Contact Image Sensor Improves Print Inspection Processes

Contact image sensor (CIS) technology improves inspection of banknote, security/hologram, silkscreen, digital, and flexographic printing processes.

The use of printing is diverse and can be found in many industries, including automotive, consumer goods, banknote, and label manufacturing. Printing can be done using various methods, such as screen printing, flexography, inkjet printing, and digital printing. It is typically done on flat substrates like paper, plastic, glass, and fabrics.

Imperfect or incorrect print quality can have varying consequences. While printing may not always affect a finished product or customer perception, in some cases, such as with medical labels or printed electrical circuits for automobiles, printing can have significant consequences for consumer safety and product performance.

For example, printed medical labels often have 1D and 2D barcodes that must be read by a scanner, as well as human-readable lot and date codes. Dosage directions must not only be 100% accurate but must also be clearly readable. A missing decimal point or an “8” that looks like a “6” could have disastrous results.

Likewise, a missing line in a screen-printed electrical circuit for an automotive rear window defroster would likely result in poor component performance or even failure in the field. Additionally, banknotes require high-quality printing of security features such as watermarks and holograms to prevent counterfeiting.

Machine vision is used in print inspection applications such as these to ensure and improve printing consistency and quality while reducing waste. Since the substrate is flat when printed, a traditional optical reduction system using a camera and lens will produce image distortion at the ends of the field of view because of the variation of working distance from object to imaging sensor.

Using CIS for Print Inspection Applications

CIS technology, in comparison, can more accurately identify printing defects because it uses a rod lens array and produces a 1:1, distortion-free image that is consistent across the entire field of view, with sharp transitions and better edge strength. Although CIS applications have been in existence since the creation of fax machines, manufacturers and integrators are increasingly utilizing CIS to improve industrial line scan machine vision applications.

Traditional optical reduction systems require multiple cameras, lenses, brackets, and calibration procedures for wide field of view applications. For instance, a 1 meter wide web might require two or three camera systems. But single CIS cameras with a 1 meter scan width are available. So CIS is perfect for web-based processes such as printing.

Using LineScanBar™ technology with a highly compact design, the KD Series CIS from Mitsubishi Electric can easily be applied to existing and new production lines. Its singular modular housing requires minimal space and provides all the elements of modern vision systems. The LineScanBar comes with an illumination system, a lens, and a sensor, all within a compact housing design. Maintenance is simple, as modules can be exchanged within minutes.

The rod lens technology provides high image quality and 1:1 scaling created by a graded index rod lens array. Telecentric viewing angles also help to create distortion-free images, resulting in precise measurements. The pixel size is 42 x 42 µm, which results in true 600 dpi.

Equipped with a trilinear CMOS sensor and RGB filters, the Mitsubishi Electric LineScanBar ensures high color fidelity. Image acquisition speed is achieved using optimally aligned integrated white LED illumination and integrated binning. The resolution is adjustable from 150 to 600 dpi with or without the integrated illumination system.

The KD Series CIS acquires undistorted images with sharp edge transitions, which is key to a machine vision system's ability to provide repeatable and reliable results. Machine controls provide real-time quality and production data, helping to improve printing efficiency.

Improve Quality and Process Control

CIS technologies integrate lenses, light, and image acquisition into a single small head. The compact design and short working distance allow inspection solutions to be easily implemented into printing equipment of various sizes, resulting in lower costs and lower space requirements.

When paired with factory automation components, KD Series CIS solutions help enable high-quality printing and improved process control. The closed loop of sensor data feeds machine controls with real-time quality and production data. Using smart data management and production transparency helps create more sustainable printing capabilities with less waste and higher efficiency.

The KD Series CIS integrates an array of sensor ICs, a rod lens array, and a light source located inside a compact image sensor module. The rod lens array's 1:1 imaging ratio creates less distortion than ordinary line scan camera systems, improving accuracy. By capturing images with higher resolution, the KD Series CIS makes it easier to detect small defects in the printing process.

The KD Series CIS includes two models, one with built-in illumination and one without illumination. The built-in illumination model's structure includes a lens array, light source, and sensor ICs. The non-illumination model provides the flexibility to use external light sources to achieve various light source angles, settings, and transmitted light options. Both options come in standard sizes to meet a variety of applications. For more detailed KD Series CIS model information and specifications, download the data sheet.