DIGITAL MOVING AND STILL PICTURE CAPTURE ADAPTOR FOR MOVING PICTURE VIDEO CAMERA

Related Application

The subject matter of this application is related to the subject matter of the following patent application:

U.S. Patent Application Serial Number 08/708,388, entitled "Moving Picture Camera with Universal Serial Bus Interface," filed September 4, 1996 for Peter Hsieh and Shyh-Rong Wang.

The above-listed patent application is commonly assigned to the assignee of this application and is incorporated herein by reference.

Field of the Invention

The present invention pertains to moving picture and still picture video cameras.

Background of the Invention

A conventional "camcorder" or moving picture camera typically includes a charge coupled device or CCD for converting light images to electrical signals (although such CCD's may soon be replaced by CMOS photosensors, such as disclosed in R. Nixon, S. Kemeny, B. Pain, C. Staller & E. Fossum, *256 x 256 CMOS Active Pixel Sensor Camera-on-a-Chip,* IEEE J. SOLID STATE CIRS., vol. 31, no. 12, p. 2046-2050, Dec., 1996). Typically, such cameras and camcorders have circuitry for sequentially capturing pictures at a rate of 60 fields per second, 30 frames per second or some other rate. The camcorder outputs an analog moving picture video signal containing the sequentially captured video

signal and other control signals such as vertical and horizontal blanking pulses. Such outputted video signals, referred to as composite video signals, typically contain an analog version of each individual picture and are produced according to some standard such as NTSC, PAL, S-Video, etc. The camcorder also typically has an analog audio signal output for outputting an analog audio signal. Cameras are also available which instead, or in addition, simply output the sequence of pictures of the moving picture signal as a digital bitstream.

Although digital camcorders are available, they tend to be substantially more expensive than analog camcorders. Thus, most camcorders currently available are analog camcorders. Frame capture cards exist that can be installed into personal computers. A frame capture card has a video input capable of receiving an analog video signal. The frame capture card can capture digital moving picture video. However, such frame capture cards suffer from a number of disadvantages as described in co-pending U.S. Patent Application Serial Number 08/708,388. First, most computers are not provided with a frame capture card. Thus, a user with a portable camera must carry the correct frame capture card to the remote shoot and install and configure the frame capture card in the available computer, assuming the available computer is amenable to such installation and configuration. Second, not all frame capture cards will work with each camcorder--compatibility is not guaranteed. In any event, communication of the video signal between the camera and the frame capture card is by means of a cable. As such, the camera must be tethered to the frame capture card/computer. Other disadvantages include the requirement for a novice user to open the computer housing to install the frame capture board, thereby possibly voiding the manufacturer warranty, a requirement to configure the frame capture board correctly, wherein each frame capture board has

different configuration settings, etc. As such, frame capture cards have not gained wide-spread adoptance in the consumer market.

It is an object of the present invention to provide a capability to capture an analog moving picture video signal, outputted from existing analog camcorders and cameras, as a digital moving picture signal.

A second kind of camera currently available is a digital still camera. This camera also has a CCD for converting light images to electrical signals. A single picture may be captured at a time and stored in digital form on a flash memory card resident in the digital still camera. Some digital still cameras also contain compressors, such as JPEG compatible compressors, for reducing the amount of data necessary to store the captured picture. The digital still cameras generally also have an interface for downloading captured pictures to a computer for further processing, such as image enhancement, printing, etc. One digital still camera manufactured by Casio™ also has an interface for receiving a picture from a computer and for outputting a composite signal displaying the still picture. The composite video signal thus formed may be outputted onto a standard monitor. Some digital still cameras (such as available from Casio™) also contain an LCD display for displaying the captured pictures stored therein. Another digital still camera manufactured by Ricoh™ enables recording an audio clip along with a captured still picture.

The resolution of digital still cameras is typically 640x480 and cost approximately $ 600. Cheaper cameras are also available but have a lower resolution. In addition, still cameras with higher resolutions, e.g., 1024x768 have recently become available. However, such high resolution cameras cost approximately $1,000 or more. Thus, high

costs have been a barrier for wide spread adoptance of these digital still cameras for consumer use.

A second disadvantage of digital still cameras is that no universal interface is provided for connecting the camera to a computer. Kodak™'s DC-40™ has a cable that can connect to either the modem port or the printer port of a Macintosh™ compatible computer. However, a second adaptor cable is needed to connect the DC-40™ to a PC compatible computer. The download time is also very lengthy; to download 48 compressed 640x480 pixel images can take approximately 15 minutes.

It is an object of the present invention to overcome the disadvantages of the prior art.

Moreover, many consumers already own moving picture video cameras but do not yet own digital still cameras. It is an object of the present invention to provide a still picture capability to such moving picture cameras.

Summary of the Invention

These and other objects are achieved according to the present invention. According to an embodiment, an adaptor for a moving picture video camera is provided. The adaptor includes an input for receiving a moving picture video signal from a moving picture video camera. The adaptor also includes a compressor connected to the input to extract a selected picture from the moving picture video signal and to compress the extracted picture. A bidirectional serial interface is connected to the compressor to serially receive data from an external source and to output the compressed extracted picture generated by the compressor. In this manner, the adaptor allows an ordinary analog camera or camcorder to function as a digital still camera.

Advantageously, the adaptor includes a housing having a volume that is less than or equal to the volume of the camera and which can attach directly to the camera. Alternatively, the adaptor may be attached via a video cable connected to the video output of the camera and the input of the adaptor.

According to another embodiment, an adaptor is provided for converting analog moving picture video signals to digital form. The adaptor has an input for receiving an analog video signal. An analog to digital converter is provided for converting the analog video signal to a digital video signal. The adaptor also has a compressor connected to the analog to digital converter for compressing the digital video signal, in real-time, to produce a compressed moving picture video signal. Furthermore, the adaptor has a bidirectional serial interface connected to the compressor, for receiving data from an external device and for outputting the compressed moving picture video signal to the external device.

Illustratively, the bidirectional interface receives instructions from the external device (which may be a personal computer) interspersed with the outputted compressed moving picture video signal for varying a compression of the compressor. The compressor responds to these commands by varying the compression of the digital video signal in accordance with each received instruction.

Alternatively, or additionally, the bidirectional interface receives, interspersed with a downloaded/outputted compressed moving picture video or still picture signal, an uploaded compressed still picture or moving picture video signal from the external device for decompression by, and output from, the adaptor.

Brief Description of the Drawing

FIG 1 shows a digital moving and still picture capture adaptor for a moving picture video camera according to an embodiment of the invention.

FIG 2 shows a host computer according to an embodiment of the invention that communicates with the adaptor of FIG 1.

Detailed Description of the Invention

FIG 1 shows a still picture adaptor 300 for an analog or digital moving picture camera 10 or 20, respectively, according to an embodiment of the invention. Illustratively, the adaptor 300 is small and is contained in a housing that has a smaller volume than a camcorder 10 with which it can be used. Preferably, the housing of the adaptor 300 is designed to attach directly to the housing of the camcorder 10. However, in one embodiment, the adaptor 300 is designed to work with camcorders 10 of various shapes and sizes and need not connect directly to the camcorder 10 housing. The adaptor 300 can also be installed within the housing of the camcorder 10 for suitable camcorder designs.

As shown, a composite NTSC, PAL, S-video, etc. video signal is outputted from analog video camcorder 10 and is received via a first video input 301 of the adaptor 300 at a video decoder 305. A composite signal typically includes an analog color video signal including I and Q color component signals superimposed on a monochrome signal M. The monochrome signal M contains analog luminance information interspersed between horizontal and vertical blanking pulses. The video decoder 305 separates the M, Q and I component signals from the composite signal. The video decoder 305 recovers the luminance Y and chrominance signals C_r and C_b or the signals R, G and B from the

M, Q and I signals, but discards the control signals, e.g., the horizontal and vertical blanking pulses. The received signals are converted to digital form, e.g., by sampling, to produce digital picture signals. In short, the video decoder 305 recovers a sequence of digital picture signals (stripped of their carrier signals and control signals) in digital form.

The recovered pictures are outputted from the video decoder 305 to a multiplexer 310. The adaptor 300 also has a second input 302 for receiving a moving picture signal from a digital camera 20 in digital form. The digital moving picture signal received from the second input 302 is fed to a second input of the multiplexer 310. In response to a select signal, which may originate from an externally operated switch or from the video processor 330, the multiplexer 310 selects either the digital picture signal generated by the video decoder 305 or the digital picture signal received from the second input 302 of the adaptor 300.

The multiplexer 310 outputs the selected moving picture signal to the video processor 330 via a video bus or V-bus. The video processor 330 illustratively may be a model W9962™ video compressor/decompressor distributed by Winbond Systems Laboratory™, located in San Jose, California. The video processor 330 receives the moving picture signal outputted from the multiplexer 310. In response to a select signal, which may be externally generated (e.g., from a push button switch on the adaptor 300 or from an attached host computer 120), or internally generated by the video processor 330, the video processor 330 extracts a selected picture from the moving picture signal. The selected picture is illustratively stored in frame buffer 350 which may be formed from DRAMs. This may be achieved as follows. A moving picture signal is outputted from the multiplexer 310 to the video processor 330. Illustratively, this moving picture signal is also outputted to either an attached LCD display 30 or via video encoder 370 to a

television monitor 35 (as described in greater detail below). As each picture of the moving picture signal is received by the video processor 330, the video processor 330 outputs the picture via a DRAM bus or D-bus to the frame buffer 350. Each successive picture illustratively overwrites the preceding picture of the moving picture signal in the frame buffer 350. When the user decides to capture one of the moving pictures as a still picture (e.g., after proper focusing, image composition, etc., as viewed on the LCD monitor 30 or television monitor 35) the user generates a picture select signal. In response to the externally generated select signal, the video processor 330 compresses the picture in the frame buffer 350, e.g., in real-time, and can transfer the compressed picture to, for example, the non-volatile buffer 360.

The video processor 330 is a programmable processor which supports video compression and decompression according to a variety of still and moving picture formats including JPEG, MPEG, MPEG-2, H.263, etc. As described in greater detail below, the particular compression format used may be selected by the user and uploaded to the video processor 330, e.g., from the host computer 120 or the non-volatile buffer 360. The compressed picture has a reduced storage capacity. For instance, suppose the original picture has 525 lines x 352 columns of pixels. Such a picture may be converter to 640 x 480 pixels by the video encoder 305 (using decimation and interpolation) in RGB form with 3 bytes/pixel. The storage requirement of such a picture is 921,600 bytes. Using JPEG compression, the storage requirement can be reduced significantly (depending on the picture and various selectable parameters). For example, good image quality can usually be achieved in JPEG using a 20:1 compression factor, thereby reducing the storage requirement to about 46 kbytes, although storage requirements of 10-25 kbytes can also be achieved using higher compression ratios.

The video processor 330 may store an extracted picture in an optional nonvolatile buffer 360, which may be constructed from flash memories situated on a removable flash card. Illustratively, to conserve space, the picture is compressed prior to storage. In addition, the extracted picture may be outputted from the video processor 330 to an RF module 355. The RF module 355 illustratively modulates the picture onto a carrier signal and transmits the modulated signal to a remote receiver. Such an RF module 355 can be used in a video teleconferencing system. For instance, the receiver may be part of a video conferencing codec which receives the transmitted video signal and transmits the video signal via a telephone network to a remote station. At the remote station, the video signal is decoded and displayed on the remote monitor station. Thus, the adaptor 300 provides greater mobility for the camera used in a teleconference since the camera is not tethered to the codec or other equipment. Again, the picture is advantageously compressed prior to output to the RF module 355 to conserve communication bandwidth.

The extracted picture can also be outputted via an interface 340 to an external device, such as a host computer 120 (FIG 2). Illustratively, the interface 340 is a Universal Serial Bus (USB) hub as described in Open HCI, Universal Serial Bus Specification v.1.0, Jan. 19, 1996. The USB hub 340 is described in greater detail in copending U.S. Patent Application Serial Number 08/708,388 and is therefore only briefly described herein. Essentially, the USB hub 340 is a bidirectional serial interface which supports data transfers at a slow rate of 1.2 Mbit/sec or a fast rate of up to 12 Mbits/sec. Multiple USB "hubs" can be connected in a tree configuration. A 1024 x 768 resolution picture compressed with a 20:1 compression ratio (to about 940 kbits) can be downloaded via the USB interface 340 in less than .1 seconds.

An advantage of the USB hub 340 is its ability to support bidirectional transfers. Thus, pictures can be downloaded, processed by the host computer 120 and then uploaded to the video processor 330. The video processor 330 is capable of decompressing the uploaded pictures. The uploaded pictures can be stored in the nonvolatile buffer 360, stored on mass storage device 60, modulated and transmitted via modulator 355, decompressed and outputted via the V-bus to the video encoder 370, or directly outputted to LCD monitor 30. Likewise, commands/instructions for varying the compression by the video processor 330 or for controlling other circuitry of the adaptor can be uploaded from the host computer 120 via the USB hub 340. Uploaded data (e.g., pictures or commands/instructions) transfers from the host computer 120 to the video processor 330 via the USB hub 340 are interspersed amongst downloaded data (e.g., compressed pictures) transfers from the video processor 330 to the host computer via the USB hub 340.

In addition to the above still picture capture and compression, the video processor 330 is also illustratively capable of performing moving picture capture and compression in real-time according to one of a number of compression standards such as H.261, H.262, H.263, MPEG, MPEG-2, motion JPEG, etc. Illustratively, the compression standard, parameters thereof or optional encoding techniques may be selected/programmed by commands received from the host computer 120 via the USB hub 340 or from the non volatile buffer 360. The above still picture process is modified to extract and compress a sequence of multiple pictures. It is also possible to only extract one out of every N pictures of a sequence for compression, where N is an integer > 1, if the video processor 330 is not capable of compressing and/or outputting a compressed moving picture video signal at the full picture rate of the inputted moving picture video signal. Note that the

outputted compressed moving picture signal can be outputted to the same devices as the still pictures, i.e., to the video encoder 370 (after decompression), the frame buffer 350, the non-volatile buffer 360, the RF module 355 and the USB hub 340. If the compressed moving picture video signal is outputted to the host computer 120 via the USB hub 340, the host computer 120 can transmit commands/instructions for varying the compression of the compressed moving picture video signal or a second still picture or moving picture video signal, interspersed amongst transfers of compressed moving picture video signal data. The transfer of compressed moving picture video signals via the USB hub 340 to the host computer 120, and processing at the host computer 120, is essentially the same or very similar to that of still pictures.

For moving picture compression, e.g., according to MPEG, MPEG-2, H.263, etc., the storage requirement increases dramatically, especially for an entire video clip or sequence of multiple moving pictures. To that end, the compressed moving pictures may be outputted from the video processor 330 to a high bandwidth and mass storage device 60 via an interface such as a SCSI port 380. Examples of high bandwidth, mass storage devices include hard disk drives, read-writable compact disks (CD-R) and writable DVD's (formerly known as "digital video disks"). As is well known, the SCSI port 380 supports bidirectional transfer of information, and thus compressed (still or) moving pictures and/or instructions or commands can also be retrieved from the mass storage device via the SCSI port 380 into the video processor 330.

The video encoder 370 receives either moving pictures outputted form the multiplexer 310 or decompressed pictures outputted from the video processor 330. The video encoder 370 contains a digital to analog converter for converting the digital pictures to analog form. The analog picture signals are converted to appropriate signals M, Q I

and appropriate control signals (e.g., vertical and horizontal blanking pulses) are inserted into the signal M. The M, Q and I signals are then combined together to produce a composite video signal in, for example, NTSC, PAL, etc., form.

The adaptor 300 may also have an audio input 303 for receiving a digital audio signal fed from the camcorder 10. A second audio input 304 may also be provided for receiving an analog audio signal from a second audio device, such as a microphone 40. The analog audio signals received from the audio inputs 303 and 304 are fed to an analog multiplexer 315. In response to a selection signal, which may be externally generated or supplied from the audio processor 335, the multiplexer 315 selects one of the two analog audio signals for output to an analog to digital converter 320. The analog to digital converter 320 samples the selected audio signal and outputs a digital audio signal onto the audio bus or A-bus.

The audio processor 335 receives the digital audio signal from the A-bus. The audio processor 335 is capable of processing the audio signals in a variety of manners including filtering the digital audio signals, compressing the digital audio signals, etc. The audio processor 335 also has a USB hub 345 connected to the USB hub 340. This enables the audio processor 335 to communicate with the host computer 120 and the video processor 330 in a bidirectional fashion. Thus, audio signals may be downloaded to the video processor 330 and/or host computer 120 or uploaded from the video processor 330 and/or host computer 120 interspersed with such downloaded audio signals. Likewise, the audio processor 335 receives instructions or commands from, or transmits instructions or commands to, the video processor 330 and/or host computer 120 interspersed with audio transfers. Such an interconnection also enables the audio processor 335 to access the modules connected to the video processor 330. In addition, the audio processor 335 is

connected via a second port to the video processor 330 for direct bidirectional communication therewith. Like the video processor 330, the audio processor 335 is also connected to the non-volatile buffer 360 and can both read information, e.g., audio clips, commands, etc., from, and write information to, the non-volatile buffer 360. In addition, the audio processor 330 is illustratively connected to the RF module 355 and can output audio signals thereto for modulation onto a carrier for transmission to a receiver. The audio processor 335 can operate contemporaneously with, or independently of, the video processor 330. Thus, for example, both compressed audio and pictures can be simultaneously modulated onto a carrier signal and transmitted from the module 355 to a remote station.

The audio processor 335 can decompress audio signals and output them via the A-bus. The outputted digital signals, provided either from the audio processor 335 or from the ADC 320 are received at a digital to analog converter 325. The digital to analog converter 325 recovers an analog audio signal from the received digital audio signal. The recovered audio signal may then be outputted, e.g., to a loudspeaker 50.

Illustratively, the adaptor 300 has a power supply 375 in the form of a battery pack (with a NiCd, NiMH, Li ion, etc. battery). As shown, the power supply 375 is connected to a power management circuit 365. The power management circuit 365 is for managing the consumption of power by the circuitry of the adaptor 300 so as to conserve power. The power management circuit 365 outputs power supply voltages to each circuit, such as the video decoder 305, video multiplexer 310, analog multiplexer 315, analog to digital converter 320, digital to analog converter 325, video processor 330, audio processor 335, frame buffer 350, RF module 355, nonvolatile buffer 360, video encoder 370, SCSI port 380, etc. Illustratively, the power management circuit 375 only delivers power to those

circuits that need it and powers down those circuits that are inactive and therefore do not need power. The power management circuit 375 receives control signals from the video processor 330 or audio processor 335 indicating which circuits should remain active and should receive power, and which should be inactive and should be powered-down.

As noted above, the video processor 330 and the audio processor 335 can communicate with external devices, such as the host computer 120 or the non-volatile buffer 360 (which illustratively is formed on a removable medium, such as a flash card). This can be done for several reasons, such as to store still pictures, moving pictures, audio clips, instructions or commands or to retrieve previously stored pictures, moving picture video clips, audio clips, instructions or commands. In the case where a host computer 120 is available for attachment to a host computer 120, instructions or commands can be uploaded to the video processor 330 and/or audio processor 335 for performing a particular kind of compression, for selecting either the compressed still operating mode or the compressed moving picture operating mode, for varying a parameter, etc. In a "stand alone" case, where no host computer 120 is available for attachment, the adaptor 300 can receive such instructions or commands from an appropriate non- volatile memory 360 flash card inserted into the adaptor. Note that this enables production of a basic adaptor 300 with basic certain capabilities yet permits upgrading/expansion of capabilities by obtaining the appropriate flash memory card or software executing on the host computer 120. Thus, for example, only still picture capability can be provided in a basic adaptor 300. However, additional flash memory cards or software may be made available that provide moving picture capability to the adaptor 300. Alternatively, the basic adaptor 300 can be provided with both still and moving picture capability, e.g., using JPEG and H.263, and additional flash memory cards or software may be available with MPEG-2

compression capability. Instructions uploaded to the video processor 330 or audio processor 335 from the non-volatile buffer 360 or the host 120 illustratively are stored in registers of the video processor 330 or audio processor 335, respectively.

In addition to providing still/moving picture selection mode instructions and compression instructions, the host computer 120 or non-volatile buffer 360 can provide commands and instructions for producing one or more photographic effects. For instance, by appropriate programming of the video processor 330, the extracted picture can be filtered prior to compression. Filtering prior to compression tends to produce pictures with higher quality. In addition to providing instructions and commands for operating the video processor 330 and audio processor 335, the host computer 120 and/or non-volatile buffer 360 can provide instructions for operating virtually any of the circuits 305, 310, 315, 320, 325, 340, 345, 350, 355, 360, 365, 370 and/or 380. For example, the host computer 120 or non-volatile buffer 360 can provide instructions for selecting a particular picture for capture, selecting a particular audio input 303 or 304, etc.

Referring now to FIG 2, the host computer 120 is shown in greater detail. Such a computer architecture is also described in copending U.S. Patent Application Serial Number 08/708,388 and is therefore only briefly described herein.

The host computer system 120 illustratively includes a cpu bus 122, a system bus 124 (e.g., a PCI bus) and an I/O expansion bus 126 (e.g., as ISA bus). Connected to the cpu bus 122 is at least one processor 128 and a "north" bridge or memory controller 130. The north bridge 130 connects a cache 132 and a main memory 134 to the processors 128 on the cpu bus 122. The north bridge 130 also enables data transfers between devices on the system bus 124 and the memories 132 and 134 or the processors 128. Also connected to the system bus 124 is a graphics adapter 136. A display monitor 138 may be connected

to the graphics adapter 136. As shown, an Ethernet adapter 160 may be connected to the system bus 124.

Connected to the I/O expansion bus 126 is a disk memory 140 and interface, such as an IDE interface, a modem 158, and input devices 142 such as keyboard 144 and mouse 146. (Alternatively, the keyboard 144 and mouse 146 may also be connected to the USB hub 150.) Also connected between the system bus 124 and the I/O expansion bus 126 is a south bridge 148 or I/O bridge. The south bridge 148 enables data transfers between devices on the I/O expansion bus 126, such as modem 158, and devices on the USB 200 or devices on the system bus 124. Illustratively, according to the invention, the south bridge 148 also includes a USB hub 150. The USB hub 150 has one or more serial ports 152 that are connected to standard USB compliant connectors 154 to which a connection may be made totally externally to the housing 156 of the computer system. Illustratively, the USB hubs 150, 340 and 345 and cables 119 form the USB bus 200.

The USB hubs 340, 345 and 150 have both transmit and receive circuitry enabling bidirectional transfer of data on the USB 200. Other peripherals may also be connected to the USB 200. The bandwidth of the USB 200 is shared in a time division multiplexed fashion.

A picture or compressed moving picture video signal downloaded from the adaptor 300 is transmitted from the USB hub 340 to the USB hub 150. From there, the picture or compressed moving picture video signal is advantageously transmitted from the south bridge 148 and the system bus 124 to the graphics adapter 136. The graphics adapter 136 illustratively includes a drawing processor capable of decompressing the picture or compressed moving picture video signal and displaying it on the display monitor 138. Alternatively, if the graphics adapter 136 does not have decompression capability, the

picture or compressed moving picture video signal may be transferred from the south bridge 148 via system bus 124 and north bridge 130 to one of the memories 132 or 134. The processor 128 accesses the compressed still picture or moving picture video signal data and decompresses it. The decompressed still or moving picture data may then be transferred to the graphics adaptor 136 for display on the display monitor 138.

The processor 128 or drawing processor of the graphics adaptor 136 may perform various kinds of processing on the decompressed picture or moving pictures, such as filtering, cut and paste, zoom, image warping, etc. To that end, the processor 128 illustratively executes suitable image processing software, such as Adobe™ Photoshop™.

After processing the downloaded picture or moving pictures, the processor 128 (or drawing processor of the graphics adaptor 136) illustratively compresses the picture or moving pictures. The compressed, processed picture or moving picture video signal is then uploaded via the USB 200 (in a reverse path as in the download transfer) to the USB hub 340 of the video processor 330. In addition, a previously stored, or artificially generated, picture or compressed moving picture video signal contained in the host computer 120, e.g., in the hard disk 140, may be uploaded to the adaptor 300 in a similar fashion.

Similar downloading and uploading may be performed on compressed audio clips. In a downloading transfer, a compressed audio clip is transferred from USB hub 345 to USB hub 340, to USB hub 150, to south bridge 148, to system bus 124 and to graphics adaptor 136. The graphics adaptor 136 illustratively has an audio decompressor which decompresses the audio and reproduces the audio on a loudspeaker (e.g., of the display monitor 138). Alternatively, the audio is first transferred to one of the memories 132 or 134 and decompressed by the processor 128. The decompressed audio is then transferred

to the graphics adaptor 136. Processing may be performed on the decompressed audio such as filtering, cutting and pasting, etc. In an upload operation, a drawing processor of the graphics adaptor 136, or the processor 128 illustratively first compresses the audio. The audio is then uploaded via south bridge 148, USB hub 150, USB hub 340 and USB hub 345 to the audio processor 335. Note that previously stored, or artificially generated, audio can also be uploaded to the adaptor 300 in a like fashion.

The processor 128 can also download commands/instructions from, or upload commands/instructions to, the adaptor 300 using a similar data path as for the pictures and audio clips. The uploaded/downloaded commands/instructions are interspersed amongst the uploaded/downloaded pictures and audio clips (within the serial bidirectional bit stream carried on USB 200) in a time division multiplexed fashion. This provides several options. As noted above, the processor 128 can upload instructions/commands for selecting a kind of compression or for varying a parameter of that selected compression. Note also that the video processor 330 and the audio processor 335 advantageously are programmable processors containing a memory for storing parameters and instructions. The uploading of instructions/commands can therefore be used to effect a software upgrade to the adaptor 300. In addition, the processor 128 can examine data/parameters stored in various memories and registers of the audio processor 335 and video processor 330. This enables the processor 128 to "auto-sense" or automatically determine exactly which compression technique and which selectable options and parameters were used to generate compressed images. For example, the same hardware can be used to perform both moving picture or still picture capture and compression depending on commands/instructions uploaded from the host computer 120.

Finally, the above-discussion is intended to be merely illustrative of the invention. Numerous alternative embodiments may be devised by those having ordinary skill in the art without departing from the spirit and scope of the following claims.

Claims



The claimed invention is:

1. A still picture capture adaptor for a moving picture video camera comprising:

an input for receiving a moving picture video signal from a camera,

a compressor connected to said input to extract a selected picture from said moving picture video signal and to compress said extracted picture, and

a bidirectional serial interface connected to said compressor to serially receive data from an external device and to output to said external device said compressed extracted picture generated in said compressor.

2. The adaptor of claim 1 further comprising:

a video decoder connected between said input and said compressor to receive a composite moving picture video signal, to extract each moving picture contained in said composite moving picture signal, to digitize said pictures and to sequentially output each of said digitized pictures to said compressor.

3. The adaptor of claim 2 further comprising:

a second input for receiving a second moving picture signal, and

a multiplexer having a first multiplexer input receiving said second moving picture signal, a second multiplexer input connected to said video decoder and an output connected to said compressor, said multiplexer selecting said second moving picture signal or said sequentially outputted digitized pictures generated by said video decoder in response to a select control signal.

4. The adaptor of claim 1 further comprising:

a non-volatile memory connected to said compressor for storing one or more of said pictures extracted by said compressor.



5. The adaptor of claim 4 wherein said non-volatile memory selectively stores said pictures prior to or after compression by said compressor.

6. The adaptor of claim 1 further comprising:

a buffer connected to said compressor to store said extracted picture prior to compression by said compressor.

7. The adaptor of claim 1 wherein said bidirectional interface receives a command for varying a compression of said compressor interspersed with said compressed extracted picture and wherein said compressor responds to said command by varying said compression of said extracted picture as specified by said command.

8. The adaptor of claim 1 further comprising:

a video encoder connected between said compressor and an output of said adaptor for receiving a picture and generating a composite signal containing said picture for display on a monitor,

wherein said compressor further comprises a decompressor which selectively decompresses compressed pictures and outputs each decompressed picture to said video encoder.

9. The adaptor of claim 1 further comprising:

a power supply for supplying power to at least said compressor and bidirectional interface.



10. The adaptor of claim 1 further comprising:

a power management circuit connected to at least said compressor and said bidirectional interface, for selectively powering down each device connected thereto, when not operating, to conserve power.

11. The adaptor of claim 1 further comprising:

an audio compressor for compressing an inputted audio signal to produce a compressed audio signal, said audio compressor also being connected to said bidirectional interface to output said compressed audio signal.

12. The adaptor of claim 11 further comprising:

a first input for receiving a first analog audio signal,

a second input for receiving a second analog audio signal, and

an analog multiplexer having a first multiplexer input for receiving said first analog audio signal, a second multiplexer input for receiving said second analog audio signal, and an output connected to said audio compressor, said multiplexer selecting said first analog audio signal or said second analog audio signal in response to a select control signal.

13. The adaptor of claim 12 further comprising:

an analog to digital converter connected between said output of said analog multiplexer and said audio compressor for converting said selected audio signal outputted from said analog multiplexer to a digital audio signal.



14. The adaptor of claim 11 further comprising:

a non-volatile memory connected to said audio compressor for storing said compressed audio signal.

15. The adaptor of claim 11 wherein said bidirectional interface receives a command for varying a compression of said audio compressor and wherein said audio compressor responds to said command by varying said compression of said inputted audio signal as specified by said command.

16. The adaptor of claim 11 further comprising:

a digital to analog converter connected to said audio compressor for receiving a digital audio signal and converting said received digital audio signal to an analog audio signal,

wherein said audio compressor further comprises an audio decompressor which selectively decompresses compressed audio signals and outputs said decompressed audio signals to said digital to analog converter.

17. The adaptor of claim 11 further comprising:

an RF module connected to said audio compressor for selectively receiving a compressed audio signal, modulating said compressed audio signal onto a carrier signal and transmitting said modulated carrier signal to a receiver.



18. The adaptor of claim 11 further comprising:

a non-volatile memory connected to said audio compressor for storing a command that can be uploaded to said audio compressor for controlling an operation of said adaptor.

19. The adaptor of claim 1 further comprising:

an RF module connected to said compressor for selectively receiving a compressed picture, modulating said compressed picture onto a carrier signal and transmitting said modulated carrier signal to a receiver.

20. The adaptor of claim 1 further comprising:

a non-volatile memory connected to said compressor for storing a command that can be uploaded to said compressor for controlling an operation of said adaptor.

21. The adaptor of claim 1 wherein said bidirectional interface receives, interspersed with said outputted compressed extracted picture, a second compressed picture outputted from said external device, and wherein said compressor comprises a decompressor for decompressing said second compressed picture.

22. An adaptor for converting analog moving picture video signals to digital form comprising:



an input for receiving an analog video signal,

a video decoder connected to said input for converting said analog video signal to a digital video signal,

a compressor connected to said video decoder for compressing said digital video signal, in real-time, to produce a compressed moving picture video signal, and

a bidirectional serial interface connected to said compressor, for serially receiving data from an external device and for outputting said compressed moving picture video signal to said external device.

23. The adaptor of claim 22 wherein said bidirectional interface receives instructions from said external device interspersed with said outputted compressed moving picture video signal for varying a compression of said compressor, said compressor responding to said commands by varying said compression of said digital video signal in accordance with each received instruction.

24. The adaptor of claim 22 wherein said video decoder receives a composite analog video signal from said input, extracts each moving picture contained in said composite analog video signal, digitizes each extracted moving picture and outputs each moving picture to said compressor as said digital video signal.

25. The adaptor of claim 24 further comprising:

a second input for receiving a second moving picture signal, and

a multiplexer having a first multiplexer input receiving said second moving picture signal, a second multiplexer input connected to said video decoder and an output connected to said compressor, said multiplexer selecting said second moving picture signal or said sequentially outputted digitized moving pictures generated by said video decoder in response to a select control signal.



26. The adaptor of claim 22 further comprising:

a video encoder connected between said compressor and an output of said adaptor for receiving a digital video signal and generating a composite signal containing said digital video signal for display on a monitor,

wherein said compressor further comprises a decompressor which selectively decompresses compressed digital video signals and outputs said decompressed digital video signals to said video encoder.

27. The adaptor of claim 22 further comprising:

an RF module connected to said compressor for receiving a compressed digital video signal, modulating said compressed digital video signal onto a carrier signal and transmitting said modulated carrier signal to a receiver.

28. The adaptor of claim 22 further comprising:

a second interface connected to said compressor for transferring a compressed moving picture video signal between said compressor and a high bandwidth, mass storage device.

29. The adaptor of claim 22 wherein said bidirectional interface receives, interspersed with said outputted compressed moving picture video signal, a second compressed moving picture video signal outputted from said external device and wherein said compressor comprises a decompressor for decompressing said second compressed moving picture signal.



30. The adaptor of claim 22 further comprising:

an audio compressor for compressing an inputted audio signal to produce a compressed audio signal, said audio compressor also being connected to said bidirectional interface to output said compressed audio signal.

31. The adaptor of claim 30 further comprising:

a first input for receiving a first analog audio signal,

a second input for receiving a second analog audio signal, and

an analog multiplexer having a first multiplexer input for receiving said first analog audio signal, a second multiplexer input for receiving said second analog audio signal, and an output connected to said audio compressor, said multiplexer selecting said first analog audio signal or said second analog audio signal in response to a select control signal.

32. The adaptor of claim 31 further comprising:

an analog to digital converter connected between said output of said analog multiplexer and said audio compressor for converting said selected audio signal outputted from said analog multiplexer to a digital audio signal.

33. The adaptor of claim 30 further comprising:

a non-volatile memory connected to said audio compressor for storing said compressed audio signal.



34. The adaptor of claim 30 wherein said bidirectional interface receives a command for varying a compression of said audio compressor and wherein said audio compressor responds to said command by varying said compression of said inputted audio signal as specified by said command.

35. The adaptor of claim 30 further comprising:

a digital to analog converter connected to said audio compressor for receiving a digital audio signal and converting said received digital audio signal to an analog audio signal,

wherein said audio compressor further comprises an audio decompressor which selectively decompresses compressed audio signals and outputs said decompressed audio signals to said digital to analog converter.

36. The adaptor of claim 30 further comprising:

an RF module connected to said audio compressor for selectively receiving a compressed audio signal, modulating said compressed audio signal onto a carrier signal and transmitting said modulated carrier signal to a receiver.

37. The adaptor of claim 30 further comprising:

a non-volatile memory connected to said audio compressor for storing a command that can be uploaded to said audio compressor for controlling an operation of said adaptor.

