

inspect

3/2021 · June 2021

UNOFFICIAL ENGLISH TRANSLATION

The original article was published in German in inspect, a trade magazine published in Germany. Prepared for CRETEC. The German original remains the reference.



Flawless biscuit production

Historic hardware, branch and contact information is retained. The original wording about aperture values and sharpness is translated as printed; this is not independent validation of those technical claims. Original publisher artwork, logos and advertisements are retained in their original language.

Flawless biscuit production

Quality assurance in food production with deep learning

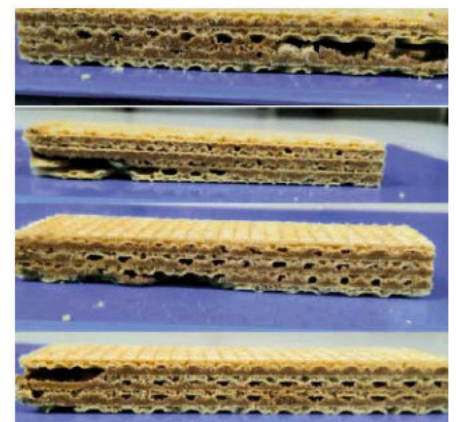
The competitive advantage of defect-free food requires consistent quality assurance across the entire value chain. Intelligent lighting with deep-learning-supported machine vision ensures this and also enables flexible production processes. At a well-known biscuit manufacturer, the inspection system demonstrates its performance.

Consistently flawless food-production quality guarantees long-term customer loyalty and prevents expensive recalls that damage a company's reputation. On wide conveyors in the confectionery and baking industry, large inspection fields containing many small objects have to be inspected quickly, simultaneously and precisely, often for numerous features. These processes require complete vision solutions with

extensive hardware and software expertise, including the benefits of deep-learning algorithms. Hygienic design must also meet the industry's required regulations and standards. For this demanding environment of high-quality inspection, Cretec Cybernetics offers extensive experience and particularly efficient, scalable complete solutions.

A consistent platform design with

modular hardware and software ensures lasting system flexibility and accelerates project development and installation. The complete application's easily managed, scalable structure is particularly important. This also applies to integrating deep learning into quality and conformity inspection and the associated data analyses as a value chain extending into corporate communication. It allows the user to install further



▲ Wafer inspection criteria include area and height, missing or incorrect filling areas, completeness of the individual layers, biscuit colour gradients, material inclusions and much more.

◀ The quality-assurance system includes all required components - eight cameras, lighting and a 3D system - in an application-specific hygienic design.



▲ 1,500 biscuits per minute must be inspected for many features and sorted into pass/fail categories.

efficient vision applications economically and transfer know-how throughout the company.

Homogeneous, intelligent illumination

For large inspection fields, the company offers a broad portfolio of modular, intelligently controlled LED lighting systems. Modules in variable,

individual sizes, ranging from borderless backlighting to homogeneous reflected illumination, ensure technologically and economically efficient vision solutions, even for very complex automated quality-assurance requirements.

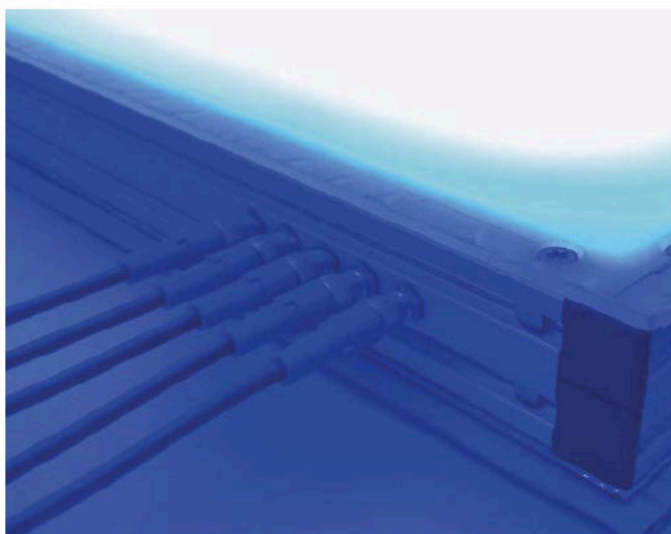
LED modules are suitable for harsh environments and the hygienic requirements of the food and pharmaceutical industries. Each

Company in detail

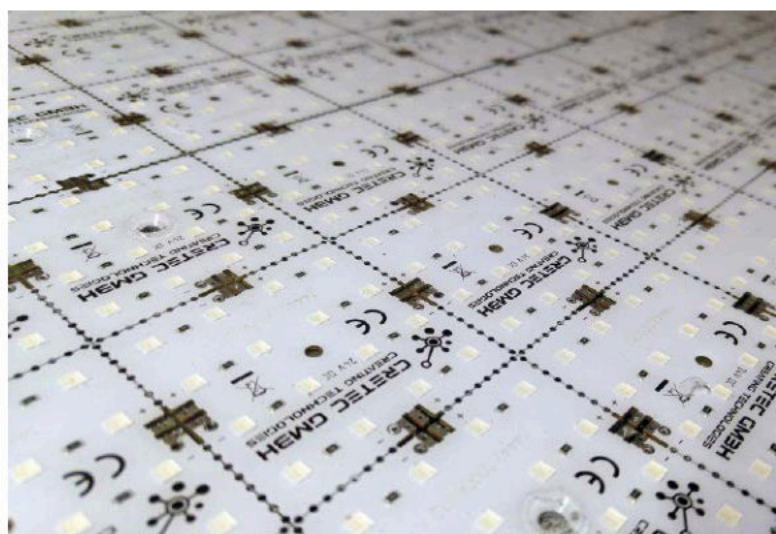
Cretec Cybernetics GmbH

The company based in Büdingen, Hesse, has branches in Barcelona, Spain, and Istanbul, Turkey. It develops, manufactures and sells industrial machine-vision modules and complete solutions, code-reading systems, intelligent LED lighting and cobot/robot vision. This includes networked digital communication from OPC UA to the integrated IOTA communication protocol. Compact construction, powerful hardware and software, robustness in harsh industrial environments and, above all, very simple operation characterise the solutions. The product portfolio is complemented by efficient expertise in industry-specific applications with short development times.

application has precisely the right light. Modules can be combined into any geometric format, such as bar lighting for conveyor applications or other large-area arrangements. Available illuminated surfaces range from smaller than 50 mm x 50 mm to square metres. Basic modules are available in all lighting colours for continuous or strobed operation. The in-house LED circuit boards carry white, red, green, blue, IR, UV, RGB or RGBW LEDs. Lights are calibrated at the factory and need no manual recalibration when replaced in an application. Lighting and connectors have at least IP65 protection against water jets, optionally up to IP67



▲ Depending on module size, power supply and external lighting control use several four-pin M8 connectors with IP65 to IP67 protection.



▲ Individual LED lighting boards can be assembled in any geometric format to create large-area lighting modules with homogeneous, intelligent lighting control.



Large-area lighting modules with four-colour LEDs in strobe, colour-change or daylight mode enable a wide range of industrial machine-vision applications.

protection against immersion. Openings in the centre of the light accommodate the camera and lens. Application-specific hygienic designs of the lighting modules are also available.

Intelligent control of coloured LED light (RGB/RGBW) and image processing using tone mapping can greatly increase reliable recognition of structures in many cases. With four-colour LEDs, several different colour exposures of a product can be captured rapidly in succession in strobe mode, allowing complex product features to be detected precisely using only one camera. Homogeneous large-area light can minimise the negative effects of reflective surfaces. All lighting parameters can be stored as complete recipes in the vision software.

Compared with continuous lighting

and therefore larger aperture values, strobe lighting with substantially more light permits smaller aperture values with considerably greater sharpness. The short flash duration readily permits operation at a nominal current 300% higher, enormously increasing available illuminance.

Enjoyment in flawless quality

Enjoying delicious baked goods is an experience involving every sense: touch, hearing, taste, smell and sight. How much we eat with our eyes is evident, for example, in the direct sensory connection with the browning of biscuits. Whatever the variety, customers immediately associate the appearance of the baked product with many impressions: crisp, tasty, fragrant and many others. In quality control, perfect lighting allows machine vision to distinguish very subtle differences among the many

features inspected.

Inspection criteria include correct area and height, surface embossing, edge condition, missing or incorrect filling areas, completeness of individual layers, corner shape, absence of spots, colour gradients in the biscuit, foreign material inclusions, damage, foreign bodies in the dough, surface contamination and many more. The baked goods' length, width and height are checked to an accuracy of 0.1 mm; their volume is also inspected.

On the wide conveyor of a European confectionery manufacturer, for example, 1,500 biscuits per minute in 33 rows must be inspected with absolute precision before subsequent production steps. Fully automated production on a continuously moving wide conveyor is very complex. Essential quality control must therefore detect many additional

process-related features reliably. Filled wafers on the belt must be free from contact, overlap, joining, incorrect alignment and many other conditions that could disrupt later processing. Eight cameras on each side inspect every piece for numerous quality features.

A high-performance industrial PC handles the enormous associated data stream and the computing power needed for real-time analysis and display. Under the current cooperation agreement, Siemens supplies Cretec Cybernetics with its latest industrial PC, equipped with an Intel Core i9 processor and a powerful graphics card. This latest-generation processor, with a new architecture and ten cores, offers very high multicore performance. It enables parallel data processing with real-time analysis and graphical display in complex vision tasks, reliably supporting demanding AI deep learning as well.

Only when all wafers are perfect do they receive the final chocolate coating, followed by another defect inspection. This high-quality inspection reduces rejects, prevents defect-related production slowdowns and avoids expensive stoppages of ongoing production.

Deep learning extends the range of applications

To improve quality assurance's detection capabilities continuously and automatically through self-learning, additional artificial-intelligence (deep-learning) algorithms are used for selected features. Conventional machine vision quickly reaches the limits of feasibility when detecting very complex features. Programming defect-free inspection then requires considerable effort from specialists. Deep learning can offer many advantages here. To begin teaching one of the defects to be detected, around 50 object images may already be enough. Users can then train feature detection themselves through a simple interface. They only need to sort images from the continuously recorded vision documentation into pass/fail categories for further deep learning.

Despite the initially higher costs of deep learning, AI-based inspection can pay for itself quickly during operation. Where even the human eye has difficulty recognising a defect, AI makes the assessment much more reliable. Its refined detection capabilities also identify emerging



“Industrial artificial intelligence allows us to create an additional powerful toolset that efficiently complements our conventional machine vision. We can now train additional defect features, just as we would teach an employee - but with absolutely consistent performance, independent of how they feel on a given day.”

Alexander Trebing
Managing director, Cretec Cybernetics GmbH

changes in individual features outside the normal pass/fail range at an early stage. Such capabilities are important for intervening early to optimise the complete process control.

The powerful industrial vision system in food production includes all required components - eight cameras on each of the left and right sides, intelligent large-area lighting, four 3D systems, a high-performance industrial PC for analysis and

communication, and more - in an application-specific hygienic design. Installed directly above the conveyor, it guarantees smooth production at the highest quality. Many features are continuously inspected and documented, and the baked goods are sorted into pass/fail categories. Many results can also be used directly as a data stream, with timely feedback during production enabling further optimisation.

The hygienically encapsulated lighting module in a stainless-steel housing provides optimised homogeneous light across the entire conveyor width, for example 1,500 mm x 800 mm. It forms the basis for extremely precise, absolutely reliable machine vision.

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