New innovations in web monitoring systems

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It was about 20 years ago when the first web monitoring systems came onto the market; based on technical principles of the first electronic analogue television cameras, and later on camcorders from the consumer sector. The optics were adapted for integration into printing machinery with specific ancillary lenses. Since then much has changed whereas at that time separate cabinets in front of the rewind were the norm, today's compact systems are hardly noticeable and are easy to integrate into the printing press. This article explains the basic principles of today's technology and describes how the work of the printer and his or her efficiency can be further improved with modern technological and conceptual approaches.

Why are web monitoring systems needed?

During the printing process the printer must tackle numerous tasks not least print quality evaluation, now even though automatic control systems on modern printing machinery contribute to a consistent printed result, the printer must still continuously keep a close eye on the quality of the print. Here web monitoring systems help the printer by providing an accurate image of the printed image, even at high speeds.

It is not possible to monitor the web with the naked eye even at speeds of 30 m/min (100 fpm). For this reason stroboscopic or drum video systems were introduced and although these systems stabilized the image, they did not provide any facility for zooming into any of the detail, for example tracking register marks with high precision.

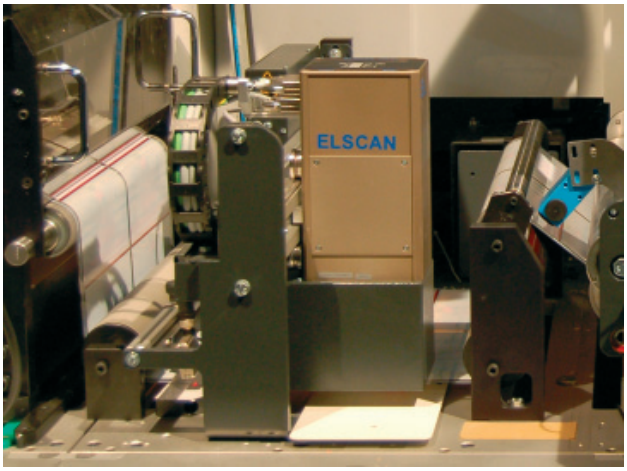

Figure 1:
Web monitoring from Erhardt+Leimer on Gallus EM 410. The motorized crossbeam with cable harness can be seen to the left of the camera.

Today's web monitoring systems are well established in the market place and are offered as a standard on printing machinery as the relationship between procurement costs and the total investment in the machinery has significantly improved, for this reason web monitoring systems are increasingly included as a basic feature. Despite high production speeds, web monitoring systems make it possible to assess the printed image with synchronization to the print repeat and position, therefore enabling the quality of the print to be continually assessed (in particular the print registration).

For narrow-web applications simple manual systems have become established which are primarily used to monitor one position on the web. In wide-web and high quality applications such as self-adhesive labels, business forms and packaging printing, motorized systems are used which enables the camera head to be moved automatically using a motorized crossbeam. A magnified image area and expanded functionality such as continuous monitoring of several web positions are significantly important here.

The use of digital camera systems is on the increase as they have advantages in relation to image quality, frame rate and resolution and are often combined with PCs to achieve additional program functions. These digital solutions can incorporate complex 3-CCD chip technology for presetting and controlling the register, colour control, barcode detection, printed image inspection, etc. They can often analyze the production run statistically, but as always only part of the complete repeat is analyzed (and also not every repeat). These camera systems based on matrix chips try to compete with the 100% print inspection systems on function relative to price, but cannot provide the same level of functionality for this level of inspection.

Which functions are available today?

Even though analogue cameras are still very widespread, digital technologies are gaining importance. This situation is heavily driven by the consumer market: every year new records for chip resolution are reported whilst in the area of web monitoring systems, the innovation cycle is significantly slower. The modern web system has digital chips with resolutions in the 1 mega pixel area, a large optical zoom range of up to 1:16 is also common, so that it is possible to display the smallest register marks all the way up to the full size printed image. The quality of the zoom lens is a key aspect here. Once the image has been taken many functions which are primarily achieved within the software become available, such as:

- Simultaneous display of the last 16 camera images, which, particularly by scanning along the web, provides an overview of ongoing production and also permits the selection of a specific position (e.g. a register mark). The press operator does not need to spend time operating the video system.
- Complete repeat scan and display of the individual images are displayed as a preview and can be opened individually.

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- Image storage for preparing reports or for further analysis.
- Software image stabilization provides jerk-free and drift-free display of register marks for example, even with high magnification.
- Job storage. The settings for image sequences, trigger points, etc, once found can be easily stored and recalled significantly reducing setup times.

Inspection with web monitoring systems

Web monitoring systems can only scan part of the printed web (or repeat). Inspection is therefore also limited to this part of the repeat that has been scanned; nevertheless this partial image can be of great benefit for the printer as the partial image provides significantly higher resolution than the camera image from 100% inspection systems. This aspect is particularly beneficial, for example, during the inspection of barcodes or during the set-up phase with detailed display of register marks. However, inspection based on a web monitoring system alone cannot be used for complete quality control, so web monitoring systems will therefore also have their value alongside true 100% inspection systems to provide the fullest solution.

At LABELEXPO EUROPE 2007 a module for colour comparison inspection based on the *Elscan* camera system was announced by *Erhardt+ Leimer*. This module can also be incorporated into existing *Elscan* systems as an upgrade without the need for any changes to the hardware.

During the analysis of the master image the first step is for the coloured area to be divided into segments. These segments are then evaluated based on colour, its intensity, and the size of the related area (in pixels). Faults in the production run are assessed separately based on the segmented colour, and relative alarm thresholds can be set individually. The deviations are output in Delta E and CIELab such that the printer can directly interpret the values and react as appropriate. In case of deviation from a set reference, an alarm signal is generated that can be output on an external module. The same analysis areas on individual panels in the repeat can be compared; this functionality is of significant interest in label and form printing and has already been proven in practical applications.

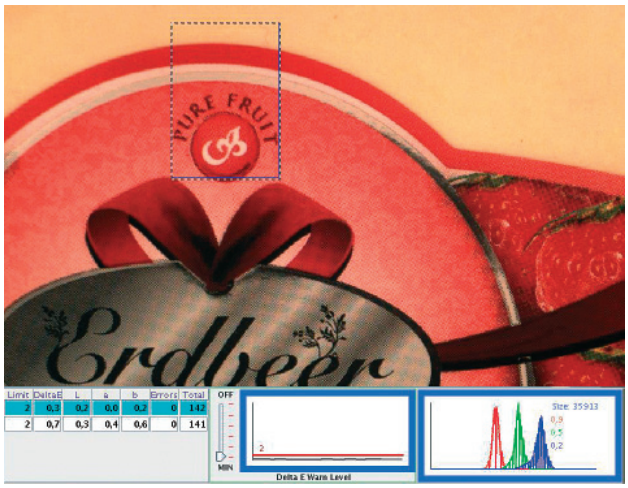

Figure 2:
Display of the colour comparison.

What will the camera of the future look like?

To address this question we first

need to look into the deficits of existing technology then show how a new innovative solution has been developed with unusual approaches.

The main weakness of web monitoring systems is the motorized zoom lens that has the following disadvantages:

- Slow adjustment due to the mechanics of the motorization.
- Complex, precision mechanism with correspondingly difficult service life.
- Large optical zoom range which degrades the image quality in comparison to fixed lenses.
- Large lens cross-sections on the camera lens prevent homogeneous illumination and cause degradation due to reflection effects with reflective web materials and printed finishes.

A new camera concept currently being launched on the market by *Erhardt+Leimer* directly addresses these weaknesses. The objective is the total elimination of the mechanical zoom lens and the improvement of the flash illumination. The principle of the new system is based on the combination of two miniature cameras each with extremely high resolution. Both cameras have fixed lenses that are ultra compact, but have significantly better optical properties than the zoom lens used to date. Compact means a diameter of approx. 12 mm (0.5") in comparison to approx. 80 mm (3.2") for a zoom lens. *Figure 3* shows the arrangement in relation to the overall field of view.

As can be seen camera 1 in red has a high magnification, while camera 2 in blue captures the entire

Figure 3:
Dual camera principle with different fields of view.

field of view of the device. Depending on whether the printer wants to look at a detailed section of the image or would prefer to see the entire image, information from camera 1 or camera 2 is displayed. The transitions between the zoom factors are smooth and the changeover is almost immediate, it is even possible to display a complete label and a register mark in different windows at the same time providing the printer with new possibilities for print monitoring. *Figure 4* shows the new device on a motorized crossbeam.

The square design of the new camera also suggests a new method of exposure. As the size of the tiny camera lens (referred to the area of the image) is negligible, a so-called area flash has been used for this concept. This flash provides ideal diffuse illumination which minimizes reflection effects and at the same time provides the best results for holograms or embossed and metallised surfaces.

The new system offers enormous advantages over previous concepts,

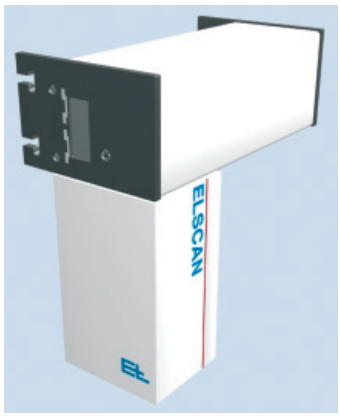

Figure 4:
New web monitoring system with dual camera principle.

an aspect that is particularly apparent in the new functions in the user software. With this new dual camera technology the printer has direct access to every position on the repeat without the need to start changing trigger values and image positions. Last but not least, this new technology has been developed without increasing production costs. ■