(54) Title: AUDIO SYSTEM AND FOOT OPERATED CONTROL SURFACE DEVICE

(57) Abstract: An audio system includes a foot-operated control surface device, which, for example, allows a musical performer to adjust personal monitor mix by foot without using hands engaged in playing a musical instrument. The control surface device includes a housing that has at least one opening. The control surface device also includes an assembly of foot-controlled elements of a user interface comprising a scroll wheel assembly and user inputs. The scroll wheel assembly includes a rotatable member positioned within the opening of the housing, which is rotatable about an axis that extends within the housing. The scroll wheel assembly includes a movement sensing system that determines when the rotatable member is rotated relative to the housing. The user input devices are positioned adjacent to the scroll wheel. The rotatable member can be used for adjustment of volume level of an audio channel in a monitor mix and the user input devices can be used for audio channel selection.

FIG. 6
Description

AUDIO SYSTEM AND FOOT OPERATED CONTROL SURFACE DEVICE


Technical Field

[0002] The present disclosure relates in general to live sound reinforcement and more particularly to monitor sound mix and personal monitor mixers.

Background Art

[0003] Personal monitor mixers were originally designed for use in recording studios as more efficient way to deal with monitor sound mix requirements of performers being recorded. Indeed, throughout the recording session less recording session time is spent achieving and maintaining the subjective right balance, tone and overall volume of personal monitor mixes of performers recorded if the performers operate their own dedicated small-sized sound mixing consoles - known as personal monitor mixers - rather than if a sound engineer does the monitor mix for the performers.

[0004] Performers monitor their own sound not only during recording sessions, but during live performance on stage as well. More than that, the importance of monitor sound mix on stage is as important as in the recording studio or even more important, because the subjective right balance, tone and overall volume of a monitor mix is much harder to achieve on stage than in a studio due to higher complexity of live sound monitor systems, poorer sound clarity due to venue acoustics, little or no time to sound check, and human factors related to the technical crew operating monitor sound systems. All these factors can be resolved at high costs and extra resources - such as performers hiring and carrying their own crew and equipment - or these issues may remain unresolved. For many top artists the costs of extra technical and human resources can become a burden. The performers “below the top level” are subjected to great deviation between excellent and very bad monitor sound during live shows because of deviation of quality of sound systems, as well as
technical crews from one show to another. So, there is a great niche for personal monitor mixer applications for live shows to fix the issues described, but personal monitor mixers available at present are applicable on shows in a very limited way.

[0005] As mentioned above, the personal monitor mixers available at present inherited their hand-operated design from serving recording studios. However, a recording studio is very different from live theatre because of two key factors.

[0006] The first key factor is that a recording studio is not a theater in regards to space. Unlike in a recording studio, in a theatre there is a stage, an audience, views, scenery, props, changeovers, video cameras and great attention is paid to how everything looks. Hand-operated personal monitor mixers were designed without live stage production issues in mind, for example, they attract unnecessary attention from the audience, they interfere with scenery and props, they cause problems during changeovers, and/or they get in the view of cameras. Hand-operated personal mixers simply look bad, because, from the audience's point of view, if musicians are tied to some electronic boxes it can make them look somewhat physically impaired.

[0007] In a regular pop and rock concert performers move on stage a lot, therefore the stage should not to be obstructed by extra equipment. However, hand-operated personal monitor mixers are mounted on stands so that hands can reach a control surface. If a band is equipped with such a system, then each performer has such a stand with a personal mixer mounted thereon, which causes major stage obstruction.

[0008] Another important factor is that guitar players, singers and other members of typical rock’n’roll bands perform standing up - not sitting down like musicians in a conventional orchestra. The performers not only stand, but their hands are engaged in playing musical instruments, such as guitars. Accordingly, any attempt to operate hand-operated equipment such as personal monitor mixers would inevitably interrupt and compromise their show, which is not an option. It is also not an option because of the second key factor, explained below.
[0009] The second key factor of how a recording studio is different from a theater is that a recording session is not a concert in regards of time. In a typical rock’n’roll show, bands do not repeat their set for the same audience - they play once and there is no chance for correction. There is no “the other time”. The show must go on! So, if a monitor sound mix is no good, the performers stopping playing their musical instruments and using their hands to operate personal mixers that are currently available is just not an option.

[0010] Unlike in a recording studio where recording can be delayed until the right balance, tone and overall volume of monitor mixes are achieved for each member of the band recorded, and there is no deadline when the recording must start, in a live show there is a deadline, therefore bands go on stage and play regardless of the monitor mix balance. This is why live shows still occur even if something is not perfect. No matter if a band has a chance to sound check or not, monitor mix can be not perfect or can be just plain bad. The last resort would be to fix it with a personal monitor mixer of the right kind - allowing for a performer to somehow mix “on the go” without using the performers hands to make adjustments, which is something that currently available personal monitor mixers do not allow for the reason explained above.

[0011] The bottom line is that currently available personal monitor mixers have no “how-to” that would make them applicable for rock’n’roll type of live shows, despite the problems that exist, which such mixers are meant to solve.

[0012] The present disclosure relates to an audio system having a foot-operated control surface device to adjust a sound mix by a user’s foot. The device includes a housing that has at least one opening. The device also includes an assembly of foot-controlled elements of a user interface within the housing. The assembly of foot-controlled elements includes a scroll wheel assembly and user input devices that are provided within the housing. The scroll wheel assembly includes a rotatable member positioned within the opening of the housing. The rotatable member is rotatable about an axis that extends within the housing and is rotatable within the opening relative to the housing. The scroll wheel assembly also includes a movement
sensing system that determines when the rotatable member is rotated relative to the housing. The assembly of foot-controlled elements also includes user input devices that allow for selection of one or more audio channels included in an output audio signal, and selection of a mode of adjustment of audio-related parameters of the one or more audio channels, such that rotation of the rotatable member causes adjustment audio-related parameters of one or more of the audio channels.

[0013] The control surface device also provides a method of adjusting volume or other audio-related parameters of audio channels of an audio mix by a user's foot using an input device having a housing and an assembly of foot-controlled elements of a user interface. The method can include the steps of rotatably moving by foot the rotatable member relative to the housing and using the user input devices in order to adjust an audio channel included in the sound mix. The method can further include outputting a command message with the control surface device which includes at least one adjusted audio channel.

[0014] The control surface device may communicate with remotely controlled devices, such as a mixing engine using a converter. The converter may include a storage medium that stores a plurality of audio-related parameters of audio devices included in the audio system. The converter may include at least one communication port to communicate with the audio devices, and receive the audio-related parameters to populate the storage medium. The converter can receive a command message in a first protocol format from a remote controlling audio device, such as the control surface device, and convert the command message to a second protocol format of a remotely controlled audio device identified in the command message, such as a mixing engine. The command message may include a request to change a stored audio-related parameter of the identified remotely controlled audio device. The converter may store the changed audio-related parameter in the storage medium and transmit the converted command message to the remotely controlled audio device via the communication port. The converter may also receive changes in audio-related parameters, such as from a remotely controlled audio
device, which may be converted, stored and communicated to a remotely
controlling device, such as the control surface device.

[0015] The foot-operated control surface device can make it easy for performers
to adjust monitor sound mix properties, such as volume of instruments in
the audio mix, by foot without having to interrupt playing musical
instruments with their hands to control a mixer of a hand-operated design.
Embodiments of the foot-operated control surface device can be
positioned on a stage floor, and therefore do not obstruct the stage, thus
allowing free movement of performers on stage. The foot-operated control
surface device also does not detract from the look of a live performance
because it stays on the floor, and thus does not stand out in front of
scenery and attract audience attention like hand-operated equipment
does.

[0016] BRIEF DESCRIPTION OF THE DRAWINGS. FIG. 1 is a block diagram of
an example audio system;

[0017] FIG. 2 is an operational flow diagram of a converter included in the audio
system;

[0018] FIG. 3 is an example of communication within the audio systems;

[0019] FIG. 4 is a block diagram showing a portion of a converter illustrated in
FIG.1.

[0020] FIG. 5 illustrates an example of a foot-operated control surface device
according to an embodiment;

[0021] FIG. 6 illustrates an example of an axis of the rotatable member, and an
axis of the user input devices of the foot-operated control surface device
according to an embodiment;

[0022] FIG. 7 is a side view of an embodiment of the control surface device of
that illustrates operation by foot;

[0023] FIG. 8 is an exploded view of an example embodiment of the
foot-operated control surface device;

[0024] FIG. 9 is an example operational flow diagram of an embodiment of a
foot-operated control surface device.

Disclosure of Invention

[0025] Various embodiments described herein can be used alone or in
combination with one another. Only a few of the many possible implementations of the present embodiments are described. For this reason, this detailed description is intended by way of illustration, and not by way of limitation.

[0026] As shown in the figures, an exemplary embodiment includes a foot-operated control surface device comprising an assembly of foot-controlled elements of a user interface for adjusting sound mix parameters by foot.

[0027] FIG. 1 is a block diagram of a portion of an example audio system 100, which illustrates an embodiment of one or more mixing engines 102, one or more converters 104, one or more control surface devices 106 and one or more audio output devices 108. The audio system 100 may include any other audio related equipment and the example illustrated should not be construed as limiting.

[0028] The mixing engines 102 may include any number of audio related devices. The mixing engines 102 may be any device with functionality to receive audio inputs, provide audio outputs, and performing processing of audio signals, such as digital or analog signal processing to mix audio signals. In addition to audio processing, the mixing engines 102 are capable of communication, in which at least some of the communication includes remote monitoring and/or control of the functionality of the respective mixing engine. Mixing engines 102 may also include functionality, such as a user interface, to enable local monitoring and/or control. Some examples of mixing engines 102 include a mixing console, an amplifier, a wireless microphone system, a wall controller, or any other audio processing device capable of being remotely controlled, and that includes audio-related parameters that are capable of being changed, or are changing during operation.

[0029] The mixing engines 102 may be communicatively coupled with the converter 104 by a communication path 112. The converter 104 may also be communicatively coupled via a communication path 112 with controlling remote devices, such as the control surface device 106. In addition, the mixing engines 102 may be communicatively coupled via a communication
path 116 with one or more audio output devices 108. Communication over the communication paths 112 and 116 may be performed with a communication medium that includes wireline based communication systems and/or wireless based communication systems. The communication medium may be, for example, a communication channel, radio waves, microwave, wire transmissions, fiber optic transmissions, or any other communication medium capable of transmitting data, audio and/or video information. The communication may include point-to-point communication and/or network communication. The network communication may include the Internet, a public and/or private intranet(s), an extranet(s), a dedicated communication line(s) and/or any other communication configuration to enable transfer of data and commands. The network communication may be performed with a predetermined protocol such as an Ethernet network using TC/PIP or a proprietary protocol. In other examples, any other network based communication protocol may be used. Included within the network may be any number of passive interconnects, intermediate networking devices, control element nodes, and any other devices used to provide functionality of the communication path. Point-to-point communication may be any form of communication medium in which all formatting occurs at the end points.

[0030] One or more communication ports may be used on the mixing engines 102, the converter 104, the control surface device 106, and the audio output devices 108 for the communication. For example, the communication may be packet based communication performed using a network interface card. The communication may alternatively, or in addition be performed using a point-to-point communication protocol, such as RS232, RS422, Firewire, Bluetooth™, ring bus, proprietary protocols, and/or any other communication protocol. The ports may also include protocol conversion capabilities to convert from one protocol to another. In an embodiment, data, such as control commands, setpoints and audio-related parameters may be communicated between the mixing engines 102 the converter 104 and the control surface device 106 over communication paths 112A and 112B. In this embodiment, audio signals
that include a number of audio channels may be communicated from the mixing engines 102 to the audio output devices 108 over the communication path 116, to drive the audio output devices 108 to produce audible sound. Accordingly, the communication paths 112A and 112B may be a data communication path, whereas communication path 116 may be an audio signal communication path.

[0031] In an embodiment, the audio output devices 108 may receive over the communication channel 116 a monitor mix from mixing engine 102, such as an audio console, in the form of an audio signal containing a number of audio channels, where each audio channel is representative of audible sound from an audio source, such as a musical instrument or a microphone input. In an example, the audio output device 108 may be one or more headphones that are driven by the audio channels included in the audio output signal to produce audible music sound for a user operating the control surface device 106.

[0032] Alternatively, in an embodiment the monitor mix may be supplied to the one or more audio output devices 108 via the converter 104 and remote controlling audio devices, such as the control surface device 106 over the communication path 112 and a communication path 116 (indicated as dotted). In this embodiment, the communication path 112 between the mixing engines 102, the converter 104 and the control surface device 106 may pass both data and audio signals, and the communication path 116 between the control surface device 106 and the one or more audio output devices 108 may pass only audio signals. The audio signals may be analog signals or digital signals.

[0033] The converter 104 may be one or more devices capable of converting between parameters communicated between the mixing engines 102 and the control surface device 106 over the data communication paths 112A and 112B. The converter 104 may include circuitry providing a storage medium 114 in which converted parameter values may be stored. In addition, different conversion protocols may also be created and stored in the storage medium 114 of the converter 104. The circuitry of the converter 104 may also include a processor, and the ports. The converter
104 may communicate commands and data, such as request messages, responsive messages, data messages, and any other information between the mixing engines 102 and remote controlling devices, such as the control surface device 106, over the communication paths 112A and 112B using one or more of the ports.

[0034] The results of the communication may be stored in a database, such as a relational database included in the storage medium 114. Accordingly, during operation, the converter 104 may maintain a substantially always-up-to-date storage of audio-related parameter values of devices that are available for remote control and/or monitoring. The stored parameters may, for example, be kept in device RAM of the storage medium 114. Therefore operational parameters of mixing engines 102, such as measured values, operational values, derived values and constant values may be retrieved by the converter 104 and stored in the storage medium 114. These stored operational parameters may be substantially continuously updated, updated in response to predetermined events, and/or updated on a predetermined schedule such that the converter 104 includes substantially up-to-date parameters for all stored operational audio-related parameters.

[0035] The circuitry of the converter 104 may include ports for communication with one or more remote controlling devices, such as the control surface device 106. In an example, where the converter 104 is in communication with multiple control surface devices 106, the control surface devices 106 may be electrically connect in series on a common bus via their respective ports, as illustrated in FIG. 1. In this configuration, each of the control surface devices 106 may include a unique identification (ID) such that communication on the common bus reaches, as the destination device, a device with the unique ID included in the message. In other examples, any other configuration of the control surface devices or other remote controlling devices is possible. In addition, in other examples, alternatively, or in addition to one or more control surface devices 106, one or more other types of remote controlling devices, such as consumer type smartphones, tablets running specialized apps, and/or purpose-built
hardware controllers may be in communication with the converter 104.

[0036] In an embodiment, the converter 104 may monitor communication with mixing engines 102 and remote controlling devices, such as the control surface device 106. For example, the converter 104 may track the communication time delay between incoming messages from the same source. If the time delay is equal or exceeds a pre-determined value, the converter 104 can send out a request message for a single parameter and track the time period until a response to the request is received. In an embodiment, if the time period is equal or greater than a pre-determined value, the converter 104 may reset all the parameters for this device which are presently stored, and again begin monitoring the communication.

[0037] The remote controlling devices, such as the control surface device 106, may receive stored audio-related parameters from the converter 104. Stored parameters may be pushed from the converter 104 to individual remote controlling devices or pulled by the individual remote controlling devices. Pushed parameters may be designated for one or more individual remote controlling devices using a unique identifier of the individual remote controlling devices. Such pushed parameters may be sent in an individual message that designates the unique IDs for one or more of the individual remote controlled devices. Alternatively, or in addition, the stored parameters may be broadcast to the individual remote controlling devices using the unique identifiers. Triggers for pushing stored parameters may be based on occurrence of user specified events, such as a predetermined amount of change in a parameter value, a parameter value outside a threshold or range, or any other criteria. Alternatively, or in addition, parameters may be pushed based on a user specified schedule, such as pushing parameters to remote controlling devices every 10 milliseconds, for example. Alternatively, or in addition, stored parameters may be pulled from the converter 104, such as by the remote controlling devices transmitting to the converter 104 a request message for one or more stored parameters.

[0038] Since the parameters supplied to the remote controlling devices are stored, the remote controlling devices do not need to request parameters
from the mixing engines 102. As a result, communication latency for receipt of parameters can be reduced. In an example embodiment, the converter 104 may connect to remotely controlled devices, such as mixing engines, first and then connect with remotely controlling devices, such as the control surface device 106 or a tablet later. This allows a period of time for the converter 104 to sync with the mixing engines 102 first in order to receive and store up-to-date audio-related parameters, and then allow connections of remotely controlling devices to receive the stored parameters. In other examples, connection to the converter 104 may be in an other order. Once the converter 104 has up-to-date parameters stored, the converter 104 can, for example, reply to incoming request messages from remote controlling devices in a timely manner.

[0039] Settable operational parameters of the converter 104, the mixing engines 102, and the remote controlling devices, such as the control surface device 106 may be predetermined and stored in the storage device 114 of the converter 104 in one or more device files. Accordingly, settable operational parameters related to the functionality of the converter 104, such as user or device authentication requirements, data synchronization frequency, or any other settable parameters related to the operation of the converter 104, may be stored. In addition, criteria for processing of operational parameters for each of the mixing engines 102, for related groups of mixing engines 102, and/or all of the mixing engines 102 may be predetermined and stored. Settable operational parameters of the mixing engines 102 and/or remote controlling devices, such as the control surface device 106, may be based on a unique ID of the mixing engines 102, or based on group characteristics, such as similar equipment parameters, equipment from the same manufacturer, or equipment using a common protocol. In addition, the number of units of mixing engines 102 as well as number of remote controlling devices connected to the converter 104 is virtually unlimited, so long as sufficient processing power is available in the converter 104 to handle the push and/or pull of stored audio-related parameters.

[0040] Further, the architecture allows converting between various
equipment-specific remote control protocols. Such protocol conversions may occur both for data received from the mixing engines 102 and for data received from the remote controlling audio devices, such as the control surface device 106. For each equipment-specific remote control protocol there can be a protocol description file stored in the storage medium 114. The protocol description file can be parsed by the converter 104. In an example embodiment, the protocol description file may be in an XML format, which describes the formats to be converted between as well as the way the conversion is to be performed. Therefore, the parameter values stored in the converter 104 are free of manufacturer-specific information. This allows seamless conversion of parameters between similar types of equipment of various different manufacturers, such as between scenes of mixing consoles of various manufacturers. In addition, commands or other information from the remote controlling devices may be converted to equipment specific protocols seamlessly using the protocol description file.

[0041] The converter 104 allows for the creation of mapping between any audio-related parameters of all and/or any type of remotely controlled equipment 102 that is in communication with the converter 104. Such mapping allows for the creation of hybrid remote control solutions for controlling a portion of parameters or all parameters of different mixing engines 102. Since stored parameters from different mixing engines 102 are readily available via the mapping, parameters to monitor and/or control different mixing engines 102 can be used together in any configuration to optimize use and control of the audio system. For example, control of an audio volume, shutter speed of a lighting fixture and a readout of a human heartbeat rate can sit next to each other on a soft or hard control surface, if needed and once mapped that way. The mapping may be performed within the protocol description files.

[0042] The converter 104 may pass through communications where conversion of parameters is not necessary. Pass through of some communication may be based on settings of the converter 104, or a protocol description file. Example communications include an audio signal containing one or more
audio channels, parameters already in the universal format, or digital data or analog data not packaged in a protocol of the transmitting device. In the case of audio signals, a mono audio signal or stereo audio signal that includes any number of audio channels may be communicated from the mixing engines 102 to one or more input ports of the converter 104, and may be passed through to output ports for transmission over the communication path 112 to the audio output device(s) 108. Alternatively, the audio signal may be transmitted over the communication path 112 to an identified remote controlling device(s), such as the control surface device 106 based on unique ID(s) included with the audio signals. Alternatively, in the case of audio signals, the communication may bypass the converter 104 completely, such as by being transmitted on the communication path 116 between the mixing engines 102 and the audio output device(s) 108, or from the mixing engines 102 to the control surface device 106 on the communication path 112, and then from the control surface device 106 to the audio output device(s) 108.

[0043] The operational architecture of the converter 104 isn't limited to audio applications and storage of audio-related parameters, but rather can be used for any type of equipment to minimize latency in receipt of operational parameters. In addition, remote control of various types of pieces of equipment may be combined when one or more of the mixing engines 102 are connected to the converter 104. For example, a single control command to adjust a parameter in a number of different mixing engines 102, such as an output volume level, may be converted to a number of different equipment specific protocols by the converter 104, and provided to all of the different mixing engines 102 to effect the change based on the single control command.

[0044] Since the parameters of mixing engines 102 are stored as a state in the converter 104, the state of the entire converter 104 and any/all of the equipment connected to the converter 104 can be saved in one or more files stored in the storage device 114. Accordingly, the state of the converter 104 and/or any of the mixing engines 102 and/or the remote controlling devices, such as the control surface device 106, can be
restored from the saved information.

[0045] FIG. 2 is an example operational flow diagram of the converter 104. At block 202, the converter 104 may be powered up. The converter 104 auto-detects the mixing engines 102 connected to it at block 204. At block 206, the converter 104 loads a sequence of request messages for all the detected pieces of equipment. In an embodiment, each request in the sequence of request messages is for a single parameter per piece of equipment. In other embodiments, a batch request message for parameters may be used in which some or all available parameters for a piece of equipment may be requested with one or more request messages. The sequence of request messages are communicated over the communication ports to mixing engines 102 at block 208. At block 210, the converter receives a response message from each identified mixing engine 102. Timely responses - if any - for each piece of equipment can be used by the converter 104 to establish the presence, and confirm/assign a unique ID, for each piece of responding equipment.

[0046] At block 212, the converter 104 may run a synchronization procedure for one of the remote controlled pieces of equipment, such as the mixing engines 102 using the predetermined protocol description file associated with the one of the mixing engines 102 and populate the storage device with up-to-date audio-related parameters from the device. Updated parameters can be all parameters, or some part of the parameters dependent on predetermined settings in the converter 104. The converter 104 can determine if there are additional pieces of equipment to synchronize with updated parameters at block 216. If there are additional pieces of equipment, the operation returns to block 212 and synchronizes another remotely controlled piece of equipment, such as a mixing engine 102.

[0047] If there are no additional pieces of equipment to synchronize, the operation proceeds to block 218 and allows remote controlling devices, such as the control surface device 106, which are connected to the converter 104, to send and receive command messages to access the stored parameters and communicate with the mixing engines 102 via the
converter 104. In an example embodiment, connection of the remote controlling devices to the converter 104 may be delayed until synchronization with mixing engines 102 is complete. At block 220, the converter 104 can communicate with the mixing engines 102 and the remote controlling devices, such as the control surface device 106, and update the stored parameters based on predetermined conditions.

[0048] At block 222, it is determined if the updated stored parameter values resulted in a parameter change that triggers further action by the converter 104. If no further action is triggered, the operation returns to block 220 to monitor for changes to stored audio-related parameter values. If an update of a stored parameter value triggers an action, the converter takes corresponding responsive action. For example, where the triggering event is, for example, receipt from remote controlling devices, such as the control surface device 106 of a remote control command changing a stored parameter, the converter 104 is triggered to send out a parameter change message to one or more of the mixing engines 102 as illustrated by block 224. In another example, the update of a stored parameter value may trigger the converter 104 to request an update of another parameter from one or more of the mixing engines 102 as illustrated by block 226. In still another example, in response to receipt of a parameter change, the converter 104 may provide a push notification message to the remote controlling device indicating that a mixing engine 102 has experienced a local parameter change at the mixing engine 102 as illustrated by block 228.

[0049] FIG. 3 is an example communication flow diagram for protocol conversion performed by the converter 104. In FIG. 3, communication between the converter 104 and remote controlling devices, such as the control surface device 106, and between the converter 104 and mixing engines 102 is illustrated. Only some communication examples are shown in FIG. 3 to illustrate operation, and other communications are possible.

[0050] In FIG. 3, the mixing engines 102 may transmit audio-related parameter changes in a parameter changes message 302 to the converter 104. The converter 104 may store the updated parameter in the storage medium
114 in a database 306. The database 306 may be a hierarchical or relational database and may use a database management system, or the database 306 may be any other organized collection of data. In addition, prior to storage the converter 104 may use a corresponding protocol description file to convert the parameter changes from a first format, such as a manufacturer specific format, to a universal protocol format using protocol converters 304. The updated parameter may also be supplied in a parameter change message 308 to one or more of the remote controlling devices, such as the control surface device 106 as a reply from the database 306 in response to a trigger condition, such as the stored parameter being changed more than a predetermined amount. Alternatively, the updated parameter may be supplied to the remote controlling devices, such as the control surface device 106 immediately after being converted where the protocol conversion or storage is the triggering condition.

[0051] The control surface device 106 may also transmit a parameter change request message 312 to the converter 104, which the converter 104 can convert from the universal protocol to a protocol of the corresponding piece(s) of equipment using one or more protocol converters 304, and transmit one or more protocol specific parameter change messages 314 to the respective one or more pieces of equipment. In this scenario the triggering condition can be receipt of the parameter change request message 312. The parameter(s) contained in the parameter change request message 312 may also be stored in the database 306.

[0052] As another example, the control surface device 106 may also transmit a parameter change message 316 to the converter 104, instructing the converter 104 to update the database 306 to store updated parameters. The converter 104 may convert the stored parameter from the universal protocol to a protocol of corresponding remotely controlled device(s) 102 using one or more protocol converters 304, and transmit a parameter change message 318 to the respective one or more mixing engines 102. The conversion and transmission of the parameter change message 318 may be based on receipt of the parameter change message 316, or may
be as a result of the changes to the stored parameters being triggering events.

[0053] The converter 104 may be configurable by a user to enable (or disable) control of some or all of the parameters in mixing engines 102. Selection of controllable parameters with the converter 104 may be used to limit the number of controllable parameters available for control by remote controlling devices such as the control surface device 106. In an example, the converter 104 may provide capability for the control surface device 106 to control parameters of a monitor mix being supplied by a mixing engine 102, such as a mixing console. In this example, message commands generated by the control surface device 106 may be used to adjust the monitor mix being provided. In this regard, the converter 104 may be configurable to only provide the capability to adjust some parameters related to some of the audio channels being supplied in the monitor mix. For example, only some of the audio channels available at a mixing engine 102 can be identified as available for remote control by the control surface device 106. Control of the identified channels may include command messages to adjust a volume, tone and pan of the individual audio channels, groups of audio channels, or all of the audio channels (global). In addition, the capability to remotely control the number of channels being supplied in the monitor mix may also be available. For example, the capability to remotely turn on and off (or mute) all but one audio channel (solo the audio channel), or a selected group of audio channels may be configured at the converter 104.

[0054] FIG. 4 is an example embodiment of a portion of the converter 104, which illustrates a user interface 402 that includes keys 404 and a display 406 in communication with circuitry 408 and the storage medium 114. The user interface 402 may be used to select specific parameters, such as audio channels of the monitor mix, for remote controlling devices, such as the control surface device 106 to remotely control. In an embodiment, the user interface 402 may include a predetermined number of keys that equal the number of specific parameters that may be selected. For example, where a remote controlling device such as a mixing engine includes forty-eight
audio channels, the converter 104 may include forty-eight keys 404, one for each available channel. The display 406 may be used in connection with the keys 404 to set the specific audio channels as being available, or not available for remote control. Thus, for example, an audio channel set at the converter 104 as not available for remote control would not be available to a remotely controlling device, such as the control surface device 106 for remote adjustment of any corresponding audio-related parameters. The display 406 may display the setting(s) for each specific parameter, such as the available/not available setting(s) for each audio channel.

[0055] During operation, the converter 104 may start up in a predetermined configuration, such as with no specific parameters, such as audio channels, selected. Upon user actuation of one of the keys, 404, specific parameters of a remotely controlled audio device may be selected by the circuitry 408. In the example of the keys corresponding to audio channels in a monitor mix supplied from a mixing engine, when a key 404 within the set is selected, the corresponding audio channel assigned at the mixing engine can be toggled between, for example, being available and being unavailable for remote control. Repeated selection of the same key 404 may toggle or otherwise cancel the previous selection. Assigned audio-related parameter numbers may be stored in the storage medium 114 by the circuitry 408. The assigned audio-related parameter number may also be indicated on the display 406. In an embodiment, assigned audio channel numbers starting from one may correspond to the keys 404. In another embodiment, any other numbering scheme may be used to identify the audio-related parameters of the mixing engine(s) 102.

[0056] Continuing the audio channel selection example, when another key 404 within the set is selected, the corresponding audio channel of the mixing engine is selected and toggled between being available and being unavailable for remote control. If the audio-related parameter, such as an audio channel, which is selected is paired or linked at the mixing engine with another audio-related parameter, such as an audio channel, the corresponding paired or linked audio-related parameter is also indicated
on the display as being selected and toggled. The maximum number of audio-related parameters, such as audio channels, within a range of pre-determined parameters available for remote control cannot exceed a predetermined value. In an embodiment, the predetermined value represents a ceiling of the maximum number of specific parameters that can be effectively controlled with a remote controlling device, such as the control surface device 106. Accordingly, the ceiling can be set based on processing power, communication bandwidth, user interface capabilities, or any other functionality. Text names, images and other means of indication of the selected specific audio-related parameters can also be entered using the display 404 and keys 406.

[0057] FIG. 5 is an example embodiment of the foot operated control surface device 106. In this example, the control surface device 106 includes a housing 502 with at least one opening, within which an assembly of foot-controlled elements of a user interface may be disposed. The user interface may include a scroll wheel assembly 504. The scroll wheel assembly 504 may include a rotatable member 506. The user interface may also include user input devices 508 and a display 510. In an example embodiment, the user input devices are push buttons that include a contact which closes while the push button is being actuated to a depressed state. In other examples, other forms of actuators may be used for the user input devices. In addition, in other embodiments other elements, such as indicators, pedals, or sliders may be included as part of the user interface. Moreover, the control surface device 106 may include elements of the user interface that can be operated by other than a foot of a user.

[0058] As shown in FIG. 6, the rotatable member 506 of the scroll wheel assembly 504 is rotatable about an axis 602 that extends substantially parallel with a substantially planar surface of the housing 502. The user input devices 508, which are foot switches in the present embodiment, can be positioned on an axis 604 which is generally perpendicular to the scroll wheel rotation axis 602, as shown in FIG. 6. Alternatively, the user input devices 508 can be at any other location in the vicinity of the rotatable
member 506 that allow transitional contact by a user’s foot between the rotatable member 506 and the user input devices 508.

[0059] As shown in the example embodiment of FIG. 7, the rotatable member 506 is rotatable within the opening relative to the housing 502 in response to contact and lateral movement by a user’s foot, which is illustrated as a shoe 702. In FIG. 7, the user input devices 508 are positioned on the housing 502 at a distance relative to the rotatable member 506 so that a human foot, when in contact with the rotatable member 506 can also reach and actuate the user input devices 508.

[0060] FIG. 8 is an exploded view of an example embodiment of the control surface device 106. In FIG. 8, the scroll wheel assembly 504 also includes a rotational movement sensing system, which in this embodiment includes a rotational sensor 802 connected to circuitry 804. The rotational sensor 802 may be a digital or analog device, such as a rotary encoder, that is capable of sensing rotation movement of the rotatable member 506 in either of two rotational directions. Rotational movement of the rotatable member 506 may be provided as a rotation signal to the circuitry 804.

[0061] The circuitry 804 may include a processor 806, a storage medium 808, one or more communication ports 810 and other elements providing the functionality described. The processor 806 may be any form of device(s) or mechanism(s) capable of performing logic operations, and may implement a software program or firmware, such as code generated manually or programmed. The processor 806 may operate and control at least a portion of the control surface device 106. The processor 806 may communicate with other elements of the control surface device 106 via an internal communication path, such as a communication bus. The communication bus may be hardwired, may be a network, and/or may be any number of buses capable of transporting data and commands. The elements and the processor 806 may communicate with each other and the ports 810 via the communication bus.

[0062] The storage medium 808 may include a main memory, a static memory, and/or a dynamic memory. In an example, the storage medium 808 includes a cache or random access memory for the processor 806. In
addition or alternatively, the storage medium 808 may be separate from
the processor 806, such as a separate cache memory of a processor,
system memory, or other memory used to store instructions, data and
parameters.

[0063] The control surface device 106 may be assigned a unique ID for
communication with other devices. The unique ID may be assigned by a
user. Assignment of a unique ID by the user may involve entry of the
unique ID using the rotatable member 506 and the user input devices 508.
Alternatively, assignment of the unique ID may be set by dip switches,
jumpers or some other mechanically based ID setting mechanism included
on or in the housing 502. In an alternative embodiment, assignment of the
unique ID may be automated, such as upon connection of the control
surface device 106 to the converter 104 and/or another control surface
device 106, a unique ID may be assigned. The unique ID may be stored in
the storage medium 808, and/or maintained with a mechanically based ID
setting mechanism, such as DIP switches.

[0064] The communication ports 810 provide a communication interface that can
include any mechanism or device providing communication with the
converter 104. In addition, the communication ports 810 can provide
communication over a network and/or with other devices, such as a laptop
or tablet. Thus, the communication ports 810 may also include input/output
capability such as analog and digital signal capability, as well as signal
conversion capability such as analog-to-digital, digital-to-analog, scaling,
frequency, or any other conversion technique. The communication ports
810 may also include communication capability in other protocols, such as
RS232, RS422, USB™, Firewire™, Bluetooth™, ring bus, proprietary
protocols, and/or any other communication protocol, as well as protocol
conversion capabilities to convert from one protocol to another.
Conversion capabilities may include conversion between physical
interfaces, such as conversions related to voltages, connectors types and
the like; wired protocol conversions such as RS232, RS485, RS422, CAN
bus, USB™, Firewire™, Ethernet, and the like, or wireless protocol
conversions such as Bluetooth™, Wi-Fi, and the like. In addition, the
converter 104 may provide conversion between data protocols, related to how data bytes are organized, such as adding/removing a TCP header when converting between TCP and RS232, for example. Further, the converter may provide conversion between data protocols for remote control of mixing engines or different manufacturers, such as converting between MIDI Sysex of YAMAHA and ROLAND.

[0065] The foot-operated control surface device 106 may be embodied as a remote control for remotely controlled audio devices, such as other mixing engines or digital audio workstations (DAWs), located remotely in different housing(s) that are separated away from the control surface device 106. In alternative embodiments, the foot-operated control surface device 106 can be embodied as a stand-alone sound mixing console containing, in the same housing, circuitry of a mixing engine. In embodiments, the foot-operated control surface device 106 may be sized to adapt to a palm of a human hand and maintain the same principles of operation described above.

[0066] In an embodiment where the control surface device 106 is a remote controlling device, the control surface device 106 may direct command messages to the remotely controlled audio device, such as a mixing engine, to control the audio channels in the output audio signal. Accordingly, in an example of a monitor mix, adjustment of volume, tone, and pan adjustments by the mixing engine can be directed based on command messages provided by the control surface device 106.

[0067] In another embodiment, where the control surface device 106 includes the functionality of a mixing engine, the control surface device 106 can receive and adjust an input audio signal in order to generate the output audio signal. In this embodiment, the number of audio channels included in the input audio signal can be different than the number of audio channels included in the output audio signal, since the control surface device 106 may itself independently receive the audio channels as the audio input signal, and configure the monitor mix therefrom to create the output audio signal. In addition, or alternatively, the type of adjustments applied to the audio channels in the input audio signal and the type of adjustments
applied to the audio channels in the output audio signal can be different. For example, a tone or pan of an audio channel may be adjusted to be different in the output audio signal than it was in the input audio signal.

[0068] Referring to FIGs. 1 and 8, the communication ports 810 of the remote controlling devices, such as control surface device 106 can transmit control messages to control audio channels of a digital or analog output audio signal generated by a mixing engine 102, which are provided to an audio output device 108 over the communication path 116, as previously discussed. Alternatively, in another example embodiment, the communication ports 810 of the remote controlling devices, such as control surface device 106 can also operate as input ports to receive an audio signal as an input audio signal, as previously discussed. The input audio signal can be a digital signal or an analog signal. Such input audio signals may be received over the communication path 112 from the converter 104. Alternatively, or in addition, input audio signals may be received from any other device or equipment, such as from mixing engines 102. The input audio signal can include multiple audio channels. For example, the control surface device 106 may receive as the input audio signal a monitor mix from a mixing engine 102 such as a mixing console. The monitor mix audio input signal can include mono or stereo channels representative of a number of different instruments and/or vocal sources. Alternatively, the input audio signal may be received at the ports 810 as individual, separate and independent audio channels. For example, separate audio channels may be transmitted to the control surface device 106 over the communication path 112, which together are the input audio signal. In another example, separate audio channels may be received as the input audio signal at the ports 810 from other equipment, such as from a mixing engine.

[0069] In an embodiment, the control surface device 106 can also provide via the ports 810 an output audio signal on an audio channel output over the communication path 116 to at least one audio output device 108. The output audio signal may include all or some portion of the audio channels included in the input audio signal. In other words, in this embodiment, the
control surface device 106 may include mixing capability of a mixing engine. The communication path 116 or this example embodiment may be a wired or wireless communication link that provides the audio output signal as a mono or stereo audio signal to drive the audio output device 108 to produce audible sound. The audio channel output 116 may also provide an audio signal to produce other forms of audible sound, and may drive other audio output devices, such as a loudspeaker.

[0070] During operation the scroll wheel assembly 504 may be used for adjustment of individual audio channels included in the output audio signal, and the user input devices 508 may be used for selection of audio channels for which adjustment is desired. In an embodiment, audio channels in the output audio signal may be independently selected and adjusted. In addition, a group of audio channels, or all the audio channels in the output audio signal may be selected and adjusted together.

Examples of adjustments to the audio channels include a volume (or signal amplitude) adjustment, a tone adjustment (equalization) and a balance (pan) adjustment when the output audio signal is a stereo signal. In other examples any other parameters related to the audio channels may be selected and independently adjusted. Selection of one or more of the audio channels for adjustment may be made based on channel selection signals received from user inputs to a channel selector user input device included as part of the user input devices 508. In addition, selection of the mode of adjustment, such as volume, tone, or pan may be made based on mode selection signals received from user inputs to a mode selector user input device included as part of the user input devices 508.

[0071] For example, as illustrated in FIGS. 7 and 8, selection with the channel selector user input device of an audio channel from among the audio channels in the output audio signal may be initiated by actuation of a first one of the user input devices 508A or a second one of the user input devices 508B. In this example embodiment, the signal generated by actuation of the first user input device 508A is a command to the circuitry to select a next channel in the mix, and the signal generated by actuation of the second user input device 508B, is a command to the circuitry to select
a previous channel in the mix. Thus, signals generated by actuation of the
first and second user input devices 508A and 508B can step forward or
backward through the audio channels in the monitor mix of the output
audio signal.

[0072] The first user input device 508A may be positioned in a first aperture 814
formed in the housing 502, and the second user input device 508B may be
positioned in a second aperture 814 formed in the housing 502. The first
and second apertures 814 and 816 may be positioned adjacent to an
aperture 818 in the housing 502 that accommodates the rotatable member
506. More specifically, the first and second apertures 814 and 816 may be
formed in a cover portion 820 of the housing 502 on opposite sides of the
aperture 818. In addition to the cover portion 820, the housing 502 may
also include a base portion 822 and a backplane portion 824. The scroll
wheel assembly 504 may be mounted on the base portion, whereas
rotational sensor 802, and the circuitry 804, may be mounted on a circuit
board 826 disposed in the housing, and the communication ports 810 may
be mounted in the back plane portion 824.

[0073] Due to the relative position of the first and second apertures 814 and 816,
and corresponding positions of first and second user input devices 508A
and 508B, a foot of a user may selectively actuate the channel selector
input device by contact with the first and second user input devices 508A
and 508B while maintaining control of the rotatable member 506. As
illustrated in FIG. 7(c) contact with the first user input device 508A may be
accomplished by a front end portion 704 of the shoe 702, while
maintaining the shoe 702 in contact with and control of the rotatable
member 506 of the scroll wheel assembly 504. As illustrated in FIG. 7(d)
contact with the second user input device 508B may be accomplished by a
back end portion 706 of the shoe 702, while maintaining the shoe 702 in
contact with and control of the rotatable member 506 of the scroll wheel
assembly 504.

[0074] In an embodiment, a currently selected audio channel(s) may be indicated
by the circuitry in the display 510. Alternatively, or in addition, the control
surface device 106 may issue a solo command message to the mixing
engine 102 to temporarily mute the non-selected channels such that only the selected audio channel(s) are included in the audio output signal driving the audio output device 108. The selected audio channel(s) may be temporarily "soloed" in the audio output signal for a predetermined time upon initial selection, followed by the output audio signal reverting back to include other non-selected audio channels when the predetermined time expires. The predetermined time may be set by a user such that the control surface device 106 may issue another audio command message to the mixing engine 102 so that all the audio channels are again provided to the audio output device 108. Accordingly, a user can audibly determine which audio channel(s) are currently selected, without reference to a display or other visual indicator. Thus, knowledge of audio channel numbers by a user of the control surface device 106 are not necessary to control the output audio signal since the user can select audio channels audibly. As such, audio channels can be arbitrarily assigned during setup of the audio system.

[0075] Selection of audio channels may be initiated by a user at the control surface device 106, as previously discussed. In an embodiment, the control surface device 106 may send a request message to the remotely controlled audio device supplying the input audio signal to the control surface device 106 to change the input audio signal received by the control surface device 106 to only include the selected audio channel(s). This may be accomplished by, for example, the control surface device 106 transmitting a command message to mute all audio channels except the selected audio channel(s) of an identified mixing engine 102, or a command message to solo the selected audio channel(s). The command message may be transmitted to the converter 104 over the communication path 114, which can convert the command to a protocol understood by the mixing engine 102, and transmit the converted command over the communication path 112 to the identified mixing engine 102. After a predetermined time, control surface device 106 may transmit a command message via the converter 104 to unselect the previously selected audio channel(s), thereby instructing the mixing engine 102 to change the input
audio signal back to include all the audio channels. In an alternative embodiment where the control surface device 106 receives an input audio signal, containing audio channels, and produces the output audio signal to drive the audio output device 108, changing the output audio signal to include only the selected audio channel(s) may be performed at the control surface device 106 by outputting fewer audio channels in the output audio signal than are received in the input audio signal.

[0076] Once the audio channel(s) in audio output signal are selected, the user may select a mode of adjustment, such as volume, tone, or pan, of the selected audio signal(s) that is desired using the mode selector user input device. In an embodiment, a volume mode used for adjustment of an amplitude (volume) of the selected audio channel(s) is a default type of adjustment selected by the circuitry, and therefore no command message containing the volume mode needs to be transmitted to the mixing engine 102 to remotely control the volume of the audio channels. Accordingly, once one or more audio channels are selected, rotation of the rotatable member 506 results in a command message to adjust an amplitude (volume) of the selected audio channel(s) since the volume mode is the default. Thus, a volume level of a single selected audio channel, a group of selected audio channels, or all of the audio channels in the output audio signal may be remotely adjusted higher or lower by rotation of the rotatable member 506. In other examples, the volume mode may be selected with a volume control user input device. Other modes of remote adjustment of the audio channel(s) may be enabled by actuation of a tone mode user selector device and a pan mode user selector device. In an alternative embodiment where the control surface device 106 receives an audio input signal containing audio channels, and produces the output audio signal to drive the audio output device 108, the control surface device 106 may, as a default mode, adjust the volume of the audio channels in the output audio signal, and tone mode and pan mode may also be adjusted by the control surface device 106.

[0077] In an embodiment, mode selector user input device 508C may be used as the volume mode user selector device, the tone mode user selector
device, and the pan mode user selector device. Different modes may be selected with the mode selector user input device 508C by applying predetermined patterns of actuation. For example, in response to a signal generated by momentary actuation of the user input device 508C, the circuitry may select all the audio channels to enable adjustment of a master volume of a monitor mix, which adjusts the overall volume (global volume) of the monitor mix. In another example, actuation of the user input device 508C for a predetermined period of time, which is longer than momentary actuation may change the control surface device 106 to tone mode. In still another example, actuation of the user input device 508C and actuation of the user input device 508B may change the control surface device 106 to pan mode.

[0078] In an example embodiment of controlling a monitor mix, the control surface device 106 may power up in volume mode and select the first channel in a range of channels previously set with the converter 104. The channel selected may be indicated in the display 510. By operating the channel selector user input device 508A and 508B, other audio channels within the range can be sequentially selected, and indicated in the display 510 accordingly. The level of the volume of the selected channel can be remotely or locally adjusted with the rotatable member 506 in different respective embodiments. The mode selection user input device 508C may be actuated momentarily to select the global master volume adjustment mode with the rotatable member 506, which may also be indicated in the display 510.

[0079] In an embodiment, the control surface device 106 may be switched to tone mode by actuating the mode selection user input device 508C for a determined period of time that is longer than the momentary actuation to select the global master volume mode. Indication that the control surface device 106 is in the tone mode may also be indicated on the display 510. The rotatable member 506 may be rotated to remotely or locally adjust the equalization (EQ) of the channel selected, in different respective embodiments. For example, rotating the rotatable device 506 boosts or cuts bass or treble, which may be indicated on the display 510.
accordingly. The mode selection user input device 508C may be actuated momentarily to select the global tone of the output audio signal for adjustment using the rotatable member 506. In an embodiment, the control surface device 106 may be returned back to a previous mode by actuating the mode selection user input device 508C for a predetermined period of time which is longer than the time to enter the tone mode.

[0080] In an embodiment, the control surface device 106 may be switched to pan mode by actuating and holding for predetermined period of time both the mode selection user input device 508C and the channel selection user input device 508B simultaneously. Indication of being in the pan mode may also be indicated in the display 510. During the pan mode, the rotatable member 506 may be used to remotely or locally adjust (depending on the respective embodiment) a perceived location in a virtual sound stage of an audio channel, which may also be indicated in the display 510, accordingly. The rotatable member 506 may be rotated to adjust just the pan of the channel selected, as indicated by the display 510 accordingly. The mode selection user input device 508C may be momentarily actuated to select the master balance for the rotatable member 506 to adjust. The control surface device 106 may be returned back to a previous mode by selecting the mode selection user input device 508C and the channel selector user input device 508B simultaneously, and holding them for period of time that is greater than the momentary actuation to enter the master balance.

[0081] In an embodiment, when selecting audio channels, a user may use "Solo-In-Place" to audibly detect the channel that has been selected without needing to look at the display 510, as previously discussed. Solo-In-Place can send a command message to a mixing engine 102 to turn off aux sends of all other audio channels in the output audio signal except for the selected channel for a period of time set by a user. Alternatively, where the control surface device 106 receives an input audio signal, containing audio channels, and produces the output audio signal to drive the audio output device 108, the control panel surface 106 can turn off the aux sends of all the audio channels in the output audio signal
except the selected channel for a period of time. In an embodiment, the Solo-In-Place time regulator may be a foot actuated user input device driving a rotary encoder. Using the rotary encoder the period of time can be set from zero (effectively turning the feature off) to some maximum pre-determined value. In embodiments where the control surface device 106 is remotely controlling the mixing engine, a solo time command message may be transmitted to the mixing engine 102 to set the period of time for the mixing engine to maintain the solo in place. Alternatively, in embodiments where the control surface device 106 is locally controlling the output audio signal, the solo time may be stored and used by the control surface device 106 to maintain the solo in place.

[0082] In an embodiment, the control surface device 106 may also include a transport control mode, in which remote transport control of a media player is provided. For example, where one or more of the mixing engines 102 include a media player, the control surface device 106 may include capability to remotely control the media player functionality. In this embodiment, the control surface device 106 may be operated with a predetermined unique ID to control operation of the media device functionality, such as playback/start/stop/rewind/next track/previous track, and the like. In an example embodiment, the user input device 508 may be actuated to enter the transport control mode. Upon entry into the transport control mode, the user interface may be used for generation of transport control command messages to the remote device. For example, the rotatable member 506 may be rotated to provide start and stop command messages, actuation of user input devices 508A and 508B can create command messages of previous track/next track, user input device 508C can create command messages of rewind, and the display 510 may indicate track number or name.

[0083] FIG. 9 is an example operational flow diagram of the control surface device 106 remotely controlling audio channels in a monitor mix generated by a mixing engine 102, or locally controlling audio channels in a monitor mix by receiving an input audio signal and generating an output audio signal. This is an example and should not be construed as limiting, since
the control surface device 106 may also remotely or locally control and/or monitor other audio-related parameters, as previously discussed. At block 902, the circuitry of the control surface device 106 receives a signal indicative of a channel selection due to actuation by a foot of a user of the channel selector user input device 508. For example, the signal may be a channel up indication received in response to actuation of the first user input device 508A, or a channel down indication received in response to actuation of the second user input device 508B.

At block 904, the circuitry of the control surface device 106 may receive a signal indicative of a mode selection due to actuation by a foot of a user of a mode selector user input device 508. For example, the user may actuate the user input device 508C momentarily to enter a global volume mode, or actuate the user input device 508C for a longer predetermined time to enter a pan mode. Alternatively, in embodiments, this step may be omitted if adjustment of a volume level of a channel is desired, and the control surface device 106 includes the audio channel adjustment as the default mode. The rotatable member 506 may be rotated by lateral movement of a foot of a user to adjust a parameter of one or more audio channels included in an output audio signal at block 906. In addition, at block 908, the display 510 may display at least the one or more audio channels being displayed, and perhaps the adjustment of the corresponding parameters.

At block 910, it is determined if the control surface device 106 is operating as a remote controlling device that provides commands to a remotely controllable mixing engine 102 to adjust the monitor mix, or if the control surface device 106 is operating with local control as a console mixer to receive individually the audio channels as the input audio signal and create the monitor mix. If the control surface device 106 is operating as a remote controlling device to control a remotely controlled device such as a mixing engine, at block 914, a command message is generated by the circuitry and sent to the mixing engine 102, which includes adjusted parameter(s) and a request that the monitor mix be changed. The command message is communicated to the converter 104 over the communication path 112 where it is stored and converted to the protocol of
the mixing engine at block 916. At block 918, the audio channels included in output audio signal may be correspondingly adjusted by the remotely controlled mixing engine 102. The adjusted output audio signal may be passed to the audio output device 108 by the mixing engine 102 over the communication path 116 at block 920.

[0086] If, on the other hand, at block 910, the control surface device 106 is operating as a mixing engine, one or more audio channels that form the input audio signal may be adjusted by the circuitry of the control surface device 106 at block 922. At block 924, the audio channels included in the input audio signal received by the control surface device 106 may be combined to form the output audio signal used to drive the audio output device 108, and the operation may proceed to block 920 where the output audio signal is output by the control surface device 106 to the audio output device 108 over the communication path 116.

[0087] In other examples of operation, tone adjustments and pan adjustments (where the audio channels are stereo) may be similarly performed after selection with either the tone mode user input device, or the pan mode user input device. In still other examples, global adjustment of the volume or tone of the monitor mix may be performed after the global volume mode or the global tone mode is selected with the global mode user input device.

[0088] The methods, devices, processing, and logic described above may be implemented in many different ways and in many different combinations of hardware and software. For example, all or parts of the implementations may be circuitry that includes an instruction processor, such as a Central Processing Unit (CPU), microcontroller, or a microprocessor; an Application Specific Integrated Circuit (ASIC), Programmable Logic Device (PLD), or Field Programmable Gate Array (FPGA); or circuitry that includes discrete logic or other circuit components, including analog circuit components, digital circuit components or both; or any combination thereof. The circuitry may include discrete interconnected hardware components and/or may be combined on a single integrated circuit die, distributed among multiple integrated circuit dies, or implemented in a Multiple Chip Module (MCM) of multiple integrated circuit dies in a
common package, as examples.

[0089] The circuitry may further include or access instructions for execution by the circuitry. The instructions may be stored in a tangible storage medium that is other than a transitory signal, such as a flash memory, a Random Access Memory (RAM), a Read Only Memory (ROM), an Erasable Programmable Read Only Memory (EPROM); or on a magnetic or optical disc, such as a Compact Disc Read Only Memory (CDROM), Hard Disk Drive (HDD), or other magnetic or optical disk; or in or on another machine-readable medium. A product, such as a computer program product, may include a storage medium and instructions stored in or on the medium, and the instructions when executed by the circuitry in a device may cause the device to implement any of the processing described above or illustrated in the drawings.

[0090] The implementations may be distributed as circuitry among multiple system components, such as among multiple processors and memories, optionally including multiple distributed processing systems. Parameters, databases, and other data structures may be separately stored and managed, may be incorporated into a single memory or database, may be logically and physically organized in many different ways, and may be implemented in many different ways, including as data structures such as linked lists, hash tables, arrays, records, objects, or implicit storage mechanisms. Programs may be parts (e.g., subroutines) of a single program, separate programs, distributed across several memories and processors, or implemented in many different ways, such as in a library, such as a shared library (e.g., a Dynamic Link Library (DLL)). The DLL, for example, may store instructions that perform any of the processing described above or illustrated in the drawings, when executed by the circuitry.

[0091] Various implementations have been specifically described. However, many other implementations are also possible.
Claims

1. An audio system comprising: a foot operated personal control surface device including a housing formed to include an aperture; a user interface included in the housing; circuitry electrically couple with the user interface and included in the housing, the circuitry configured to process a communication protocol comprising audio-related parameters of a respective plurality of audio channels included in an output audio signal used to drive an audio output device; and a scroll wheel assembly included in the user interface, the scroll wheel assembly comprising a rotatable member rotatably disposed in the aperture for access by a foot of a user, the scroll wheel assembly being electrically coupled with the circuitry such that rotation of the rotatable member enables adjustment of audio-related parameters of any of the plurality of audio channels included in the output audio signal.

2. The audio system of claim 1, further comprising a channel selection input device included in the user interface and accessible by the foot of the user, which upon actuation provides a signal to the circuitry to select an audio channel included in the output audio signal for independent and exclusive adjustment of audio-related parameters of the selected audio channel with the rotatable member.

3. The audio system of claim 2, wherein independent and exclusive adjustment of the audio-related parameters comprises adjustment of a volume level of the selected audio channel.

4. The audio system of claim 2 or 3, where multiple actuations of the channel selection input device instructs the circuitry to step through the plurality of audio channels one at a time.

5. The audio system of claim 1, further comprising a master volume selection input device included in the user interface which upon actuation by a foot of a user provides a signal to the circuitry to select all audio channels such that rotation of the rotatable member enables a global volume level adjustment of all the audio channels included in the output audio signal.

6. The audio system as in any of claims 1-5, further comprising a tone mode input device included in the user interface, which upon actuation by a foot of a user provides a signal to the circuitry to enable adjustment of a tone of any of the
plurality of audio channels with the rotatable member.

7. The audio system as in any of claims 1-6, further comprising a pan mode input device included in the user interface, which upon actuation by a foot of a user provides a signal to the circuitry to enable adjustment of a tone of any of the plurality of audio channels with the rotatable member.

8. The audio system of claims 1 or 2, wherein a default mode of adjustment of audio-related parameters is a volume mode such that rotation of the rotatable member enables adjustment of a volume level of any of the plurality of audio channels with the rotatable member, and the audio system further comprises a mode selection input device included in the user interface, which upon actuation for a first predetermined time period provides a signal to the circuitry to select all audio channels such that rotation of the rotatable member enables a global volume level adjustment of all the active audio channels, and upon actuation for a second predetermined period of time provides a signal to the circuitry to select an audio channel for independent and exclusive adjustment of a tone level of the selected audio channel with the rotatable member.

9. A method of audio management of an audio system, the method comprising: receiving, at a foot operated personal control surface device, a signal indicating a channel selection of at least one audio channel included in an audio signal; receiving, at the foot operated personal control surface device, a signal indicative of rotation of a rotatable member by a foot of a user; and adjusting, with the foot operated personal control surface device, an output audio signal for receipt by an audio output device, the output audio signal including a plurality of audio channels, where at least one of the audio channels is adjusted in accordance with the channel selection and the rotation of the rotatable member.

10. The method of claim 9, further comprising generating a command message, and transmitting the command message to a remote device that is providing the output audio signal to a drive an audio output device, the command message comprising instructions to adjust the at least one of the audio channels included in the output audio signal.

11. The method of claims 9 or 10, wherein receiving a signal indicating a channel selection further comprises generating a command message, and transmitting
the command message to the remote device that is providing the output audio signal, the command message instructing the remote device to adjust one or more of the audio channels indicated with the channel selection.

12. The method as in any of claims 9 - 11, wherein receiving a signal indicating a channel selection further comprises generating a command message, the command message includes a command to mute, for a determined period of time, all the audio channels in the output audio signal except an audio channel selected by the channel selection.

13. The method of claim 9, further comprising receiving at the foot operated personal control surface device an audio input signal, which comprises a plurality of audio channels, adjusting at least one of the audio channels, and outputting the output audio signal to include the adjusted at least one of the audio channels.

14. A foot operated personal control surface device comprising: a scroll wheel assembly disposed in a housing, the scroll wheel assembly comprising a rotatable member rotatably disposed in an aperture of the housing and accessible from outside the housing by a foot of a user; a channel selector input device disposed in the housing and accessible by the foot of the user to select at least one of a plurality of audio channels included in an output audio signal; and circuitry electrically coupled with the scroll wheel assembly, and the channel selector, the circuitry senses rotation of the rotatable member as an adjustment of any of the plurality of audio channels based on selection of the any of the plurality of audio channels with the channel selector input device.

15. The foot operated personal control surface device of claim 14, wherein the adjustment of any of the plurality of audio channels comprises adjustment of one of a volume, a tone or a pan of any of the plurality of audio channels based on selection of the any of the plurality of audio channels with the channel selector input device.

16. The foot operated personal control surface device of either claims 14 or 15, further comprising a mode selection input device disposed in the housing, which upon actuation provides a signal to the circuitry to select a mode of adjustment of any of the plurality of audio channels based on selection of the any of the plurality of audio channels with the channel selector input device,
the modes comprising a volume mode, a tone mode and a pan mode.

17. The foot operated personal control surface device as in any of claims 14 - 16, wherein the circuitry is configured to send a parameter change request message for one of the plurality of audio channels to an audio device that is supplying the audio output signal, in response to rotation of the rotatable member.

18. The foot operated personal control surface device as in any of claims 14 - 17, wherein the channel selector input device is positioned on the housing relative to the rotatable member for simultaneous contact by a foot of a user with both the rotatable member and the channel selector input device.

19. A foot operated personal control surface device comprising: a communication port configured to communicate with an external audio device via a converter, the converter configured to converter a protocol of messages received from the foot operated personal control surface device to be compatible with the external audio device; a scroll wheel assembly disposed in a housing, the scroll wheel assembly comprising a rotatable member rotatably disposed in the housing and accessible from outside the housing by a foot of a user; and circuitry electrically coupled with the communication port and the scroll wheel assembly, the circuitry transmits for receipt by the external audio device via the communication port and the converter a parameter change request message to adjust a volume level of at least one of the audio channels in response to rotation of the rotatable member.

20. The foot operated personal control surface device of claim 19, further comprising a channel selector disposed in the housing and accessible to select at least one of the plurality of audio channels so that the selected at least one of the plurality of audio channels may be included in the change request message.

21. An audio system comprising: a converter having a storage medium configured to store a plurality of audio-related parameters of audio devices included in the audio system; the converter including at least one communication port configured to communicate with the audio devices, and receive the audio-related parameters to populate the storage medium; the converter configured to receive a command message in a first protocol format from a
remote controlling audio device, and convert the command message to a second protocol format of a remotely controlled audio device identified in the command message, the command message comprising a request to change a stored audio-related parameter of the identified remotely controlled audio device; and the converter configured to store the changed audio-related parameter in the storage medium and transmit the converted command message to the remotely controlled audio device via the communication port.
FIG. 2

Power Up
→ Detect Devices
→ Load Requests
→ Communicate Requests
→ Receive Responses
→ Synch. Equipment

216

Additional Equipment?

218

NO
→ Communicate with Mixing Engines

220

Update Stored Parameter Values

222

Parameter Value Change?

224

Send Parameter Change Command Message

226

Send Parameter Request Message

228

Send Push Parameter Changed Message

YES

YES
FIG. 3
PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT
(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference

FOR FURTHER
ACTION

see Form PCT/ISA/220
as well as, where applicable, item 5 below.

International application No.
PCT/EP2014/058439

International filing date (day/month/year)
25 April 2014 (25-04-2014)

(earliest) Priority Date (day/month/year)
20 August 2013 (20-08-2013)

Applicant

JURI BEKLEMISEV INDIVIDUALI IMONE

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of _______ 4 _______ sheets.

X It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report
   a. With regard to the language, the international search was carried out on the basis of:
      X the international application in the language in which it was filed
      [] a translation of the international application into _______ , which is the language
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   b. [] This international search report has been established taking into account the rectification of an obvious mistake
      authorized by or notified to this Authority under Rule 91 (Rule 43.3(b)(a)).
   c. [] With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.

2. [] Certain claims were found unsearchable (See Box No. II)

3. [] Unity of Invention is lacking (see Box No III)

4. With regard to the title,
   X the text is approved as submitted by the applicant
   [] the text has been established by this Authority to read as follows:

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6. With regard to the drawings,
   a. the figure of the drawings to be published with the abstract is Figure No. 6
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   b. [] none of the figures is to be published with the abstract

Form PCT/ISA/210 (first sheet) (July 2009)
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. G10H1/34
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G10H G06F H04H G05G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X Further documents are listed in the continuation of Box C. X See patent family annex.

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Date of the actual completion of the international search

2 July 2014

Date of mailing of the international search report

10/07/2014

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