

LVT LEBENSMITTEL Industrie

3/2021 · March 2021

UNOFFICIAL ENGLISH TRANSLATION

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



Flawless biscuit production

Historical technical and warranty claims are retained. The source's statements about aperture values and sharpness are translated as printed, without independent technical validation. Original publisher artwork, logos and advertisements are retained in their original language.

Flawless biscuit production

Intelligent large-area LED lighting

The competitive advantage of flawless food requires consistent quality assurance at the highest level. Optimised lighting and intelligent light control ensure reliable operation and flexibility in industrial machine vision.

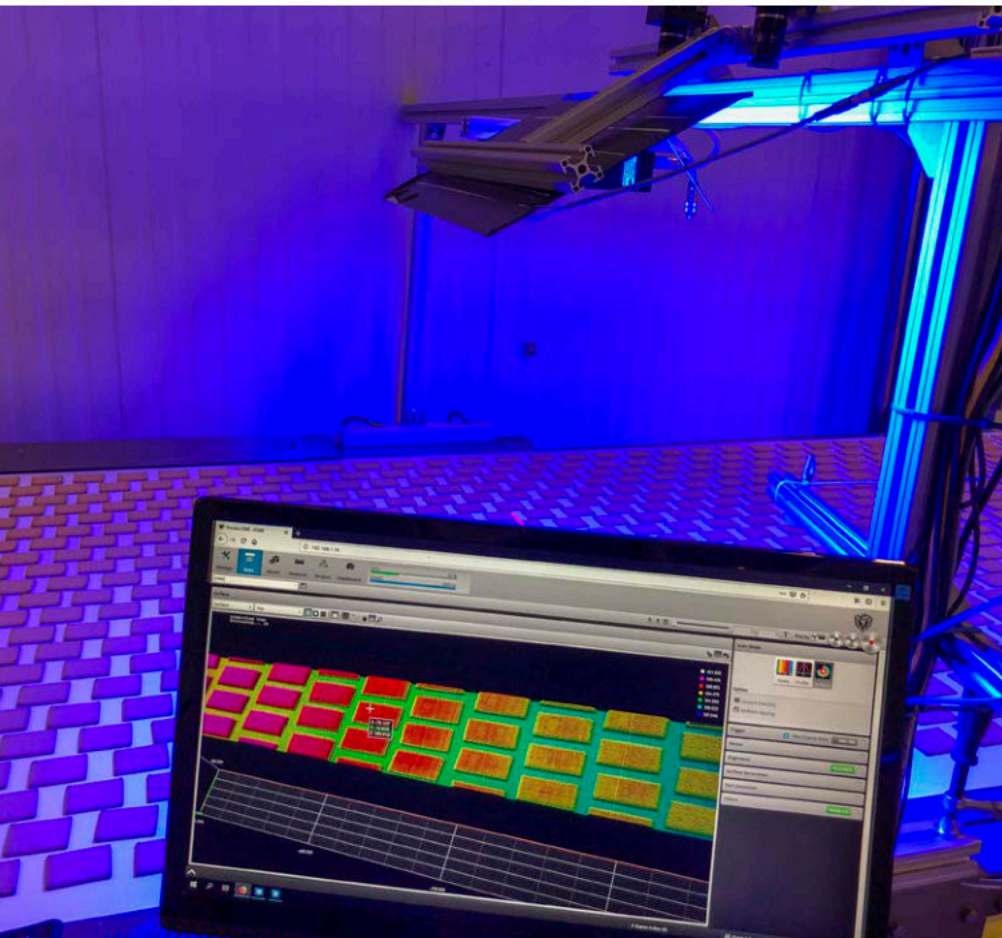


Figure 1 | Designing the complex vision system for biscuit production involves capturing many relevant inspection functions. The hygienically encapsulated lighting module delivers the same illumination characteristics in the implemented solution.

Consistently perfect biscuit quality guarantees long-term customer loyalty and prevents expensive recalls that damage reputation. Large inspection fields often have to be handled on wide conveyors in the confectionery and baking industry.

Machine-vision quality assurance requires much more extensive hardware and software expertise in lighting technology. Hygienic design must meet the industry's required regulations and standards. On small inspection fields, covers or high light

intensity can more easily prevent interference such as daylight. Conventional methods would require substantial effort over large areas, severely restricting flexible inspection of different objects arranged across a wide field.

Consistently modular technology in hardware and software accelerates complex projects through scalability. Demanding industrial vision applications are solved by combining powerful LED lighting with intelligent, universal light

control.

Homogeneous large-area illumination

For extensive inspection fields, Cretec offers a broad portfolio of large-area, modular LED lighting systems with intelligent control. Modules in variable and individual sizes range from borderless backlighting to homogeneous reflected illumination, providing economical and technologically efficient solutions even for very complex, fully automated quality inspection. Besides optimised application-specific lighting, the company provides the complete vision solution, from feasibility studies and installation to dependable support.

Confectionery and baked goods must be illuminated so that critical, complex features can be detected precisely with clear contrast. This requires lighting expertise and application experience: how light travels from source to object, how it is reflected or scattered, and how the lens forms a high-quality image on the camera sensor.

As in professional photography, the Hesse-based company uses luminance as its basis for illumination. It describes the brightness of light from emitting surfaces and precisely characterises homogeneous light emission across the entire illuminated area. This matters greatly for difficult objects whose shape and reflective properties, such as applied glazes, impose demanding requirements. For fast-moving objects requiring intense illumination, their centres must not be overexposed. Maximum borderless uniformity is essential for consistently clear vision results.

Broad spectral range for feature extraction

Cretec's lighting modules are developed for industrial environments, including harsh conditions and the hygiene requirements of food processing and pharmaceuticals. Every application

has precisely the right light. Basic LED modules can be combined into any geometric format, including bar lighting for conveyors and other large-area arrangements.

Illuminated areas range from 50 mm × 50 mm to 6,000 mm × 6,000 mm. All lighting colours are available as basic modules for continuous or strobed operation. In-house LED boards carry white, red, green, blue, IR, UV, RGB or RGBW LEDs.

In backlighting modules, the spacing of the dimmable LEDs relative to each other and to a special diffuser is chosen to produce an optimised, borderless and homogeneous field. Openings for optics can be incorporated so that vision cameras sit behind the lighting and look through it. The lights are calibrated at the factory and require no manual recalibration when replaced in an application. Growing demand for large-area lighting spans many industries, including automotive manufacturing, surface and coating technology, large packaging inspection areas and wide conveyors in automated food processing.

Lighting and connectors have at least IP65 protection against water jets, optionally up to IP67 protection against immersion. Central openings accommodate the lens and camera. Application-specific hygienic designs are available as an option.

Versatile intelligent light control

External control of the LED modules provides a wide range of individual adjustments. Separating grayscale brightness values can produce higher-contrast images of multicoloured objects. Intelligent control of coloured LED light (RGB/RGBW) and image processing with tone mapping can greatly improve reliable structure recognition. Four-colour LEDs allow



Figure 2 | 4,200 biscuits per minute must be inspected very precisely for many quality features and classified as pass or fail.

several different colour exposures in rapid succession, precisely detecting complex features with just one camera.

Homogeneous large-area light is also important for minimising the negative effects of reflective surfaces. Lighting parameters for product variants are stored as complete recipes in the vision software. White light with adjustable colour temperature enables further applications. Strobe operation provides many advantages for demanding tasks, particularly high cycle rates or fast conveyors. Synchronised with the camera in the microsecond range, it effectively freezes objects and captures sharper images. Compared with continuous lighting and larger aperture values, potentially associated with image noise, substantially more strobe light permits smaller aperture values with considerably greater sharpness. A very short flash readily permits operation at a nominal current 300%

higher, enormously increasing available illuminance. Ambient influences such as stray light are also largely eliminated.

Changes in LED intensity over service life or with temperature can be considered and compensated by the control system. Cretec offers an exceptional five-year warranty for the lighting modules, supporting operational and investment security, sustainability and payback. Unnecessary interruptions to production are thereby a thing of the past.

Enjoyment in flawless quality

Enjoying delicious biscuits involves all the senses: touch, hearing, taste, smell and sight. How much we eat with our eyes is evident in browning and glazing. Whether made from classic or wholegrain dough, their appearance immediately suggests crispness, flavour, fragrance and other sensations.

In quality control, perfect lighting allows machine vision to distinguish very subtle browning differences among many properties. Further features reveal defects at high detail resolution. Criteria include correct area and height, surface embossing, corner shape, absence of spots, colour gradients in the centre, material inclusions, damage, foreign bodies, contamination and many others. Butter biscuits' length, width and height are checked to an

The company

Cretec GmbH, based in Hammersbach, Hesse, develops, manufactures and sells powerful industrial vision modules and complete solutions, code-reading systems, intelligent LED lighting and cobot/robot vision. Its networked digital communication on Industry 4.0 platforms ranges from OPC UA to the integrated IOTA protocol. Solutions combine compact design, powerful hardware and software, robustness in harsh industrial environments and, above all, very simple operation. The extensive portfolio is complemented by efficient expertise in industry-specific applications with short development times.

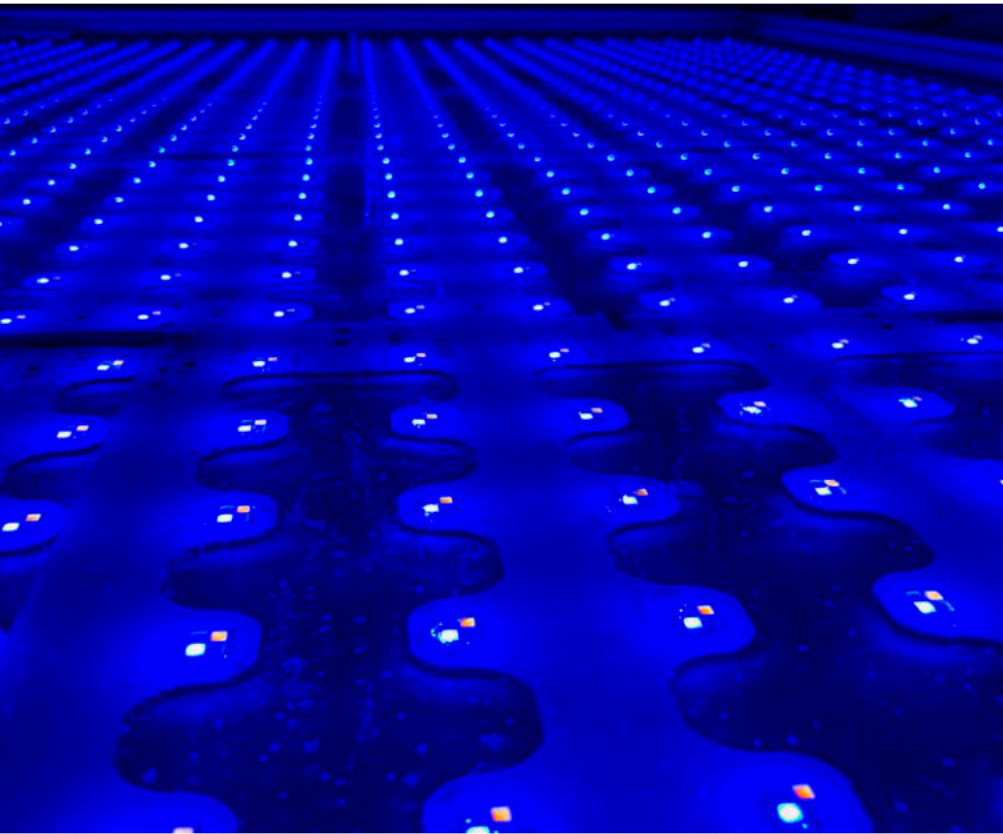


Figure 3 | Large-area lighting modules with four-colour LEDs in strobe, colour-change or daylight mode enable an exceptionally broad range of industrial vision applications.

accuracy of 0.1 mm. A 3D scan also precisely checks biscuit volume.

At 4,200 biscuits per minute on a wide conveyor, everything must run with absolute precision for subsequent production stages. Fully automated production on a continuously moving wide conveyor is complex. Quality control must therefore reliably detect many

additional process-related features. Biscuits must be free from contact, overlap, joining, incorrect orientation and other conditions that cause downstream faults across the value chain. This high-quality inspection also prevents infrequent but expensive stoppages.

AI deep-learning algorithms are used for selected features to continuously

improve detection automatically through self-learning. This is a decisive step towards steadily improving quality-control performance. Refined AI detection can identify developing changes in individual features early, outside the normal pass/fail range. These capabilities matter for early fault detection and process control.

The powerful industrial vision system includes all required components, such as eight cameras, intelligent large-area lighting, two 3D systems and a PC for analysis and communication, in an application-specific hygienic design. An encapsulated lighting module in a stainless-steel housing supplies optimised homogeneous light across the entire conveyor width, for example 1,500 mm x 800 mm. It is the basis for extremely precise, absolutely reliable machine vision. Installed directly above the conveyor, it ensures smooth production at the highest quality. Ongoing production is continuously inspected and documented for over 20 features, and defective biscuits are rejected. Many results are used directly as a data stream within the ongoing production process.

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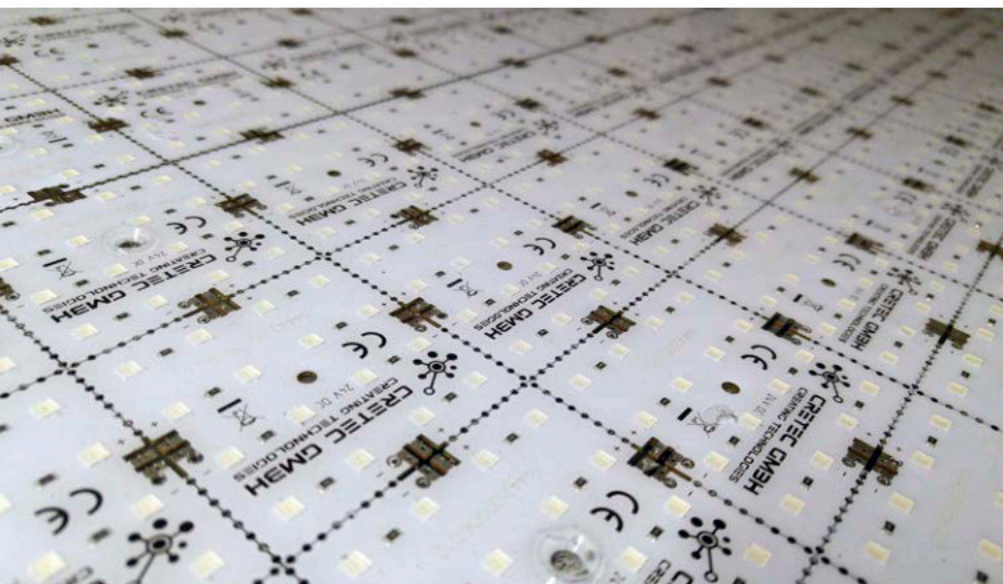


Figure 4 | Individual LED lighting boards can be combined into any geometric format to produce large-area modules with homogeneous, intelligent light control.

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