

# The Goal of Electronization of Photography Still Video System to Digital Photography System

*Shin Ohno*

*Image and Sound Communication Co., Sony Corporation  
Okata, Atsugi, Japan*

## Introduction

Digital photography is a new electronic imaging system which has appeared in the process of electronization of photography<sup>1</sup>. It is a harmonized imaging of an electronic still photography and a hybrid photography. The electronic still photography is a complete electronized system using no film and the hybrid photography is composed of a film image and digital data.

The main frame of this system consists of image capturing, manipulating and output processes. In the image capturing process, a three-dimensional object image and a two-dimensional film image are taken by electronic still camera and film scanner, respectively. The image manipulation is an image processing of image data using personal computer. The output process is provided by both displayed softcopy on a monitor and printed hardcopy on a paper. The advance of this system is mainly due to the development of key equipment of digital electronic still cameras, digital scanners, color printers and computer monitors.

Recently, many small size digital cameras appeared on the consumer market. They initially aim to be three dimensional image capturing peripherals for personal computers and recently some cameras combined with printers. A digital color printer providing a NIP, non-impact printing method can print out excellent color prints compatible with those of the traditional color photography. That printing out process is available using the desktop consumer products

This paper discusses the advance of digital photography system and its applications.

## Procedure of Electronization

In 1981, the first actual electronization of photography was proposed by Sony Corporation as a name of "Mavica System."<sup>2</sup> The proposal was very sensational because of the demonstration was provided by prototype products and the timing of the announcement just fit to the speculative silver shortage. During the one and half decade, the electronization has been proceeding step wise in three generations of still video (SV), electronic photography (EP) and hybrid

photography (HB) systems and recently it has attained the tentative goal of "Digital Photography" system.

## SV System

The first electronic still photography system had announced to realize following four advantages: an instant capturing and recording of object image, a reproducing of output images both on a displayed softcopy and a printed hardcopy, a nondestructive recording realizing reusable media, an easy and direct access to the telecommunication. The captured image was the same as a frozen frame of TV scene. The signal format was analog and its allocation followed to the broadcasting TV standards because of the softcopy displaying on home TV receivers. Thus the first system was named as a still video (SV) system. The severe technical competition to develop key equipment of electronic cameras and color printers have continued during the 1980s.

By the end of the 1980s SV cameras and color printers producing new color photographic prints were on the market. These cameras were priced in the higher than those of traditional high level film cameras. The analog magnetic recording is inferior to the quality of input and output signal so that the read-out image signal cannot form a hand-held size excellent picture satisfying customer's demand. Thus these cameras could not get the consumer market. Although in the some business fields of photojournalists, government agencies and so on, the previous four advantages overcame the poor image quality and the new system was very usable. On the other hand, the development of color printer was very successful and the color photographic prints utilizing a perfect dry NIP method of sublimation dye transfer was also completed.<sup>3</sup>

As the result, the first attempt to replace film cameras with SV camera in the traditional consumer photography field failed because of the price and quality problem.

## EP System

At the beginning of the 1990s, digital cameras utilizing IC card, card type semiconductor memory device for the recording media appeared on the market.<sup>4</sup> The memorized information in the IC card was digital image data. The imagers for the first digital camera itself was the same as

that of the SV camera, however the image quality was markedly improved.

The big feature of digital camera was to unfasten from the restriction of TV signal standards. Then many professional cameras attached with the high density solid state imager of CCD, charge coupled device having 1 to 42 million pixels came on the market.<sup>5</sup> These all digital cameras were named as "digital (still) cameras" and the digital data from the camera suggested the easy access to the computers. The image data was easily modified by manipulation using personal computer. In the EP system, a new function of this easy access to the computer was the fifth and the greatest advantage on the electronization of photography.

On the other hand in the output, above sublimation dye transfer printers advanced to receive digital signal and then produced high definition photography like color prints. These printers were named as digital printer. The system utilizing those digital equipment invited the second generation of electronization of photography and named as the "Electronic Photography (EP) system."

### HB System

At the beginning of the 1990s, Eastman Kodak Company established a new "Photo-CD" system based on a conversion of film image into digital data. The film image was formed by capturing of the object image and photographic development. The digital data was recorded on the recordable Compact Disc, CD-R. The film image of 35 mm picture is quantified to  $2,000 \times 3,000$  or  $4,000 \times 6,000$  pixel image data and memorized on the CD-R disc by film scanner.<sup>6</sup> In the Photo-CD film scanner, a one dimensional CCD imager named as a line sensor having 4,000 apertures in vertical direction scans sequentially on 6,000 positions of film in horizontal direction. The structure of film scanner is simpler than EP camera having high density imager and the device cost of the line sensor is generally cheaper than the two dimensional CCD imager.

The key equipment in the new system was the film scanner and the key device was CD-R, a recording type compact disk. The read-out play back from the disc is equivalent to that from EP camera as described previously and it was easily manipulated by personal computer. This is a mixed system of traditional chemical and new electronic photography systems and refers to "Hybrid Photography (HB) System."

### Digital Photography

The latter half processes of the EP and the HB systems were the same and the image data in those systems were compatible with each other. Thus those were feasible to combine and the merging of them was resulted in the "Digital Photography" system.

The digital photography system does not accomplish the perfect electronization however it indicates the tentative

goal of the innovation of the traditional photography system. At present, the cost of high density CCD imager is extremely expensive and its productivity in the manufacturing stage is not good condition. On the other hand the traditional film environment is perfect and the cost of line sensor in the scanner is reasonable and handling of it is convenient. The big deal and high density image data is easily extracted from films.

It will expand the future photography to the extremely useful new electronic still imaging. Moreover, it expect to apply to the Multimedia technology in the NII, National Information Infrastructure and Networking environments in the offices and homes.

### Development of Digital Photography Technology

Advance of digital photography technology had been provided by continuous development of equipment and devices after the "Mavica" proposal. Many manufacturers have joined the technical competition to develop electronic still cameras and color printers. The current digital cameras appeared in the middle of the 1990s and color printers printing NIP color prints have come in the middle of the 1980s. Recently, the data storage technology for image data in semiconductor card device was nearly completed.

The most important equipment for any photographic system is cameras. In this paper, the discussion is focused in the electronic still cameras. The basic consists of electronic still camera are an optical system, imager(s), processing circuits and signal memory devices. The differences between the first analog cameras and current digital cameras exist in the signal processing and memory processes.

In the first SV camera was developed by modification of video-camera in order to realize the above four advantages of electronic photography. The consists of the first proto-type SV camera were the MOS type solid state imager and a small size, around 2.2 inch floppy disc stored analog picture signal for 25 frames.<sup>1</sup> Later the imager was changed to CD and now it is the only imager for digital cameras and also for digital scanners. At present there are two kinds of electro-photo devices, one is a two dimensional one named as the imager and the other is one dimensional one of a sensor. The basic functions and structures of them are the same.

In the electronic imaging system, the signal format is one of the most important factors. The signal allocation in the SV system followed to those of the TV standards. Thus the equivalent pixel number in a picture was  $484 \times 650$  for NTSC compatible system and  $575 \times 700$  for PAL compatible standards, respectively. At present, an imager in the digital camera having above pixel number classified as the VGA, video graphic array class imager.

In the any types of one-shot electronic still cameras, there are two imager consists for capturing color images; one is a single imager camera and the other is multi-imagers camera. The single imager consist has one CCD imager

attached with a mosaic type three color filters of R (red) G (green) and B (blue). The multi-imager consist has three CCD imagers attached R, G and B filters, respectively. The single imager consist is introduced both in low-end consumer and high-end professional cameras and the multi-imager consist is only for the high-end products.<sup>7</sup>

By the end of the 1980s once over fifteen SV cameras appeared on the market. The stage of SV camera was finished by problem of price and quality described earlier and now one or two cameras still remain in catalogs.

In the beginning of the 1990s, two digital cameras appeared on the market.<sup>4</sup> The recorded signal in the memory device was the digital data. The imager consists were the same as the VGA class, however the image quality of the output was pretty improved by digital recording.

After that until today, many professional cameras attached high density CCD imagers having over 1 million to 42 million pixels were supplied on the market.<sup>8</sup> The high density CCD device is expensive and high volume data handling required complicated electronic devices. Thus the current digital cameras divided in two categories: one is the low-end camera having VGA class CCD imager and the other is the high-end professional cameras consisting of high density CCD imager. The cheapest low camera is priced three hundred dollars level in Japan.

At present the big problems in addition to the imager are the memory device and signal processing for it. Now the most convenient memory device is a card type semiconductor integrated circuit named as IC card. Currently the output image data from the camera is increased by introduction of high density imager and user request the high recording capacity. The number of memorized frame is a big concern for the users. Currently various image data compression techniques have been proposed. The most popular data compression is the JPEG method and various low end cameras introduced this method and announce their frame memory capacity of 30 or 40. However most of the decompressed images lose their image quality and thus the high-end professional cameras for the graphic arts application do not introduce the compression.

The standardization of the electronic still photography system has started in the table of International Standard Organization (ISO) from 1991).

### **Application of Digital Photography**

The applications of electronic photography in every generation has been based on the first four advantages for the SV system and one more additional big advantage for the digital photography.

At present in the "Digital Photography" era, the new applications connect with the computer manipulation ability of it.

The all current applications are connect with digital image processing by computer and are divided into two styles; one is the "Kilo pixel" applications which are the

successors of those in SV era. Most theme parts in the world introduced the "Kilo-pixel" camera application for producing of pleasure amusement pictures for customers. Now small photo-booths take girls picture and print out small sticky prints by SV cameras and color printers are very popular in Japan. These are named "Print Club: and after school time every afternoon, long lines of girls wait their order in game centers and amusement shops. Currently many VGA level Kilo-pixel cameras have appeared on the Japan and US markets. Although in their advertising copies, only few products say photographic applications. Most of them are assigned as the object capturing equipment for personal computers. In other words, these are equivalent with the computer peripheral three dimensional scanner.

The newcomers in the digital era is the applications using the "Mega pixel" cameras. The application of the HB system is equivalent to this category. A desktop publishing for the prepress work of the graphic arts field welcomes to introduce this "Mega pixel" application. Many graphic designers introduced "Digital Photography" equipment and enjoy the profitable works to prevent cash out procedure to hire photographers for their works. Many photo-studio photographers also introduce this system and enjoy the easy retouching of customer photographs using the computers.

The current environmental regulation for the waste of photographic development will facilitate the introduction of digital photography. In the past Atlanta Olympic Games, many photojournalists used the "Mega pixel" cameras for the news war of deadline for a copy.

The application of digital photography has just opened and the advanced photographers and enthusiasts have tried new use of digital cameras. Various unexpected applications will be proposed and the replacement of film to CCD will proceed gradually from now to the 21st century.

### **Summary**

At present, the digital photography system is tentatively completed because of the introduction of the HB system. The final stage of electronization is supposed to be realized in the near future by progress of imager, processing and memory electronics.

Present situation of the digital photography is a term of starting business. It has not got the major fixed customers. The business related to the digital photography are looked to be bright although the conditions of costs of equipment and media, productivities of equipment and prints and applicability of the system are not sufficient enough to replace the current photography system.

The digital photography will grow up to the one of the key technologies for the pictorial information exchange in the multimedia and networking environment. The simple and high performance image capturing and output equipment are very useful for the information transmission and receiving in the offices and homes. Actually the customers

purchasing the cheap VGA class digital cameras in Japan expect to use them for the image input devices for authoring of home pages in the internet environment.

### References

1. S. Ohno, *JIST*, **40** (6) 556 (1996).
  2. N. Kihara, et al, IEEE, CE-28325 (1982).
  3. S. Masuda, et al., *ibid* CE-w8226 (1982).
  4. J. K. Moronaga et al, Extd. Print. 1st EP Workshop, p69 (1990) SPSTJ.
  5. J. A. Jackson et al, Proc. IS&T 44th Annl. Conf., p.326 (1991).
  6. G. R. Harbbard, Proc. IS&T 46th Annl. Conf., p.336 (1993).
  7. M. Shindo et al, Proc. IS&T 45th Annl. Conf., p.336 (1993).
  8. T. Tredwell et al, Proc. IS&T 47th Annl. Conf., p.336 (1994).
  9. F. Faramarzpour, Proc. IS&T 46th Annl. Conf., p.23 (1993).
-