors. A DMC will then be printed onto the cardboard blanks according to the requirements of the production lines. This DMC is then automatically read and triggers the distribution of the erected cartons to the respective production line. This increases the productivity and reduces the risk of errors.

One-dimensional or two-dimensional – A Question of the Application

Simple bar codes – such as the European-standardized EAN code (European Article Number) or the IBM-developed UPC (Universal Product Code) – only require one dimension for the analysis (e.g. a laser line), which is why they are also called 1D codes. They contain a standardized country and manufacturer identification, followed by a manufacturer-specific article number and a check character. Represented as a series of digits and a bar code, they can be analyzed by scanner checkouts.
If further information has to be encoded beyond this or no bar codes are to be used, 2D codes are the right solution. They contain the information in a pattern made up of square dots and require two dimensions (length and width) for the analysis. Their big advantage: within the scope of their standardization, they offer the possibility for a customized formatting. Besides pure pixel graphics, as employed for example by the data matrix code, mixed forms such as stacked codes (several bar codes stacked on top of each other) or RSS codes (Reduced Space Symbologies, with linear and matrix portions) are defined today, which enable the continued use of existing 1D reading infrastructures. The latest generation of the portrayed vision sensors from Siemens can also analyze such 2D codes.

www.siemens.com/simatic-sensors/mv

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