EXHIBIT 1012

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Smith, Jr. et al.

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[54] **DIGITAL VIDEO SWITCHER INCLUDING A GENERAL PURPOSE PROCESSOR AND A CONTROL PROCESSOR**

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[73] Assignee: **ECHOlab, Inc.**, Chelmsford, Mass.

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[52] **U.S. Cl.** **348/722**; 348/705

[58] **Field of Search** 348/705, 706, 348/782, 571, 578, 584

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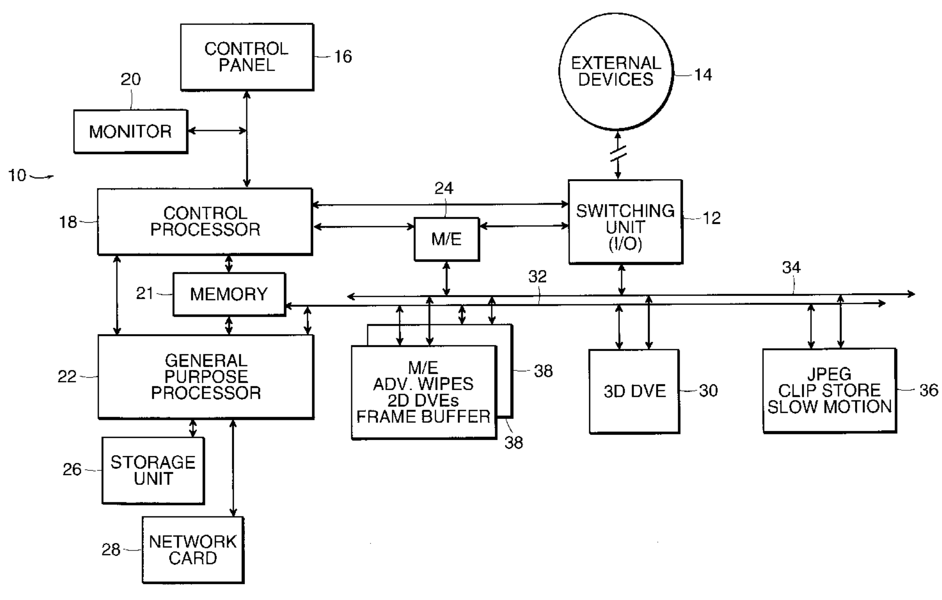
[57] **ABSTRACT**

A digital video production switcher processes a plurality of video signals in a production environment. The switcher includes a control panel for receiving operator inputs and switching unit for receiving video input signals and for providing video output signals. The switcher also includes a pair of tightly coupled, independent processors synchronized to the video frame rate: a control processor and a general purpose processor. The control processor controls the "live critical" production functions. The control processor provides control signals, in response to operator inputs, that program the switching unit to provide desired video output signals in real time. The general purpose processor runs an open architecture operating system and provides control signals, in response to operator inputs, that cause the switching unit to provide desired video output signals in real time.

19 Claims, 1 Drawing Sheet



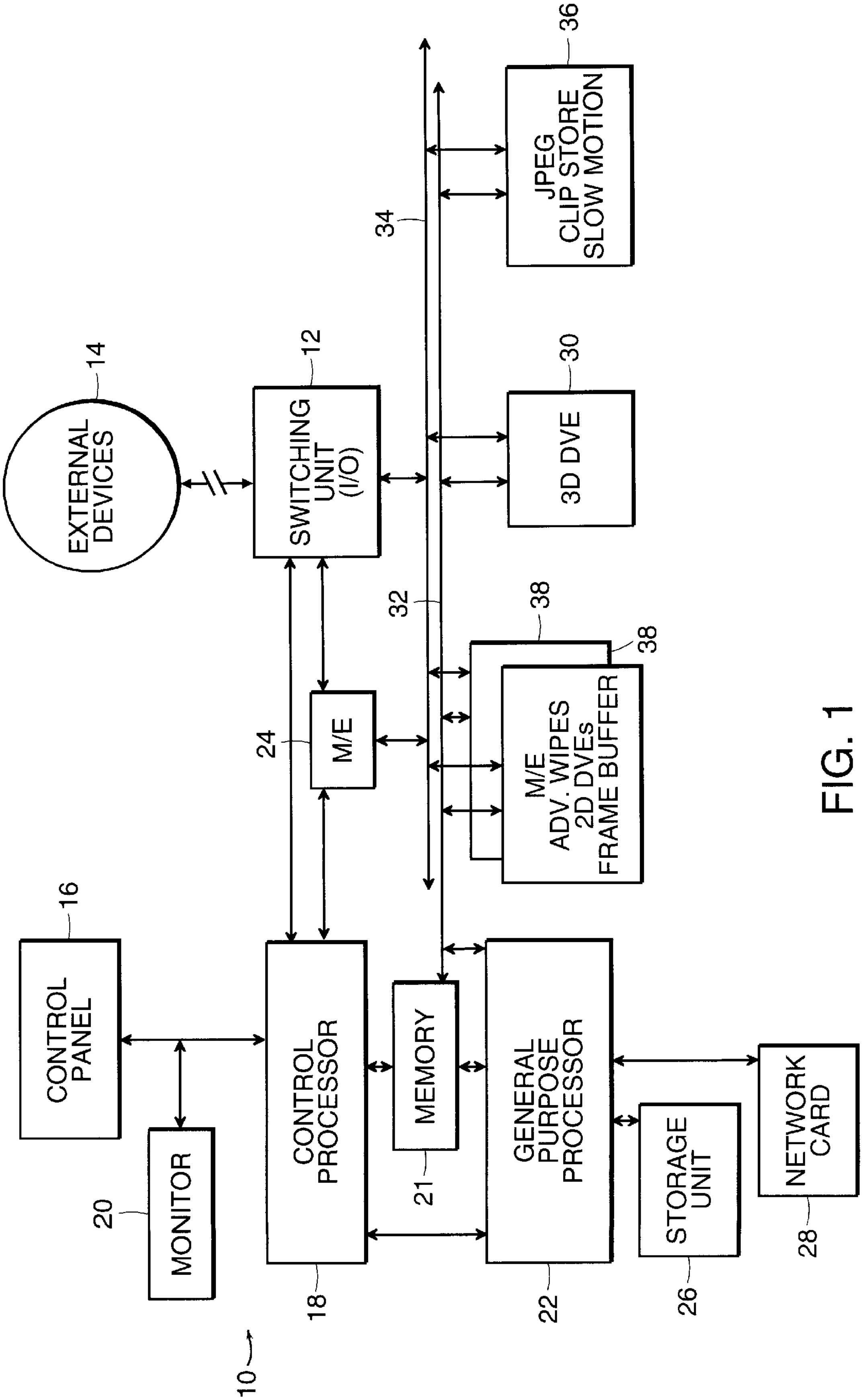

EXTERNAL DEVICES
14
SWITCHING UNIT (I/O)
12
JPEG CLIP STORE SLOW MOTION
36
34
3D DVE
30
32
38
38
M/E ADV. WIPES 2D DVEs FRAME BUFFER
M/E
24
CONTROL PANEL
16
MONITOR
20
CONTROL PROCESSOR
18
MEMORY
21
GENERAL PURPOSE PROCESSOR
22
STORAGE UNIT
26
NETWORK CARD
28
10

FIG. 1

DIGITAL VIDEO SWITCHER INCLUDING A GENERAL PURPOSE PROCESSOR AND A CONTROL PROCESSOR

FIELD OF THE INVENTION

The invention relates generally to digital video switchers. More particularly, the invention relates to digital video switchers including two processors (i.e., a general purpose processor and a control processor) which are independent, tightly coupled and synchronized to the video frame rate for real time switching functionality in broadcast environments.

BACKGROUND

In television programming, video switchers receive video input signals from various video sources and direct (or "switch") to the switcher outputs for transmission (or recording) picture images from selected sources. The video sources can include network feeds, satellite feeds, cameras, receivers and recorders. Switching can be done manually by an operator or automatically by programming the switcher to perform a plurality of operations (or "transitions") in an predetermined sequence. Transitions can include cuts, fades, mixes and combinations thereof.

A conventional video switcher typically includes a switching unit, mix/effects (M/E) amplifiers, a control processor and a control panel. An operator manipulates various knobs, levers, and switches on the control panel. The control processor controls the switching unit and M/E amplifiers to provide the video output signal. The switching unit receives video input signals and provides the input signals to the M/E amplifiers. The M/E amplifiers, responsive to control signals from the control processor, combine selected input signals to produce a video output signal. For convention switchers capable of supporting live broadcasts, the control processor is synchronized to the video frame rate and provides real time switching functionality within 1/60th of a second.

Over the years, video switchers have utilized various types of technology. Known analog video switchers have used analog circuitry and a single processor running a proprietary closed architecture operating system. Known digital switchers have used one or more processors running a proprietary closed architecture operating system. For example, the Grass Valley Group manufactures a digital production switcher (Model 2200™) having multiple processors running a proprietary closed architecture operating system. These closed architecture switchers are essentially fixed in their capabilities when manufactured and are generally not upgradeable by third parties.

In recent years, video switcher companies have attempted to take advantage of the increased capability of standard platform computing systems (i.e., PC-based open architecture systems). By way of example, Pinnacle manufactures a digital switcher (Alladin™) that operates in conjunction with a personal computer (PC). The switcher couples to the PC through a SCSI port. The switcher includes a control processor running a proprietary closed architecture operating system, and the PC includes a general purpose processor running an open architecture operating system. The control processor provides real time switching for live broadcasting. The PC processor provides non-real time switching (e.g., off-line image processing and image storage), but is incapable of providing real time switching functionality. In another example, Matrox manufactures a digital switcher (DigiMix™) that includes standard platform computing capability. More specifically, the switcher includes a control processor and a general purpose processor. However, the two processors are not independent of each other, and the general purpose processor is not synchronized to the video frame rate. Thus, the switcher is incapable of providing real time switching functionality.

The assignee of the subject application, ECHOlab, Inc., manufactures two switching products that include standard platform computing capability. ECHOlab's PC-A is a two-channel audio switcher on a standard IBM circuit card that can be plugged into a PC. ECHOlab's PC-3 is a video switcher on a standard IBM circuit card capable of being plugged into a PC. Both products can be controlled by an on-board control processor or a general purpose processor running the Windows™ NT operating system on the PC. After installation of either product in the PC, the two processors are independent of each other and tightly coupled.

The PC-3 is incapable of providing real time switching functionality in live broadcast environment for at least two reasons. First, the general purpose processor is not synchronized to the video frame rate. Second, Windows™ application software running on the general purpose processor provides the control panel as a window on the PC display. Thus, the control panel would not survive a PC failure in a broadcast environment.

OBJECT OF THE INVENTION

It is therefore a principle object of the invention to provide a digital video switcher that includes two processors (i.e., a general purpose processor running an open architecture operating system and a control processor running a second architecture operating system and supporting real time critical functions) which are independent, tightly coupled and synchronized to the video frame rate for real time switching functionality in broadcast environments.

SUMMARY OF THE INVENTION

The present invention features a digital video production switcher for processing a plurality of video signals in a production environment. The switcher includes a switching unit for receiving video input signals from various devices (e.g., network feeds, satellite feeds, cameras, receivers and recorders) and for providing video output signals and a control panel for receiving operator inputs. The switcher also includes a pair of independent processors synchronized to the video frame rate—a control processor and a general purpose processor. The two processors are tightly coupled (i.e., they share a section of memory) to allow for high bandwidth communications.

The control processor controls the "live critical" production functions (i.e., input/output video switching, mixing, wiping and keying). The control processor is electrically connected to the switching unit and the control panel and supports control panel operations independent of the general purpose processor. The control processor provides control signals, in response to operator inputs received from the control panel, that program the switching unit to provide desired video output signals in real time. In one embodiment, the control processor runs a closed architecture operating system.

The general purpose processor is electrically connected to the switching unit and the control processor. The general purpose processor runs an open architecture operating system and generates control signals in response to operator inputs received from the control processor. These control signals cause other processing units to process selected input signals and generate desired video output signals. The general purpose processor programs the switching unit to provide the desired video output signals in real time. In one embodiment, the general purpose processor is running a self-contained, multitasking operating system (Windows NT™).

The switcher can also include various units that support live and post productions environments. A mix/effects amplifier can be electrically coupled to the switching unit and the two processors. The mix/effects amplifier, in response to control signals from the processors, combines selected video input signals to produce desired video output signals. A storage unit can be coupled to the processors for storing video signals. A network interface unit can be coupled to the general purpose processor for receiving video input signals and for providing video output signals over a local area network or a wide area network. A digital video effects unit can be coupled to the two processors for processing of video input signals for generating special effects video output signals (e.g., page curls, flying video cubes, water ripples, spheres, highlights and shadows, and slats and waves). A multi-function video effects unit electrically coupled control and general purpose processors for providing JPEG clip store, still store and slow motion processing capabilities. A post-production digital video effects unit can be coupled to the two processors for non-real time processing of video input signals for generating special effects video output signals.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features of the invention are more fully described below in the detailed description and accompanying drawing.

FIG. **1** is a block diagram illustrating a digital video production switcher for processing a plurality of video signals in a production environment in accordance with the invention.

DETAILED DESCRIPTION

FIG. **1** is a block diagram of a digital video production switcher for processing a plurality of video signals. The assignee, ECHOlab, Inc., manufactures digital video production switchers (e.g., ECHOlab 5000 Series) incorporating the principles of the invention.

As shown, the switcher **10** includes a switching unit **12** for receiving video input signals from various external devices **14** (e.g., network feeds, satellite feeds, cameras, receivers and recorders) and for providing video output signals for television broadcasts. In one embodiment, the switching unit **12** has twenty-seven input channels and twelve output channels. A control panel **16** receives operator inputs and provides such inputs to a control processor **18**. The assignee, ECHOlab, Inc., manufactures control panels (e.g., ECHOlab Models 5700, 5800 or 5900) that can be used in the switcher **10**. A monitor **20**, which is electrically connected to the control panel **16** and the control processor **18**, displays selected video output signals to the operator.

The switcher **10** includes a pair of independent processors (i.e., the control processor **18** and a general purpose processor **22**) synchronized to the video frame rate. The two processors are "tightly coupled" in that they share a section of a dual port memory **21** to allow for high bandwidth interprocessor communications. The control processor **18** is electrically connected to the switching unit **12** and the control panel **16**. The general purpose processor **22** is electrically connected to the switching unit **12** and the control processor **18**. Both processors are synchronized to the video frame rate (i.e., 1/60th of a second) and, therefore, can provide desired video output signals in real time. The video processing operations are partitioned between the two processors to provide "fail-safe" switching operations in a live broadcast environment.

More specifically, the control processor **18** controls the "live critical" production functions and supports control panel **16** operations independent of the general purpose processor **22**. During a broadcast, the "live critical" functions include input/output video switching and mix-effect control functions (i.e., mixing, wiping and keying).

In one embodiment, the control processor **18** runs a closed architecture operating system. The control processor **18** provides control signals, in response to operator inputs via the control panel **16**, that cause other processing units (**22**, **24**, **26**, **28**, **30**) to process selected input signals and generate a desired video output signal. The control processor **18** programs the switching unit **12** to provide desired video output signal in real time.

The general purpose processor **22** hosts an open architecture operating system and provides real time and non-real time control of open architecture peripherals and other networked peripherals. In one embodiment, the general purpose processor **22** is a Pentium™ processor running a self-contained, multitasking operating system (Window NT™). The general purpose processor **22** provides control signals, in response to operator inputs, that cause the other processing units (**24**, **26**, **28**, **30**) to process selected input signals and generate a desired video output signal. The processor **22** programs the switching unit **12** to provide desired video output signal in real time.

The switcher **10** includes various processing units to provide complete support for both live broadcast and post production environments. A mix/effects (M/E) amplifier **24** is electrically coupled to the switching unit **12**, the control processor **18** and the general purpose processor **22**. The M/E amplifier **24** combines selected video input signals and produces desired video output signals. A storage unit **26** is coupled to the processors for storing video signals and video processing and system software. The storage unit **26** can include disk and CD ROM bays and memory. A network interface unit **28** can be coupled to the general purpose processor **22** for receiving input signals from remote devices and for providing output signals to remote devices over a local area network or a wide area network. More specifically, the network interface unit **28** can be used for image transmission/reception, transfer of control information to/from a network device (e.g., a CG or routing switcher) and to send/receive time and control parameters to network devices.

A digital video effects (DVE) unit **30** is coupled to the two processors via a PCI bus **32** and a Movie2 bus **34**. In one embodiment, the DVE unit **30** is a GenieFusion™ 3D DVE manufactured by Pinnacle. The DVE unit **30** processes of video input signals and generates special effects video output signals. Such special effects can include page curls, flying video cubes, water ripples, spheres, highlights and shadows, and slats and waves. A multi-function video effects unit **36** can be coupled to the two processors via the buses **32**, **34**. The unit **36** provides JPEG clip store, still store and slow motion processing capabilities. In one embodiment, the unit **36** is a DigiMotion™ card manufactured by Matrox. At least one post-production digital video effects unit **38** can be coupled to the two processors for non-real time processing of video input signals for generating special effects video output signals. In one embodiment, the post-production

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