

Technical paper

In the user's focus

Applications and opportunities of modern smart cameras using the LSIS 400i series from Leuze electronic as an example

Today's user knows that an image processing application depends on more than just processor performance and algorithms. Criteria such as illumination, flexibility during camera adjustment and the costs associated with integration are also decisive factors for success. Features such as simple Web configuration, motor-driven focus adjustment and homogeneous light design are, for this reason, of particular importance. These features simplify integration and offer the user flexibility in the application and a wide usage spectrum as well as high process reliability.

In the industrial image processing, a key technology of automation technology, various device classes have established themselves over time, which differ, among other things, also in their flexibility and the associated costs of integration. PC- or controller-based vision systems are at the peak of the performance spectrum. For the majority of automation tasks, however, vision sensors - or the mostly more-powerful, faster and flexible smart cameras - are the better choice. They can be integrated quickly and at low cost, yet offer flexibility and performance that is sufficient for many applications (graphics).

Image processing sensor requirements

The requirements placed on components and products have increased continuously over recent years. More and more customers demand 100% control. The only way to satisfy these requirements is with industrial image processing systems, which can perform the necessary tasks quickly, reliably and economically.

Modern image processing sensors must be suitable for integration at each point of the manufacturing process in a simple, economical and controllable way. The sensor must be easy to integrate in control networks, it should offer all necessary functions - up to and including evaluation - and be equipped with diagnostics and remote-maintenance

functions. Also desirable are software technologies such as Web-browser-based operation, which eliminates the need for additional configuration software.

Image processing – a fixed part of today's automation

The precision and speed required in modern production systems are, in part, the result of mechanical or mechatronic manufacturing technologies. Without the massive use of visual inspection systems, the impressive increase in production and quality would not be possible.

As a trendsetting instrument for automated production systems and a pacemaker for quality control, quality assurance and quality planning, industrial image processing leads to considerable savings. But professional image processing sensors perform more than just quality inspections, they also serve to visualize a more-effective process sequence and, thus, help to control highly complex processes.

Easy integration and location-independent communication

The communication with the smart camera LSIS 400i from Leuze electronic is by means of eight freely configurable I/O ports, one RS232 interface or via Ethernet. As a result, the fast and easy access to the device and the simple integration are ensured. The software first used by Leuze electronic in the barcode readers for web configuration, currently enables the configuration of the smart camera directly via standard browser.

Because all of the image processing software is integrated in the smart camera, the level of performance greatly exceeds that which is possible in cameras equipped with only a simple configuration tool. No configuration software needs to be installed on the user's PC - everything needed is included in the device and can be accessed via a Web browser. This means that, should servicing be needed, all configuration software, including online help, are present in the device, and can thus be used both on-site as well as remotely - whenever and wherever necessary.

Uniform illumination of free-form surfaces

Illumination, because it is a decisive performance-determining factor, is among the most important topics in the industrial image processing. LEDs are normally arranged in a ring shape, whereby each individual LED emits its light at a specific angle. The

inevitable result of such an arrangement is relatively inhomogeneous illumination. Furthermore, the round light spot is in contrast to the rectangular camera image.

The LSIS 400i is different. Here, free-form areas represent the current state of the art: specially calculated lenses are arranged in front of the individual LEDs to distribute the point-shaped light of the source very homogeneously on the image field in a rectangular shape. Without these lenses, the circularly arranged LEDs would illuminate the image field inhomogeneously and make the evaluation difficult. The technology is well protected: a glass window (plastic window available optionally) sealed airtight in accordance with protection rating IP 65 reliably protects the camera technology and the integrated illumination under harsh environmental conditions.

Motor-driven focus adjustment – an important new feature

Just as relevant to quality for a vision system and the achievable measurement and test results is the focusing of the image. A wide range of solutions, from replaceable to adjustable objectives, is now available on the market for this purpose. Most often they require in the application the manual access in areas with constrained space. As a result, exact focusing is associated with difficult alignment and is often difficult to reproduce.

On lot changes with different object distances, the LSIS 400i motor-driven focus adjustment saves the user the need to perform manual focusing. Instead, the new test program is simply loaded with the focus setting for the specific camera distance. The motor-driven focus adjustment moves the camera to the corresponding focus position. This innovation guarantees reproducible adjustments and thereby facilitates improvements in quality. Particularly in applications with limited installation space, this considerably simplifies adjustment.

Short exposure times for fast movements

Usually the exposure time must be kept very short in order to capture a sharp image during a rapid movement of the object being inspected. Smart cameras of the LSIS 400i product family permit an exposure time as fast as 54 μ s; the resulting images have almost no blurring. A short exposure time, however, means that the amount of incident light is low. As a result, the image tends to be too dark. With an innovative illumination system, Leuze electronic provides a solution to this problem: during the short exposure time, the LEDs are flashed through the application of a corresponding overcurrent. The result: An image that is brighter than obtained by comparable

devices. The ability to read quickly moving objects expands the range of use of the smart camera into areas that could not previously be covered.

Meaning of the software and BLOB-analysis

A key part of the performance of the LSIS 400i is the BLOB analysis implemented by Leuze electronic. BLOB stands for "Binary Large Object" - this is a common and proven method of image processing. A BLOB identifies a contiguous area of pixels in an image. By limiting geometric features, such as "area" or "circumference", individual objects or object groups can be specifically detected.

Furthermore, by checking the major and minor axes of a BLOB, the rotational position of an object can be determined. With this high-performance BLOB analysis, the new generation of smart cameras can simply and reliably perform a wide range of tasks in completeness and presence inspections as well as in position detection.

Readability of codes included

The LSIS 400i device versions with the latest code-reader software can read barcodes and 2D Data Matrix codes - both high-contrast, affixed (printed) codes as well as directly marked (laser-etched or dot-peened) codes. If the code is on a glossy surface, reflections make reading more difficult. The homogeneous illumination, as offered by the modern smart cameras from Leuze electronic, proves to be very advantageous here. Benefiting from this feature are, above all, the circuit board and automobile industries, which, in addition to the part number, also need to unmistakably identify individual serial numbers for traceability purposes.

Optimization by means of software opens further possibilities to the user. If the user knows what type of code is being used, he can set the corresponding properties. With 1D codes, the step size of the code search in the image can also be increased in order to boost the performance of the camera. With two-dimensional codes, the reading mode can also be set: "fast" for codes of good quality or "robust" for more critical, e.g. directly marked, codes.

If Data Matrix codes are not the typical squares, but are instead a pattern of holes, the algorithm recognizes these codes as well. Even reflected codes can be read by the software.

Determining and evaluating code quality

In addition to reading the codes, quality parameters of the read codes can optionally be determined and evaluated. This is particularly useful if it is anticipated that the codes will be read later by various types of readers. This means the code quality can be checked immediately after printing to ensure readability. The user can specify the quality criteria himself and, for example, define a value below which a warning is output.

Further aspects and outlook

For industrial use, the devices are designed with a metal housing in protection rating IP 65 or IP 67 and with the typical M12 connection system. For particularly sensitive areas, such as the food industry, the windows are also available in plastic. A built-in display for diagnostics and status display, as well as standalone operation, round out the advantages of the LSIS 400i series.

Because smart cameras lie between the "vision sensor" and "vision system" device categories with respect to both operation and performance, they serve as a bridge between the upper and lower performance limits of the two categories. In doing so, they cover a broad performance range.

Of course, development of the smart cameras will continue as well: for example in the area of 2D, where increasingly intelligent functions and greater performance are demanded - with continued simple operation. Or in the 3D realm, where a great deal will take place in the future.

Press inquiries

Leuze electronic GmbH + Co. KG
Matthias May, Tel. +49 8141 5350-123
matthias.may@leuze.de, www.leuze.com

