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LOW-COST IMAGE CAPTURE SYSTEM FIR INDUSTRIAL PRINTERS

HP INC

Low-Cost Image Capture System for Industrial Printers

Abstract: A low-cost image capture system automatically detects image quality defects during unattended operation of industrial printers.

This disclosure relates to the field of printers.

A low-cost image capture system is disclosed that relieves customers from constant supervision of the jobs being printed on industrial printers by automatically stopping printing and informing the operator whenever something goes wrong with the quality of the printed image before time and print media are wasted.

One obstacle to achieving trusted unattended printing in an industrial printer is the complexity of the system. There are many factors - mechanical, electrical, environmental, etc. - that can affect the final image quality (IQ) achieved, and these factors can vary from one job to another because of the high diversity of: medias types (e.g. flexible or rigid), media subtypes (e.g. paper, vinyl, plastic), print modes (e.g. number of passes, paper advance, scan axis speed), thermal setups, types of inks used, and more.

Whenever an image quality issue occurs, operator intervention is necessary to restore the printing conditions applying the necessary correction measures (for instance: service routines, hard recovery routines, drop detection procedures). In the best case, the operator is present and the effect on IQ is so evident than the operator can recognize it and stop the printer to apply corrections in a short time after it arises. In other cases, however, the problem is not readily perceived by the human eye, the IQ defect persists and will be detected only many hours later after large amounts of media have been printed and wasted. This is also the case during unattended printing, where no operator is present to detect and correct even the most readily apparent IQ errors. In addition to wasting time and media, in some cases damage to the printheads or other components of the printing system may occur.

Up to now, there have been no solutions in commercial and industrial printers based on a scan axis to capture images during printing with accuracy and precision using a low-cost commercial CMOS or CCD sensor. Solutions using CIS cameras or customized scanners with limited performance are costly, insufficiently robust, and difficult to implement in a printer with high spatial and weight constraints in dynamic parts such the printhead carriage.

According to the present disclosure, and as understood with reference to the Figure, as image capture system includes a low-cost commercial CMOS/CCD image sensor (area field sensor) camera 10 and a high-power lighting flash system 20 attached to the printer carriage 30 to enable image capture under dynamic conditions at a close distance from the media 40 without blurring or image distortion. The flash system 20, which compensates for the exposure time of the camera 10 being reduced below the minimum sensor exposure time, may be an LED flash light sourced by a precision current LED driver. The captured images are post-processed for image stitching and artifact pattern recognition such as, for example, grain, DLZB, and/or smears occurring during printing using classifier algorithms or AI networks. The camera 10 and flash 20 are coupled to a strobe controller 50, implementable on a printer carriage board 60, that can synchronously trigger the camera 10 and high-power flash light source 20 within a resolution of microseconds for the period of a short exposure time (4-10 usec).

In some implementations, the printer carriage board 60 is an analog and digital PCA that implements the printhead driving via an FPGA device and an MCU for processing and driving the printheads 70 as well as the data interface connection with the printer engine 80. The FPGA enables the control of the high-speed signals required for the camera 10 and light source 20 synchronization. The image capture system can be implemented on the board 60 at an additional cost of approximately $30. Image captures up to a maximum linear speed of 148 ips can be achieved with acceptable image quality, resolution, and uniformity to enable the image stitching and artifact pattern recognition.

The disclosed technique advantageously reduces cost of the imaging system by at least a factor of ten versus prior imaging designs. The design is robust to temperature and ambient light, and can capture accurate, high-resolution still images even when the carriage 30 is moving at high speed while printing. The post-processing pattern detection of artifacts can warn the operator of image quality problems and allow correction to be made in a timely manner to reduce the cost in time and material waste.

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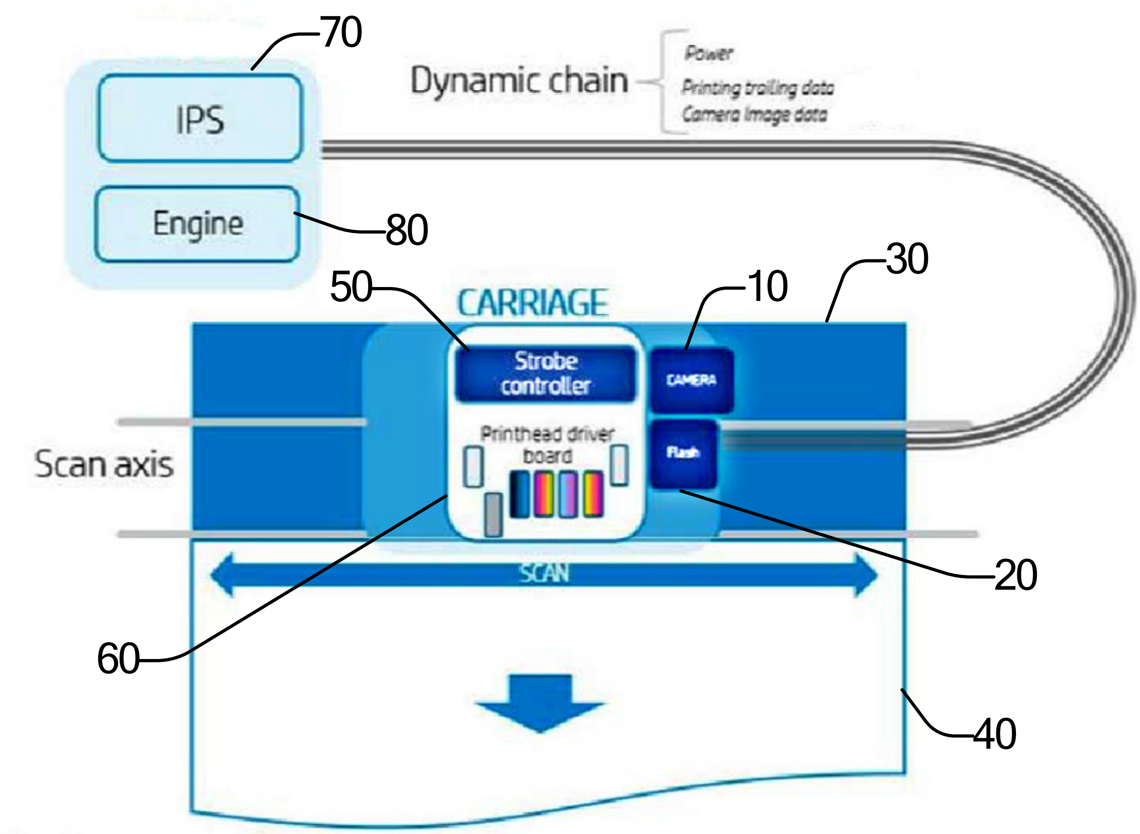
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CAMERA
Flash
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Scan axis
SCAN
20
60
40