

Development of MPEG Camera

T. Kurashige^{*}, J. Shiokawa^{**}, H. Chiba^{**}, N. Yamamoto^{**},
T. Kitade^{**}, H. Tarumizu^{*}, H. Kami^{*}, T. Imai^{**},

^{*}Hitachi Video & Information System Co.Ltd. Kanagawa, Japan

^{**}Multimedia Systems Research & Development, Hitachi, Ltd. Kanagawa, Japan

ABSTRACT

We have developed a handy digital camera to record MPEG-1 video and JPEG still photo. The newly developed camera signal processing LSI and real-time MPEG-1 CODEC LSI compress and decompress image, and a RISC MPU, SH-3, does MPEG-1 audio compression and decompression. We adopt PC card type HDD to record compressed image and audio instead of tape media for easy file handling and high adaptability with PC. Users are able to arrange, retrieve and playback files on the camera easily using the 1.8" TFT-LCD and "Media Navigation System," the built-in file handling function.

Picture1: Outlook of MPEG camera



1. INTRODUCTION

With a rapid growth of multimedia technology, we have more opportunities to handle pictures on a PC or the network. Many types of digital still cameras have already been realized. Most of them compress pictures with JPEG format and play back them on a PC or a TV set. It also become easier to distribute photos through network.

However, there has never been a camera that records digital full-motion picture easily and simply. We have developed a real-time encoding and decoding (CODEC) LSI with MPEG1 format. We have realized the new handy digital camera which can treat MPEG1 image easily with that CODEC LSI.

We also developed a picture improvement system to reduce block distortion and mosquito noise easily appeared in the high-contrast edge outskirts or the scene change.

This paper describes the developed camera structure and picture improvement system.

Table1:Major Specification

size	83(W) × 143.5(H) × 56(D) mm
weight	385g 540g (Buttery & HDD include)
motion picture	MPEG1(352*240), IBP / 30fps
still picture	JPEG(704*480)
Audio	MPEG-1 layer II
Interface	NTSC analog video PC-CARD (ATA HDD) Hi-Speed Serial (original protocol)
File Format	MS-DOS compatible
Recording capacity (260MB HDD)	20minute(MPEG system) 3000 photo 4hours digital audio
LCD	1.8" TFT (279*220)
PC Adapters	ISA, ECP, SCSI (option)

(home page: <http://www.mpegcam.net>)

2. CONSTRUCTION of MPEG CAMERA

Figure1 shows the block diagram of MPEG CAMERA.

2.1 CAMERA HEAD BLOCK

1/4" size 720*480 Inter Line CCD

3-times optical zoom lens and 2-times electrical zoom

2.2 CAMERA PROCESSOR BLOCK

Camera digital signal processing (DSP) LSI has changeable filters, Up/Down sampling circuits and CCD scanning circuits for coexistence of still picture (JPEG) mode and moving picture (MPEG) mode. The CCD is driven in the line-mixed readout and DSP outputs 352*240(4.2.0) pixels picture at the MPEG mode. At the JPEG mode, CCD is driven in the frame(non line-mixed) readout and DSP outputs 704*480(4.2.2) pixels picture.

And this LSI has detectors for image brightness, color information, and integral value of the edge signal. Most of parameters of these filters and detectors are set by camera-micro-processor(H8-3042) and are able to be updated even in the middle of the recording.

2.3 CODEC BLOCK

CODEC LSI carries out realtime MPEG1 picture compression, including such as DCT, motion estimation, and quantization. 8Mbit SD-RAM is used for working-RAM and a VBV(Video Buffering Verify) buffer.

Bit rate Control for every macro block is done by built-in processor, and for every picture frame by System MPU(SH3, RISK processor, 54mips).

2.4 MPU BLOCK

System MPU is in charge of CODEC Control, MPEG audio (Layer II) compression, MPEG system stream generation (MUX), and File management. The MPU also controls "Media Navigation System," the file handling system. It displays thumbnail images for a user to manage files easily. Figure2 shows the signal flow at the MPEG system encoding.

2.5 LCD BLOCK

1.8" TFT LCD is used to monitor recording image, and playback image.

2.6 HDD

HDD interface is PCMCIA-ATA standard compliant. File Format is FAT compatible and improved. Proprietary emergency method is because the camera is easy to receive a physical shock and sudden power off.

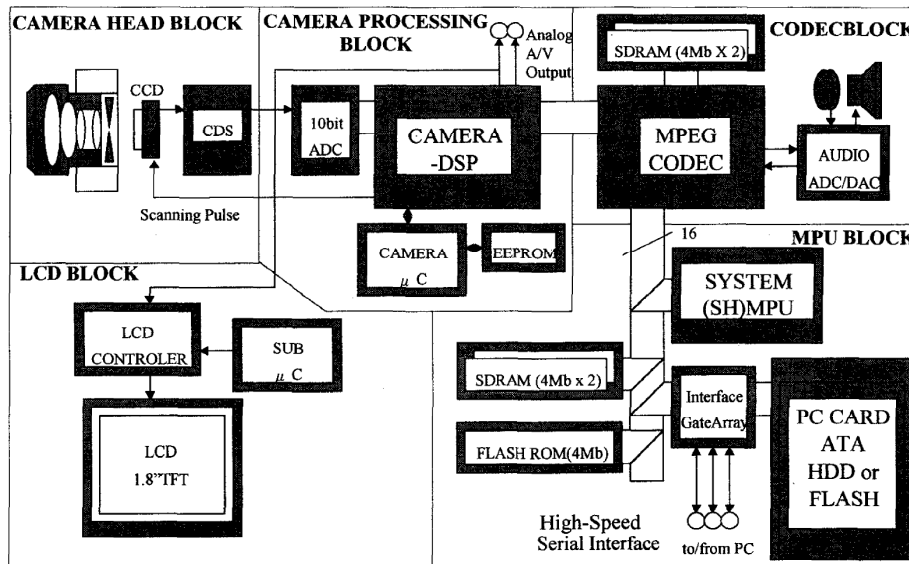


Figure1 Block Diagram of MPEG Camera

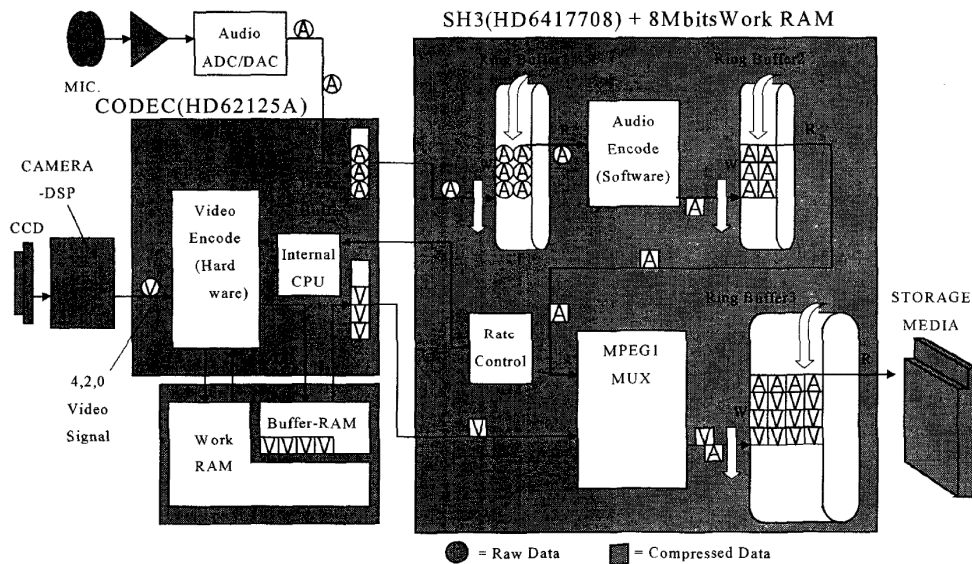


Figure2 : MPEG system encoding signal flow

3. PICTURE IMPROVEMENT

Block distortion and mosquito noise easily appear in the high-contrast edge outskirts or the scene change.

This problem is serious in realtime MPEG encoding because it is difficult to optimize bit distribution. As a solution for this problem, a method is known to optimize bit distribution based on the past dozens of frames stored in frame memory. However, it is not appropriate due to its cost, size and power consumption for a handy camera.

To solve the problem, we focus on a characteristic of MPEG camera that camera block and compression block are connected. Due to the rate control, block distortion and mosquito noise easily appear at edges in high resolution picture where enough bit is not given and Qscale is not small enough. It means that the block distortion and mosquito noise can be reduced if the camera block controls the detail information of the image adaptively on the picture scene by using the Edge Enhance Filter or the Coring filter.

We have adopted a system that the system MPU(SH3) always watches the quantization coefficient and the picture information from camera block, such as image brightness and total amount of edge signals. The system MPU orders to the camera processing block to update its signal processing characters. The signal processing characters include filtering coefficient such as horizontal and vertical edge enhancement, and coring filter to reduce low level signal response.

In other words, this method controls the system at the optimum point on the compression noise and blurring. Therefore, the system significantly reduces block distortion and mosquito noise and realize good picture quality.

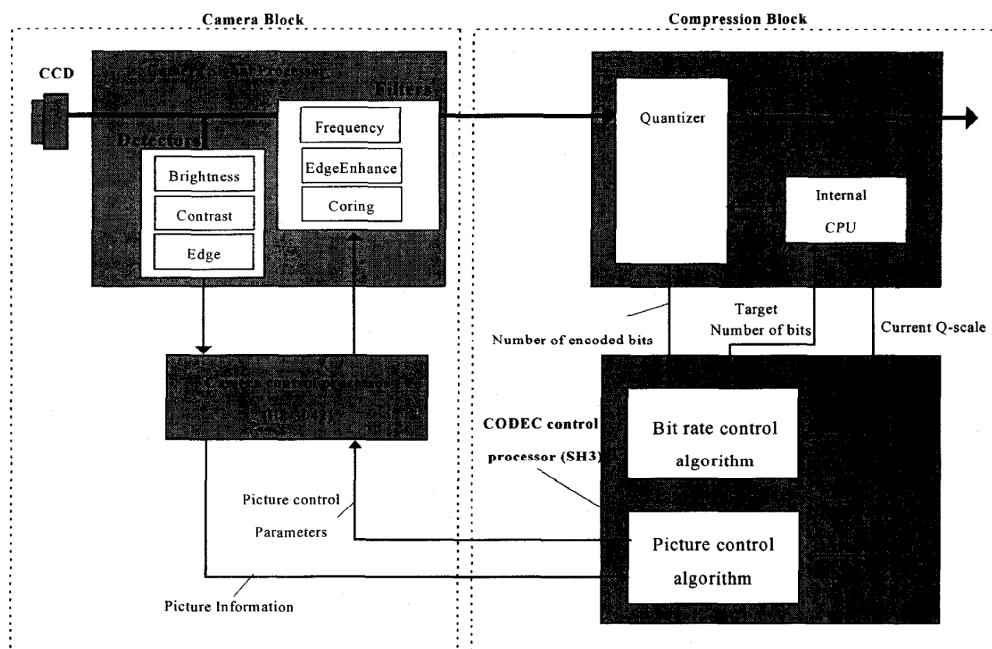


Figure3:Internal communication system for Picture Controlling

4. CONCLUSION

We have developed a real-time MPEG-1 CODEC LSI and a camera signal processing LSI and to realize a handy MPEG-1 video and JPEG still photo camera together with RISC MPU(SH-3)

We have improved the picture quality with new signal processing system that always communicates picture information between the compression block and the camera signal processing block, and update filtering parameters according to the picture scene.

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