

Digital Video Recorder with Motion JPEG using LabVIEW and IMAQ Products

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The Challenge: Determining time-dependent features in motion pictures.

The Solution: Using online digital recording with motion JPEG to perform off-line image analysis.

Introduction

Identifying motion in a sequence of grey colour images is a frequent problem in medical research. If the online motion analysis is not necessary, the unambiguous chronological assign to every single image is sufficient. CCD-Cameras or analogue VCR in CCIR or RS 170 norm are conventionally used as image sources. The acquisition time varies from one to 60 minutes. These medical terms of reference form the basic of the technical demands on the image acquisition system.

System Hardware

- Sony CCIR CCD-Camera
- Grundig analogue VCR
- PCI 1407 Frame grabber
- PC 500 MHz Pentium III
- Dual processor system
- Intel BX Chip set
- 128 Mbytes RAM
- UW-SCSI Bus

The digitized video signal is displayed on the PC monitor (768*576 pixel, 25 frames/s). Therefore no additional analogue monitor is required to control the sharpness or the brightness of the image.

System Software

- Windows NT 4.0
- LabVIEW 5.1
- IMAQVision 5.0
- Intel JPEG Library

Within a cycle of

40 ms, the software has to manage the following tasks:

- Acquire the image
- Display the image on the PC monitor
- Compress the image and write to file

The standard VI from the IMAQ Vision Library "Write JPEG File" is the only one with compression functionality, but is not fast enough to compress the images in real time (150 ms for 768*576 pixel). To avoid the file handling in every cycle, the destination of the JPEG byte stream should be the memory and not a file. But there is no VI in the IMAQ Vision library containing these properties. Nevertheless, the application of the JPEG standard is suitable for the compression

of sequences. JPEG Encoder does not use any frame differencing or motion estimation. This makes accurate frame analysis possible without any loss of image quality. So, the goal was to create an encoder and a decoder VI using the JPEG still-image compression standard.

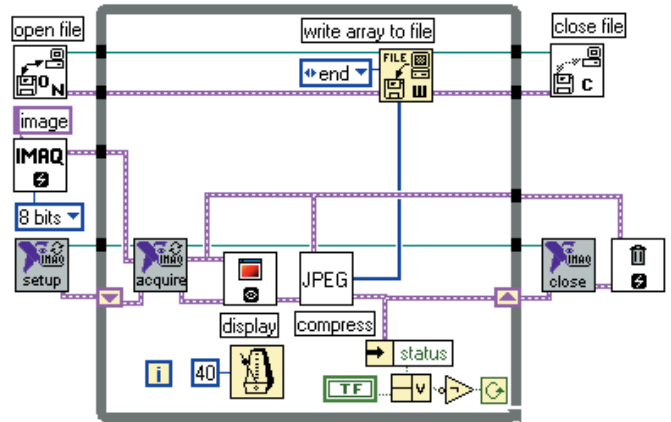


Figure 1. Digital Video Recorder with Motion JPEG

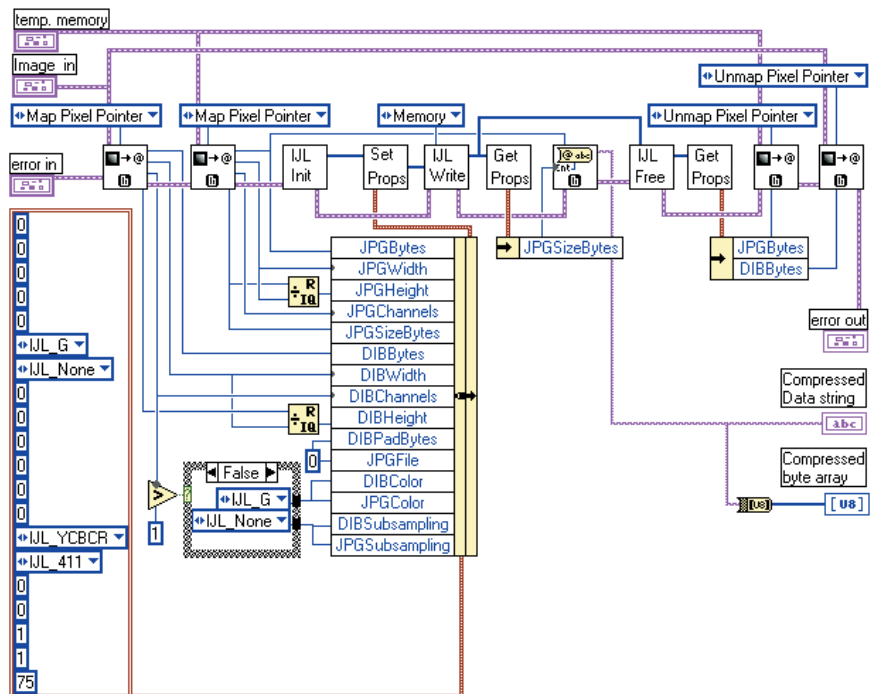


Figure 2. JPEG Encoder Using LabVIEW and the IJL DLL

LabVIEW Calls Intel

An important benefit of using LabVIEW is the ability to call dynamic link libraries (DLL). In search of a JPEG compression algorithm, we found the Intel JPEG Library (IJL). The IJL contains a DLL that provides high-performance JPEG encoding and decoding of full color and grey scale images. The IJL was designed for use on Intel processor-based systems and has been tuned for high performance (MMX) and efficient memory usage. You can download it for FREE at developer.intel.com

This DLL makes conversion to and from JPEG simpler by working on a DIB byte format. This makes it easier for LabVIEW programmers to use than the Independent JPEG Group's C code, because the input and output format in memory is a standard Windows format. Figure 2 shows the LabVIEW diagram of the JPEG encoder, containing some non-standard VIs. The SetProps and GetProps VIs write or read the JPEG Core Properties, serving as passing parameter. The VIs IJLinit, IJLfree, IJLwrite, and IJLread call the DLL functions of the same name. That shows, no C code (CIN) is necessary to develop the JPEG encoder and decoder (see Figure 3). But how time consuming is the IJL compression algorithm?

Benchmarks

Using the VI Performance Profiler, the following VI times we measured on different PC systems for encoding one frame with a resolution of 768*576 pixel and an 8-bit grey level.

The selected JPEG image quality has no effect on the VI time, only the size of the compressed byte stream changes. As you can see from the benchmarks, a full-sized digital

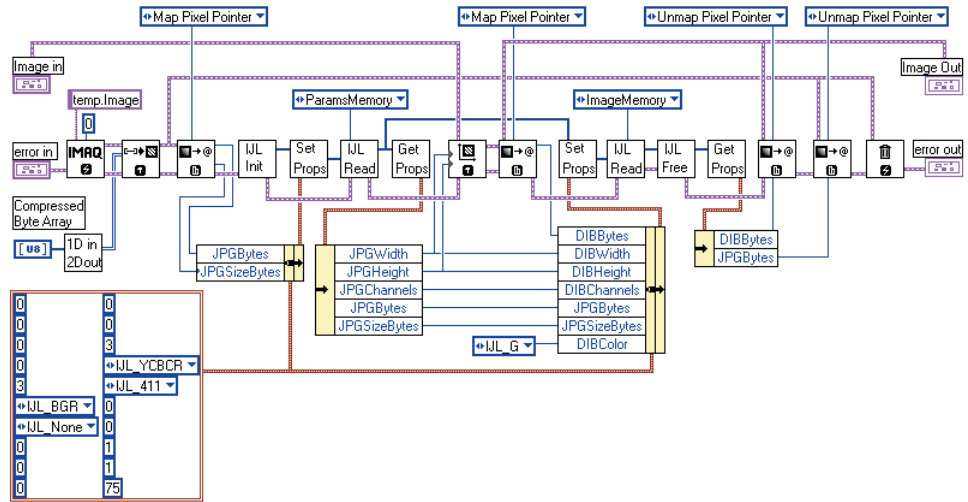


Figure 3. JPEG Decoder Using LabVIEW and the IJL DLL

PC System	Speed	VI Time
Pentium II 233 MHz	Dual FSB 66 MHz	110 ms
Pentium II 333 MHz	Single FSB 66 MHz	89 ms
AMD K6-2 333 MHz	Single FSB 100 MHz	80 ms
Pentium III 500 MHz	Dual FSB 100 MHz	47 ms

All systems: 128 Mbytes RAM

recording system, using LabVIEW and the IJL DLL, may soon be possible. To keep real-time conditions, JPEG images are currently scaled to 1/2. You can save the large binary files to cost effective DVD RAM.

Conclusion

Using LabVIEW and IMAQ products, we developed a digital video recorder in a very short time. The high performance of PC technology makes it possible to create inexpensive real-time applications based on VIs.■

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