Ink Jet Print Engine for Digital and Analog Industrial Press

Paul Morgavi
IMPIKA
Aubagne, France

Abstract

Traditional offset printing does not offer to the issuers the opportunity to print multiple print designs in a single run. Other printing technologies are not compatible with an industrial environment in terms of speed and cost. The target for final customers is to have a unique product at a very low cost. This problem is today a difficult reality and the related suppliers are looking for solutions meeting positively this demand.

The goal of this paper is to describe an ink jet print engine able to be implemented into a digital and/or analog industrial press. This document will explain the architecture of the print engine including the data management, hydraulic and fluid control, software, firmware architecture and the capabilities to address monochrome, color and other applications.

For conclusion, experiences on industrial equipment and application are described.

Introduction

It is no secret that the trend of printing, finishing and customizing markets is the decrease in size of the batches to be produced. The efforts conducted by equipment manufacturers addressing these different market segments have enabled to improve the performances in terms of flexibility but this is not always sufficient. Indeed, industrialists are confronted with two main demands from different printing markets that are:

- the modification of only one part of information for each printed product.
- the possibility to print on the whole product, a different pattern on any of these products so as to make it unique, different from the former and the following one.

Although this demand is real and more and more important, industrialists do hesitate to take the plunge towards new generations of printing machines, in general digital ones, because they use some new technologies. This brake results from several factors that can be summed up by what follows:

- the investments that have already been made in traditional printing machines are important and not always amortized.
- the new technologies are not well understood and/or accepted by printers yet.
- the use of digital technologies requires that the workflows and the flows of data to be printed are adapted (entirely digital chain), which generally requires some additional investments.

These different reasons and behaviors show us that to manage successfully the challenge of job lots, the possibility to use new printing technologies through different approaches, according to the maturity of markets and different printers' profiles must be proposed to printers.

To facilitate this transition while keeping the existing systems and machines, IMPIKA proposes an especially designed digital print engine that can be integrated into traditional existing print lines but that can be also the heart of new equipment in digital printing.

State of Art

If the digital printing technologies are numerous, few of them are those meeting the necessary conditions to be able to address the printing industrialists' needs and this, in different market segments. The biggest obstacle comes from the fact that a good many of these technologies do require a physical contact between the support and the printing system, which seriously limits their use. However, ink jet technology is one of the most serious technical solutions to this problem and we are going to describe in the following lines the achievement of an ink jet print engine (IPS) that can address monochrome and/or color applications, that can be integrated into traditional print lines but that also can be the heart of a new generation of printer or digital press.

Design

One of the biggest difficulties is to design a system as universal as possible. The IPS (Impika Printing System) is a modular piezoelectric ink jet printing system that can address several ink jet heads. It is presented in the form of a 19'' rack that can be proposed in a standalone bay especially provided or integrated within the existing or under construction equipment.

IPS integrated for two print heads application

The IPS accommodates the whole printing chain, for this it integrates the following functions:
- the decomposition of images to be printed (RIP)
- the size setting and the serialization of data to be sent to ink jet heads
- the generation of high voltage pulses for activating jets
- the management of ink circuit in terms of level and temperature
- a cartridge-type ink tank
- the regulation of accurate pressures and depressions to ensure the good management of inks within heads
- the automatic management of heads cleaning
- the management of ink dryers, if needed (UV, solvent,..)
- the input/output interface with equipment.

In order to be compatible with the biggest number of applications, the IPS can be configured so as to address applications requiring different printing resolutions, such as for example:

- monochrome for marking	(150 dpi – 200 dpi)
- monochrome for logo	(300 dpi)
- 4 colors for logo	(300 dpi)
- 7 colors for photo	(600 dpi)

If the resolution and/or the surface to be printed exceed the specifications of the ink jet head, it is then necessary to carry out several printing passes to obtain the expected cover. It deals then with a "multipass'' system opposed to a "single pass'' system. One example is : if the native resolution of an ink jet head is 100 DPI, it is then necessary to carry out 6 passes to obtain 600 DPI, for the same printing width. In this case, between each pass, the head must move perpendicular to the surface to be printed at one pixel minimum. However, some supports such as product reels do not enable several passes of the support under the heads, which forces to be able to manage the serialization of several heads and enables thus to obtain the desired resolution without a head displacement (simple pass system).

Another method consists in slanting the heads to obtain the desired resolution but the printing width is reduced in proportion to the increase in resolution. This particular mode is used for low printing width.

Finally, according to the printing machines, some of them are working in continuous mode without a support stop (linear run) and others in single-step mode, the support pausing momentarily between two displacements.

The IPS can manage the whole of functionalities described above thanks to the monitoring of 5 ink jet heads at maximum by IPS and the possibility to chain, synchronize several IPS between themselves to address some applications requiring a great deal of colors, a high resolution or large format supports.

Fire Pulse Generator

A quite particular feature in IPS is its ability to be able to generate some waveforms with powers that can be entirely programmed in order to control the piezoelectric actuators of heads. Thanks to this technique, it is thus possible to optimize the form, the volume as well as the speed of ink drops to be deposited, which enables a bigger latitude for adjusting the operating points for different types of inks, of ink jet heads, of supports but also of printing speeds.

Equipment Synchronization

The synchronizations between the IPS and the mechanical equipment are carried out via hardware signals and software ones. These signals enable the equipment to know the progress of printing tasks. (IPS memory ready to print, memory ready to load the following job, beginning of the following job loading …). The synchronizations enable for example to launch the pop of the series of objects corresponding to the following job.

Print Head Maintenance

In order to ensure a constant efficiency of the ink jet head, it is necessary to follow some use recommendations in particular in the phases where the IPS is not in current print. The ink jet process imposes what follows:
- the head can't remain without printing beyond a certain time.
- the head can't exceed a defined printing time.
- the stop and start stages of the head are carried out under the controlled conditions (temperature, maintenance printing, purge….)

All these constraints are handled by the IPS via its command set support that places it in different statuses such as: OFFLINE, ONLINE, STANDBY, MAINTENANCE. The integrator must handle the displacement of heads according to any status so that these latter are in the following positions : Printing, Maintenance and Cleaning. The Printing position is above the substrate to be printed, the Maintenance position enables to easily access the head and the Cleaning position is above an ink retrieval device or above a Maintenance Station supplied by IMPIKA.

Software Monitoring

The IPS working (signals, commands sequence, loading of printing batches) is identical whatever its configuration may be. Its monitoring is carried out

through TCP commands and synchronization electric signals relating to the substrate speed and its detection.

The features of printings to be carried out are specified in a file called Job. The job describes and provides the whole of data forming each printing (number of printings, number of variable fields, gutter image, texts, variable images …). The job must then be backed up in the IPS storage memory, this backup being able to be carried out via either the TCP commands, or by using the JobCreator software from IMPIKA. Once loaded, the latter comes to be added to the list of IPS available jobs, just select it to print it.

IPS Setup

The IPS is a modular system that is configured according to the customer application. This configuration depends on the following specifications:
- the number of ink jet heads
- the resolution
- the size of the surface to be printed
- the type of ink
- the type of substrate

The whole of parameters enabling to meet the customer application specifications constitute what is called the "printer type'' The IPS can be configured in order to meet several customer applications. In this case, the user can select its "printer type'' through a simple TCP command in the list of printer types downloaded in the IPS. The "printer type'' is intimately linked to different possibilities of ink jet heads assemblies.

Applications

Today, and as a result of the very young settingup of the IMPIKA Company, two main applications have been carried out in different fields.

The first one has been the achievement of an industrial digital press for plastic card that is able to print 6,000 cards/hour with a resolution of 600 dpi and with UV inks. This machine is being industrialized and should give rise to performances more adapted to markets of service bureau type.

The second application is designed for the deposit of clear coating per ink jet on an existing offset printing machine with a rate of 12,000 products/hour. The varnish thickness is about 20 µm and the IPS enables to varnish only the necessary surfaces without polluting, making dirty the surfaces that are designed for receiving other treatments.

Other very various applications are being studied but it can already be told that the IPS perfectly fulfils its function thanks to its great flexibility and modularity.

Conclusion

Although it is fast, this description of a print engine, that is able to be used just as well on existing traditional equipment as in a new digital press, shows well the ability of new technologies in digital printing, and more particularly ink jet, to address different problems encountered by the traditional processes. The IPS enables to smoothly gather the present and the future of different technologies and printing jobs, it is an essential step for a better understanding, use and operation of the potential in the gathering of different printing technologies.

A significant evolution, revolution is coming and will change the manufacturing approach, organization and probably, the industrial printing market.

References

1. Paul Morgavi. How Digital Printing Can Address the Smart Card Industry. The International Conference on Digital Production Printing and Industrial Applications, pg 192-196 (2001).
2. Paul Morgavi. Industrial Digital Color Printing Press for the Plastic Card Industry. IS&T NIP18, The international Conference on Digital Printing Technologies, (2002).

Biography

Paul Morgavi is the founder and C.E.O. of Impika, the ink jet technology specialist in industrial application. Previously, he was the Director of the Manufacturing Equipment Department, part of the Gemplus R&D division where he worked on the development of Printing Technologies and associated systems for 15 years. In 2001, he developed the first Digital Color Printing Press for plastic card using the inkjet technology.

His background covers the technologies such as offset, thermal transfer, dye sublimation, laser and ink jet, applied on plastic materials. In 1996, he worked in U.S. in collaboration with an American company in order to develop a color plastic card printer using dye sublimation technology. Email: paul.morgavi@impika.com