

(19) AUSTRALIAN PATENT OFFICE

(54)	Title Method and system for allowing a media player to transfer digital audio to an accessory		
(51) ⁶	International Patent Classification(s) G06F 3/16 (2006.01) 0BMEP G10L G06F 13/00 (2006.01) 19/00 G10L 19/00 (2006.01) 20060101ALI2008050 G11B 20/10 (2006.01) 8BHEP G11B H04L 12/28 (2006.01) 20/10 G06F 3/16 20060101ALI2008050 20060101AFI2008050 8BHEP H04L 8BHEP G06F 12/28 13/00 20060101ALI2008050 20060101ALI2005111 8BHEP PCT/US2007/072154		
(21)	Application No:	2007265077	(22) Application Date: 2007.06.26
(87)	WIPO No:	W008/002935	
(30)	Priority Data		
(31)	Number	(32) Date	(33) Country US
	11/476,312	2006.06.27	
(43)	Publication Date :	2008.01.03	
(71)	Applicant(s)	Apple Inc.	
(72)	Inventor(s)	Tupman, David, Filson, John B., Holden, Paul, Novotney, Donald J., Fletcher, Daniel R., Twycross, Barry, Archibald, John	
(74)	Agent/Attorney	Freehills Patent & Trade Mark Attorneys, Level 43 101 Collins Street, Melbourne, VIC, 3000	
(56)	Related Art	CRAWFORD, D I et al., Sample Rate Conversion And Bit Rate Reduction In The Studio, IEE COLLOQUIUM ON DIGITAL AUDIO SIGNAL PROCESSING, 22 May 1991 US 5592588	

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
3 January 2008 (03.01.2008)

PCT

(10) International Publication Number
WO 2008/002935 A3

(51) International Patent Classification:
G06F 3/16 (2006.01) *H04L 12/28* (2006.01)
G11B 20/10 (2006.01) *G10L 19/00* (2006.01)

(21) International Application Number:
PCT/US2007/072154

(22) International Filing Date: 26 June 2007 (26.06.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/476,312 27 June 2006 (27.06.2006) US

(71) Applicant (for all designated States except US): **APPLE INC.** [US/US]; 1 Infinite Loop, MS 3-PAT, Cupertino, California 95014 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **HOLDEN, Paul** [CA/US]; 1 Infinite Loop, MS 3-PAT, Cupertino, California 95014 (US). **FLETCHER, Daniel, R.** [US/US]; 1 Infinite Loop, MS 3-PAT, Cupertino, California 95014 (US). **TYWCROSS, Barry** [GB/US]; 1 Infinite Loop, MS 3-PAT, Cupertino, California 95014 (US).

(53) International Search Report (ISR) and International Preliminary Examination Report (IPEA) (if applicable):

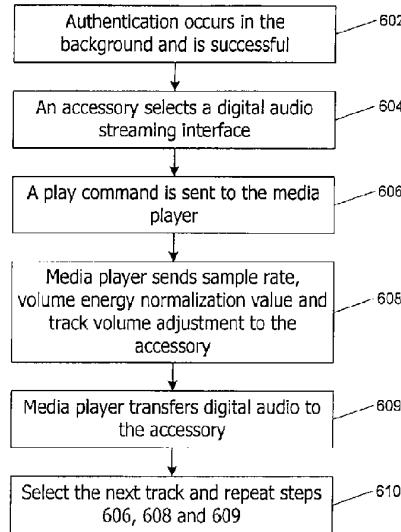
(54) Title: METHOD AND SYSTEM FOR ALLOWING A MEDIA PLAYER TO TRANSFER DIGITAL AUDIO TO AN ACCESSORY

(55) Description (Summary): A method and system for allowing a media player to transfer digital audio to an accessory. The method and system comprises sending a play command to the media player; returning information about the media player; and providing digital audio to the accessory based upon the information about the media player. In a system and method in accordance with the present invention a plurality of commands allow a media player to transfer digital audio to an accessory. These commands are used by the media player to gather a list of supported sample rates from the accessory and to inform the accessory of the media player's information.

(56) Abstract: A method and system for allowing a media player to transfer digital audio to an accessory is disclosed. The method and system comprises sending a play command to the media player; returning information about the media player; and providing digital audio to the accessory based upon the information about the media player. In a system and method in accordance with the present invention a plurality of commands allow a media player to transfer digital audio to an accessory. These commands are used by the media player to gather a list of supported sample rates from the accessory and to inform the accessory of the media player's information.

/Continued on next page/

WO 2008/002935 A3





TI, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA,
ZM, ZW.

PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM,
GA, GN, GQ, GW, ML, MR, NI, SN, TD, TG).

Published:

— *with international search report*
— *before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments*

(88) Date of publication of the international search report:

10 April 2008

**METHOD AND SYSTEM FOR ALLOWING A MEDIA PLAYER TO TRANSFER
DIGITAL AUDIO TO AN ACCESSORY**

FIELD OF THE INVENTION

[0002] The present invention relates to media players communicating with accessory devices.

BACKGROUND OF THE INVENTION

[0003] A media player stores media assets, such as audio tracks, videos, and photos that can be played or displayed on the media player. One example of a media player is the iPod™ media player, which is available from Apple Inc. of Cupertino, CA. Often, a media player acquires its media assets from a host computer that serves to enable a user to manage media assets. As an example, the host computer can execute a media management application to manage media assets. One example of a media management application is iTunes®, version 6.0, produced by Apple Inc.

[0004] A media player typically includes one or more connectors or ports that can be used to interface to the media player. For example, the connector or port can enable the media player to couple to a host computer, be inserted into a docking system, or receive an accessory device. There are today many different types of accessory devices that can interconnect to the media player. For example, a remote control can be connected to the connector or port to allow the user to remotely control the media player. As another example, an automobile can include a connector and the media player can be inserted onto the connector such that an automobile media system can interact with the media player, thereby allowing the media content on the media player to be played within the automobile.

[0005] Many accessories such as USB speakers are capable of receiving digital audio. Accordingly, it is desirable that the media player be able to provide digital audio to these types of accessories. Heretofore, only analog audio signals have been provided from the media player to an accessory.

[0006] Thus, there is a need for improved techniques to enable manufacturers of media players to provide digital audio tracks to associated accessories. It is an object of the present

15 Jun 2010

2007265077

invention to address such a need; or at least to provide an alternative for those concerned with media players.

It is not admitted that any of the information in this specification is common general knowledge, or that the person skilled in the art could reasonably be expected to have ascertained, understood, regarded it as relevant or combined it in anyway at the priority date.

BRIEF SUMMARY OF THE INVENTION

In one aspect the invention provides a method for transmitting digital audio data to an accessory by a media player, the method comprising, by the media player:

requesting from the accessory a list of sample rates supported by the accessory;

10 receiving from the accessory the list of sample rates supported by the accessory;

selecting, from the list of sample rates supported by the accessory, a first sample rate for playing a first track of digital audio data;

transmitting track information including the first sample rate to the accessory; and

subsequent to transmitting the track information including the first sample rate, delivering 15 digital audio samples of the first track via a digital audio interface to the accessory at the first sample rate.

In another aspect the invention provides a method for obtaining digital audio from a media player by an accessory, the method comprising, by the accessory:

sending to the media player a list of sample rates supported by the accessory;

20 receiving from the media player track information including a first sample rate for a first track of digital audio data to be played, wherein the first sample rate is selected by the media player and is one of the sample rates on the list of sample rates supported by the accessory;

configuring a digital audio interface of the accessory according to the first sample rate; and

2007265077 15 Jun 2010

subsequent to configuring the digital audio interface according to the first sample rate, receiving digital audio samples of the first track from the media player at the first sample rate via the digital audio interface.

In another aspect the invention provides a media player including a storage device, a digital audio interface and a control module. The storage device is configured to store media assets including a plurality of tracks of digital audio data. The digital audio interface is configured to send digital audio samples of a track of digital audio data to an accessory. The control module is coupled to the storage device and the digital audio interface, and configured to:

request from the accessory a list of sample rates supported by the accessory;

0 receive from the accessory the list of sample rates supported by the accessory;

select, from the list of sample rates supported by the accessory, a first sample rate for playing a first track of digital audio data;

communicate track information including the first sample rate to the accessory; and

subsequent to transmitting the track information including the first sample rate, 15 deliver digital audio samples of the first track to the accessory at the first sample rate via the digital audio interface.

In another aspect the invention provides an accessory for use with a media player. The accessory includes a digital audio interface and a control module. The digital audio interface is configured to receive digital audio samples of a track of digital audio data from the media player.

20 The control module is coupled to the interface and to an audio output section and configured to:

send to the media player a list of sample rates supported by the accessory;

receive from the media player track information including a first sample rate for a first track of digital audio data to be played, wherein the first sample rate is selected by the media player and is one of the sample rates on the list of sample rates supported by the accessory;

25 configure the digital audio interface to receive data at the first sample rate;

subsequent to configuring the digital audio interface according to the first sample rate, receiving digital audio samples of the first track from the media player at the first sample rate via the digital audio interface; and

deliver the digital audio data samples to the audio output section.

5 [0007] A method and system for allowing a media player to transfer digital audio to an accessory is disclosed. The method and system comprises sending a play command to the media player; returning information about the media player; and providing digital audio to the accessory based upon the information about the media player.

[0008] In a disclosed system and a disclosed method a plurality of commands allow a media player to transfer digital audio to an accessory. These commands are used by the media player to gather a list of supported sample rates from the accessory and to inform the accessory of the media player's information.

As used herein, except where the context requires otherwise the term 'comprise' and variations of the term, such as 'comprising', 'comprises' and 'comprised', are not intended to exclude other additives, components, integers or steps.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described, by way of example only, with reference to the accompanying figures, in which:

[0009] Figures 1A and 1B illustrate a docking connector in accordance with an embodiment 20 of the present invention.

[0010] Figure 2A is a front and top view of a remote connector in accordance with an embodiment of the present invention.

[0011] Figure 2B illustrates a plug that can be utilized in the remote connector of Figure 2A.

15 Jun 2010
2007265077

4a

- [0012] Figure 2C illustrates the plug of Figure 2B inserted into the remote connector of Figure 2A.
- [0013] Figure 3 A illustrates connector pin designations for the docking connector.
- [0014] Figure 3B illustrates connection pin designations for the remote connector.
- 5 [0015] Figure 4A illustrates a typical Fire Wire connector interface for the docking connector.
- [0016] Figure 4B illustrates a reference schematic diagram for an accessory power source.
- [0017] Figure 4C illustrates a reference schematic diagram for a system for detecting and identifying accessories for the docking connector.
- 10 [0018] Figure 4D is a reference schematic of an electret microphone that may be connected to the remote connector.
- [0019] Figure 5A illustrates a media player coupled to different accessories.
- [0020] Figure 5B illustrates the media player coupled to a computer.
- [0021] Figure 5C illustrates the media player coupled to a car or home stereo system.
- 15 [0022] Figure 5D illustrates the media player coupled to a dongle that communicates wirelessly with other accessories.
- [0023] Figure 5E illustrates the media player coupled to a speaker system.
- [0024] Figure 6 is a flow chart illustrating how a media player provides digital audio to an accessory.
- 20 [0025] Figure 7 is a table that lists examples of media player supported sample rates.

15 Jun 2010
2007265077

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0026] The present invention relates generally to media players communicating with accessory devices. The following description is presented to enable one of ordinary skill in the art to make and use the invention and is provided in the context of a patent application and its requirements. Various modifications to the preferred embodiment and the generic principles and features described herein will be readily apparent to those skilled in the art. Thus, the present invention is not intended to be limited to the embodiment shown but is to be accorded the widest scope consistent with the principles and features described herein.

[0027] In a system and method in accordance with an embodiment of the present invention a plurality of commands allow a media player to transfer digital audio to an accessory. The method and system comprise sending a play command to the media player; returning information about the media player; and providing digital audio to the accessory based upon the information about the media player. The media player may perform sample rate conversion internally to transfer digital audio at a supported sample rate. The plurality of commands could be utilized in a variety of environments. One such environment is within a connector interface system environment such as described in detail hereinbelow.

Connector Interface System Overview

[0028] To describe the features of the connector interface system in accordance with the embodiment of the present invention in more detail, refer now to the following description in conjunction with the accompanying drawings.

Docking Connector

[0029] Figures 1A and 1B illustrate a docking connector 100. Referring first to Figure 1A, the keying features 102 are of a custom length 104. In addition, a specific key arrangement where one set of keys are separated by one length are at the bottom and another set of keys are separated by another length at the top of the connector is used. The use of this key arrangement prevents noncompliant connectors from being plugged in and causing potential damage to the device. The connector for power utilizes a Firewire or USB specification for power. The connector includes a first make/last break contact to implement this scheme. Figure 1B illustrates the first make/last break contact 202 and also illustrates a ground pin and a power pin related to providing an appropriate

2007265077 15 Jun 2010

4c

first make/last break contact. In this example, the ground pin 204 is longer than the power pin 206. Therefore, the ground pin 204 would contact its mating pin in the docking accessory before the power pin 206. Therefore internal electrical damage of the electronics of the device is minimized.

5 [0030] In addition, a connector interface system in accordance with the present invention uses both USB and Firewire interfaces as part of the same docking connector alignment, thereby making the design more compatible with different types of interfaces, as will be discussed in detail hereinafter. In so doing, more remote accessories can interface with the media player.

Remote Connector

10 [0031] The connector interface system also includes a remote connector which provides for the ability to output audio, input audio, provides I/O serial protocol, and to provide an output for video. Figure 2A is a front and top view of a remote connector 200 in accordance with the present invention. As is seen, the remote connector 200 includes a top headphone receptacle 202, as well as a second receptacle 204 for remote devices. Figure 2B illustrates a plug 300 to be utilized in the remote connector. The plug 300 allows the features to be provided via the

remote connector. Figure 2C illustrates the plug 300 inserted into the remote connector 200. Heretofore, all these features have not been implemented in a remote connector. Therefore, a standard headphone cable can be plugged in but also special remote control cables, microphone cables and video cables could be utilized with the remote connector.

5 [0032] To describe the features of the connector interface system in more detail, please find below a functional description of the docking connector, remote connector and a command set in accordance with the present invention.

Docking and Remote Connector Specifications

[0033] For an example of the connector pin designations for both the docking connector

10 and for the remote connector for a media player such as an iPod™ device by Apple Inc., refer now to Figures 3A and 3B. Figure 3A illustrates the connector pin designations for the docking connector. Figure 3B illustrates the connection pin designations for the remote connector.

Docking Connector Specifications

15 [0034] Figure 4A illustrates a typical Firewire connector interface for the docking connector. The following are some exemplary specifications:

[0035] Firewire Power: 8V - 30V DC IN, 10 W max. Firewire can be designed to IEEE 1394 A Spec (400 Mb/s).

USB Interface

20 [0036] The media player provides two configurations, or modes, of USB device operation: mass storage and media player USB Interface (MPUI). The MPUI allows the media player to be controlled using a media player accessory protocol (MPAP) which will be described in detail later herein, using a USB Human Interface Device (HID) interface as a transport mechanism.

25 Accessory 3.3 V Power

[0037] Figure 4B illustrates the accessory power source. The media player accessory power pin supplies voltages, for example, 3.0 V to 3.3V+/-5% (2.85 V to 3.465 V) over the docking connector and remote connector (if present). A maximum current is shared between the docking and remote connectors.

30 [0038] By default, the media player supplies a particular current such as 5mA. Proper software accessory detect is required to turn on high power (for example, up to 100 mA)

during active device usage. When devices are inactive, they must consume less than a predetermined amount of power such as 5mA current.

[0039] Accessory power is switched off for a period of, for example, approximately 2 seconds during the media player bootstrap process. This is done to ensure that accessories are 5 in a known state and can be properly detected. All accessories are responsible for re-identifying themselves after the media player completes the bootstrap process and transitions accessory power from the off to the on state.

[0040] Accessory power is grounded through the Digital GND pins.

[0041] Figure 4C illustrates a reference schematic diagram for a system for detecting and 10 identifying accessories for the docking connector. The system comprises a resistor to ground that allows the device to determine what has been plugged into the docking connector. There is an internal pullup on Accessory Identify within the media player. Two pins (Accessory Identify & Accessory Detect) are used.

[0042] Figure 4D is a reference schematic of an electret microphone that is within the 15 remote connector.

[0043] Serial Protocol Communication:

[0044] a) Two pins used to communicate to and from device (Rx & Tx)

[0045] b) Input & Output (OV=Low, 3.3V=High)

[0046] As before mentioned, media players connect to a variety of accessories. Figures 20 5A-5E illustrate a media player 500 coupled to different accessories. Figure 5A illustrates a media player 500' coupled to a docking station 502. Figure 5B illustrates the media player 500" coupled to a computer 504. Figure 5C illustrates the media player 500' coupled to a car or home stereo system 506. Figure 5D illustrates the media player 500"" coupled to a dongle 508 that communicates wirelessly with other devices. Figure 5E illustrates the media player 25 500' coupled to a speaker system 510. As is seen, what is meant by accessories includes but is not limited to docking stations, chargers, car stereos, microphones, home stereos, computers, speakers, and accessories which communicate wirelessly with other accessories.

[0047] As before mentioned, this connector interface system could be utilized with a command set for allowing the transfer of digital audio from a media player to an associated 30 accessory. In the USB environment, the transfer is performed by streaming the digital audio

to the accessory. It should be understood by one of ordinary skill in the art that although the above-identified connector interface system could be utilized with the command set a variety of other connectors or systems could be utilized and they would be within the spirit and scope of the present invention. To describe the utilization of a digital audio command set in more detail refer now to the following description in conjunction with the accompanying drawings.

5 [0048] The command set allows the media player to transfer digital audio to an accessory. These commands are used by the media player to gather a list of supported sample rates from the accessory and to inform the accessory of the media player's information such as current sample rate, sound check (e.g., volume or sound energy normalization) value, and track 10 volume adjustment value. The media player may perform sample rate conversion internally to transfer digital audio at a supported sample rate.

Typical transactions for digital audio

[0049] Under normal circumstances, the media player and the accessory requesting digital audio over USB audio will perform the following steps:

15 [0050] 1. User connects the media player to the accessory using the connector interface system 100 to a USB cable.

[0051] 2. Media player provides a plurality of configurations to the accessory, for example, mass storage and USB audio.

[0052] 3. The accessory selects the USB audio configuration using an USB standard 20 request.

[0053] The accessory may authenticate with the media player before digital audio is enabled. When the accessory identifies as one supporting digital audio signal, authentication can be provided and the media player can proceed immediately as if the process was successful. If the authentication process fails, digital audio on the media player can be 25 disabled immediately.

[0054] Figure 6 is a flow chart illustrating a process by which a media player provides a digital audio signal to an accessory. First, authentication occurs in the background and is successful, via step 602. Next, the accessory selects a digital audio streaming interface for streaming the digital audio, via step 604. Then, a play command is sent to the media player, 30 via step 606. Next, the media player sends a sample rate, a normalization of the audio tracks, and a track volume adjustment to the accessory, via step 608. The media player transfers

digital audio to the accessory through the selected audio streaming interface via step 609. Thereafter, a next track is selected and steps 606, 608 and 609 are repeated, via step 610.

[0055] To describe this process in more detail refer now to the following description in conjunction with the accompanying information. The steps shown hereinbelow illustrate

5 enabling and disabling digital audio by the media player over a USB interface of the connector interface system 100.

[0056] 1. Connect the media player to an accessory.

[0057] 2. Select a media player configuration that has a USB Audio interface.

[0058] 3. Identify the supported commands and authenticate the accessory. The media

10 player requests from the accessory the list of sample rates it supports. The sample rates should be taken from the list of media player supported sample rates (for example as listed in Figure 7).

[0059] 4. Successfully respond to a command that requests the list of sample rates supported by the accessory. The sample rate sent to the accessory for a track taken from the

15 list of sample rates returned to the media player. If the accessory supports the sample rate of the current audio track, then that rate can be sent as the current sample rate. If the accessory does not support the sample rate, the media player will resample the audio data to a supported sample rate in real-time and will send this new supported sample rate as the current sample rate.

20 [0060] 5. Enable the appropriate streaming interface on the media player.

[0061] 6. Enter a mode that allows for the media player to provide digital audio.

[0062] 7. Place the media player in the play state.

[0063] 8. Accessory receives a sample rate, normalization of the energy of the sound and track volume adjustment from the media player.

25 [0064] 9. Configure the accessory using the media player information of step 8 above.

[0065] 10. Transfer digital audio from the media player to the accessory through the selected digital interface.

[0066] In one embodiment, digital audio is disabled when the USB connection between the media player and the accessory is lost. The accessory can also disable digital audio by selecting a zero bandwidth USB audio streaming interface on the media player.

[0067] To re-enable digital audio after the accessory has disabled it, steps 5-10 are
5 repeated.

[0068] If the accessory requests digital audio data before digital audio is enabled or before the correct digital sample rate has been negotiated, the media player will return packets filled with zeros. The media player will also return packets filled with zeros if authentication fails.

[0069] A method and system in accordance with the present invention provides a plurality
10 of commands that allow a media player to provide digital audio to an accessory. In so doing, an accessory can play digital audio media from the media player.

[0070] Although the present invention has been described in accordance with the
embodiments shown, one of ordinary skill in the art will readily recognize that there could be
variations to the embodiments and those variations would be within the spirit and scope of
15 the present invention. For example, the present invention can be implemented using
hardware, software, a computer readable medium containing program instructions, or a
combination thereof. Software written according to the present invention is to be either stored
in some form of computer-readable medium such as memory or CD-ROM, or is to be
transmitted over a network, and is to be executed by a processor. Consequently, a
20 computer-readable medium is intended to include a computer readable signal, which may be,
for example, transmitted over a network. It should be also understood that although the
present invention was disclosed in the context of a wired USB streaming environment, the
present invention could be utilized in any wired or wireless environment and that use would
be within the spirit and scope of the present invention. Accordingly, many modifications
25 may be made by one of ordinary skill in the art without departing from the spirit and scope of
the appended claims.

2007265077 15 Jun 2010

10

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for transmitting digital audio data to an accessory by a media player, the method comprising, by the media player:

requesting from the accessory a list of sample rates supported by the accessory;

5 receiving from the accessory the list of sample rates supported by the accessory;

selecting, from the list of sample rates supported by the accessory, a first sample rate for playing a first track of digital audio data;

transmitting track information including the first sample rate to the accessory; and

10 subsequent to transmitting the track information including the first sample rate, delivering digital audio samples of the first track via a digital audio interface to the accessory at the first sample rate.

2. The method of claim 1 wherein the digital audio interface corresponds to a Universal Serial Bus (USB) interface.

3. The method of claim 2 further comprising:

15 prior to delivering the digital audio samples of the first track, receiving from the accessory, an instruction to set a sample rate of the USB interface to the first playback sample rate.

4. The method of claim 1 wherein in the event that a stored sample rate for the first track and the first sample rate are different, delivering the digital audio samples further includes:

20 converting, within the media player, the digital audio data of the first track from the stored sample rate to the first sample rate.

5. A method for obtaining digital audio from a media player by an accessory, the method comprising, by the accessory:

sending to the media player a list of sample rates supported by the accessory;

receiving from the media player track information including a first sample rate for a first track of digital audio data to be played, wherein the first sample rate is selected by the media player and is one of the sample rates on the list of sample rates supported by the accessory;

configuring a digital audio interface of the accessory according to the first sample rate; and

5 subsequent to configuring the digital audio interface according to the first sample rate, receiving digital audio samples of the first track from the media player at the first sample rate via the digital audio interface.

6. The method of claim 5, wherein the digital audio interface corresponds to a Universal Serial Bus (USB) interface, the method further comprising:

0 configuring a USB connection between the media player and the accessory to operate a USB audio mode.

7. The method of claim 6 wherein configuring the digital audio interface includes sending to the media player an instruction to set a sample rate of a digital audio output interface of the media player to the first playback sample rate.

15 8. The method of claim 5 wherein the first sample rate is different from a stored sample rate associated with the first track as stored in the media player.

9. A media player comprising:

a storage device configured to store media assets including a plurality of tracks of digital audio data;

20 a digital audio interface configured to send digital audio samples of a track of digital audio data to an accessory; and

a control module coupled to the storage device and the digital audio interface,

wherein the control module is configured to:

15 Jun 2010
2007265077

12

request from the accessory a list of sample rates supported by the accessory;

receive from the accessory the list of sample rates supported by the accessory;

select, from the list of sample rates supported by the accessory, a first sample rate for playing a first track of digital audio data;

5 communicate track information including the first sample rate to the accessory; and

subsequent to transmitting the track information including the first sample rate, deliver digital audio samples of the first track to the accessory at the first sample rate via the digital audio interface.

10. The media player of claim 9 wherein the digital audio interface includes a Universal Serial Bus (USB) interface.

11. The media player of claim 9 wherein the control module is further configured such that, in the event that the first sample rate is different from a stored sample rate associated with the first track, the control module converts the digital audio data of the first track from the stored sample rate to the first sample rate.

15 12. The media player of claim 9 wherein the control module is further configured to select, from the list of sample rates supported by the accessory, a second sample rate for playing a second track of digital audio data; to communicate track information including the second sample rate to the accessory; and to deliver to the accessory, via the digital audio interface, digital audio samples of the second track at the second sample rate.

20 13. An accessory for use with a media player, the accessory comprising:

a digital audio interface configured to receive digital audio samples of a track of digital audio data from the media player; and

a control module coupled to the interface and to an audio output section,

wherein the control module is configured to:

send to the media player a list of sample rates supported by the accessory;

receive from the media player track information including a first sample rate for a first track of digital audio data to be played, wherein the first sample rate is selected by the media player and is one of the sample rates on the list of sample rates supported by the accessory;

5 configure the digital audio interface to receive data at the first sample rate;

subsequent to configuring the digital audio interface according to the first sample rate, receiving digital audio samples of the first track from the media player at the first sample rate via the digital audio interface; and

deliver the digital audio data samples to the audio output section.

10 14. The accessory of claim 13 wherein the digital audio interface is a Universal Serial Bus (USB) interface.

15. The accessory of claim 13 wherein the control module is further configured to:

receive, from the media player additional track information including a second sample rate associated with a second track of digital audio data to be played, wherein the second sample rate is 15 selected by the media player and is one of the sample rates included in the list of sample rates supported by the accessory; and

in the event that the second sample rate is different from the first sample rate, reconfigure the digital audio interface to receive data at the second sample rate.

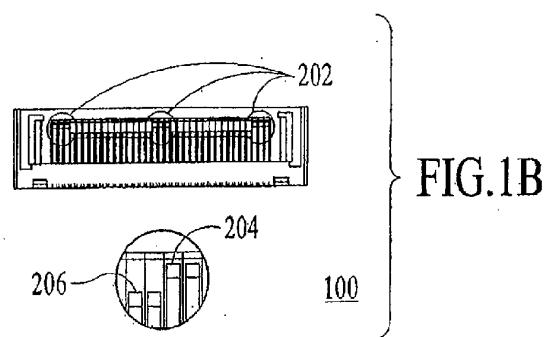
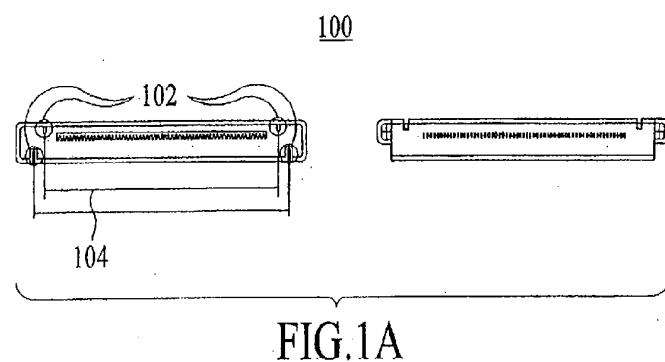
16. The accessory of claim 13 wherein the digital audio interface includes:

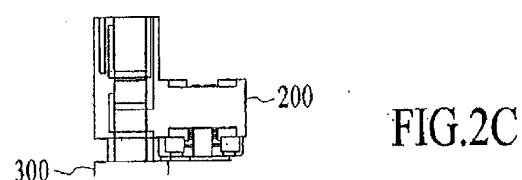
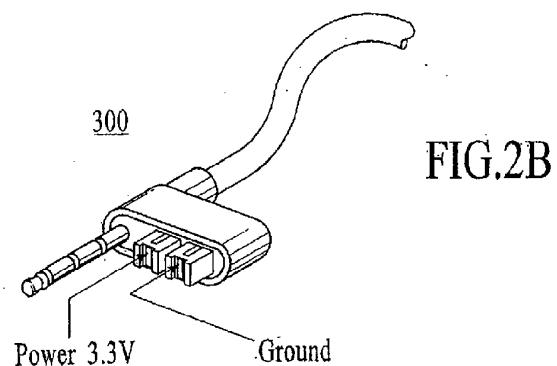
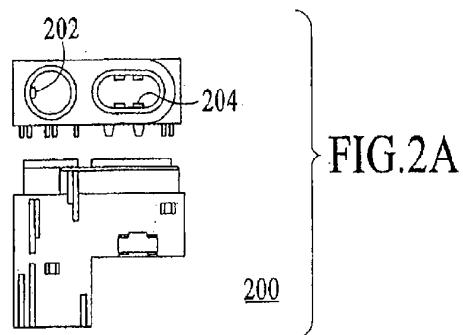
20 a connector having a plurality of pins configured to mate with a corresponding plurality of pins of a connector of the media player; and

an accessory-identifying resistor connected between two of the plurality of pins of the connector.

17. The accessory of claim 13 wherein the accessory includes a speaker.
18. The method of claim 5 further comprising authenticating the accessory to the media player prior to sending the list of supported sample rates to the media player.
19. The method of claim 5 wherein the track information received from the media player further includes a normalization of sound energy and a track volume adjustment.
5
20. The method of claim 1 further comprising:
 - performing an authentication operation to determine whether the accessory is authenticated;
 - and
 - disabling the digital audio interface in the event that the accessory is not authenticated.

1/12





PIN	Signal Name	I/O	Function
1	DGND	GND	Digital Ground
2	DGND	GND	Digital Ground
3	TPA+	I/O	FireWire signal
4	USB D+	I/O	USB signal
5	TPA-	I/O	FireWire signal
6	USB D-	I/O	USB signal
7	TPB+	I/O	FireWire signal
8	USB PWR	I	USB power in; used to detect USB hub
9	TPB-	I/O	FireWire signal
10	Accessory Identify	I	Connection for accessory identification resistor
11	F/W PWR+	I	Firewire and charger input power (8V to 15V dc)
12	F/W PWR+	I	Firewire and charger input power (8V to 15V dc)
13	Accessory Pwr	O	Nominal 3.3V output; current limited to 100 mA
14	Reserved		
15	DGND	GND	Digital Ground
16	DGND	GND	Digital Ground
17	Reserved		
18	RX	I	Serial protocol input to media player
19	TX	O	Serial protocol output from media player
20	Accessory Detect	I	Connection for accessory identification resistor
21	S Video Y	O	Luminance component for S-video
22	S Video C	O	Chrominance component for S-video
23	Composite Video	O	Composite video signal
24	Remote sense	I	Detect remote
25	LINE-IN L	I	Line level input for left audio channel
26	LINE-IN R	I	Line level input for right audio channel
27	LINE-OUT L	O	Line level output to left audio channel
28	LINE-OUT R	O	Line level output to right audio channel
29	Audio Return	---	Signal, not to be grounded in accessory
30	DGND	GND	Digital ground
31	Chassis		Chassis ground for connector shell
32	Chassis		Chassis ground for connector shell

FIG. 3A

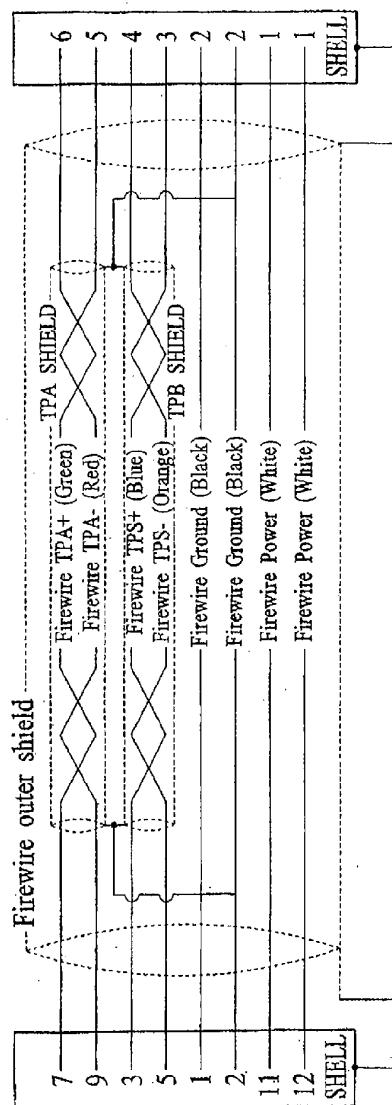


FIG.4A

Pin	Signal name	I/O	Function
1	Audio Out Left / Mono Mic In	I/O	30mW audio out left channel, also doubles as mono mic in
2	HP Detect	I	Internal Switch to detect plug insertion
3	Audio Return	GND	Audio return for left and right audio
4	Audio Out Right	O	30mW audio out right channel
5	Composite Video	O	Video Signal
6	Accessory 3.3V	O	3.3V Accessory power 100mA max
7	Tx	O	Serial protocol (Data from iPod to Device)
8	Rx	I	Serial protocol (Data to iPod from Device)
9	D GND	GND	Digital ground for accessory

FIG.3B

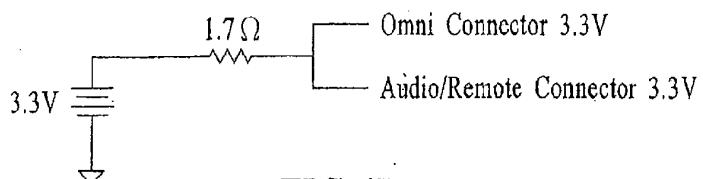


FIG.4B

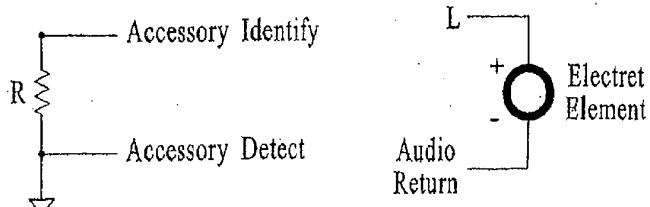


FIG.4C

FIG.4D

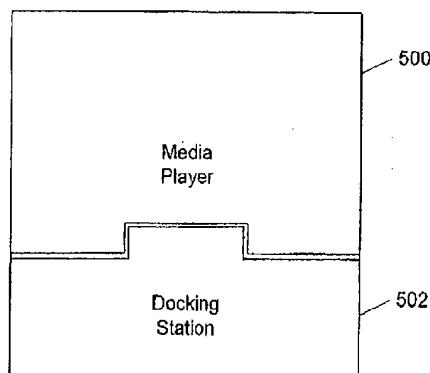


Fig. 5A

7/12

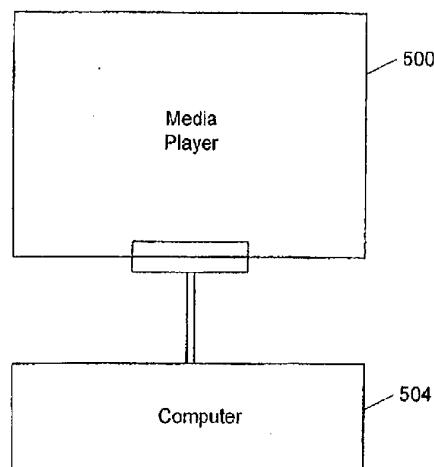


Fig. 5B

8/12

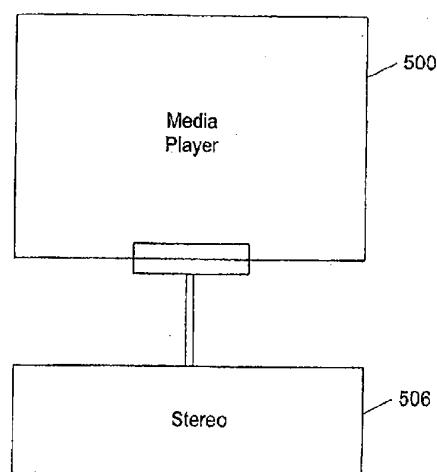


Fig. 5C

9/12

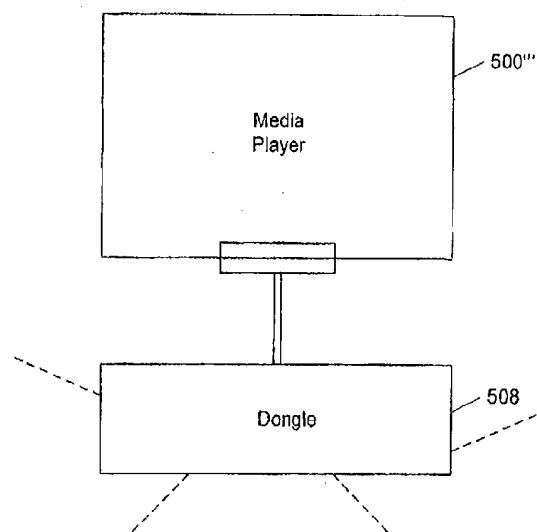


Fig. 5D

10/12

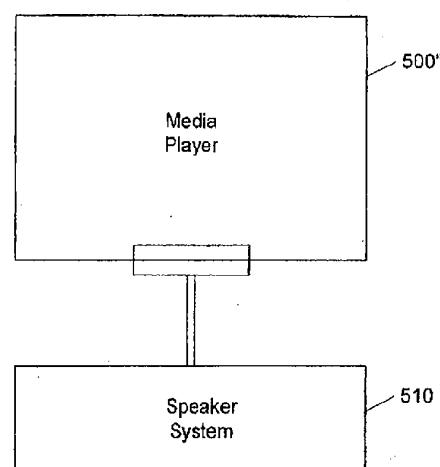


Fig. 5E

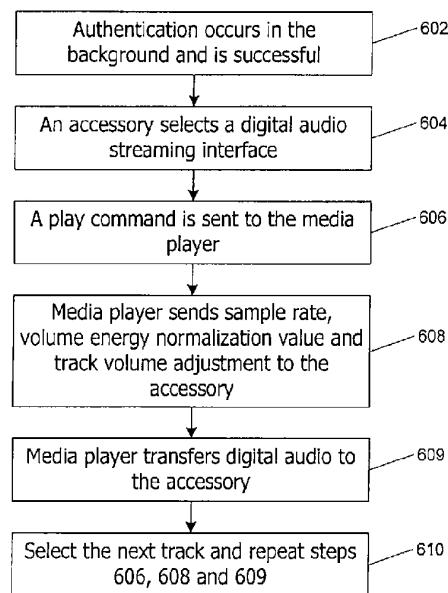


FIG. 6

12/12

Decimal Sample Rate (Hz)	Hex Sample Rate (Hz)
8,000	0x00001F40
11,025	0x00002B11
12,000	0x00002EE0
16,000	0x00003E80
22,050	0x00005622
24,000	0x00005DC0
32,000*	0x00007D00*
44,100*	0x0000AC44*
48,000*	0x0000BB80*

Fig. 7