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(54) **Automotive information system and method of controlling the same, recording medium storing control program, disk playback apparatus, and semiconductor integrated circuit**

(57) An automotive information system has a main unit including a CPU and component units connected to the main unit through a universal serial BUS (USB), such as a car audio system including a CD-ROM auto-changer, a security control system, and a telephone system. At least one of the USB-connected component device, e.g., the security control system and/or the telephone system, has a detecting unit that detects occurrence of an event such as illegal approach to the automobile or receipt of telephone call. The USB-connected component device also has a start signal transmitting unit that transmits a start signal to the main unit when occurrence of the event is detected by the detecting unit. The main unit has a start signal receiving unit and a power control unit that serves turn on the power supply to the main unit in response to the start signal received by the start signal receiving unit. The main unit also has an inquiring unit which inquires the USB-connected component devices whether these component devices have sent the start signal. The USB-connected component device has an answering unit which answers the inquiry.

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an automotive system which is composed of systems such as a car audio system and also to a method of controlling such an automotive information system, as well as to a storage medium that stores a control program. The present invention also is concerned with an information processing apparatus, an electronic device and a control unit that are suitable for use in the automotive information system. The present invention also pertains to a disk playback apparatus, as well as to a semiconductor integrated circuit, suitable for use in the automotive information system.

2. Description of the Related Arts

[0002] Car audio systems that are used on automobiles are known. Such a car audio system has a major function to provide audio information through a speaker mounted on the automobile, based on sound information acquired through a radio tuner, a cassette tape deck or a CD player. Current progress in the semiconductor technology has made it possible to combine with a car audio system various systems or apparatuses such as a car navigation system, a CD auto-changer or an MD auto-changer, cellular phone and so forth. In this specification, such a consolidated system will be referred to as "an automotive information system", while systems or apparatuses combined with a car audio system will be collectively referred to also as "peripheral devices".

[0003] Automotive information system of the kind described generally employs highly complicated wiring layouts. For instance, a complicated wiring layout is necessary when a compatible auto-changer that is adapted both for music CDs and CD-ROMs is connected via cables to a main unit of the automotive information system that has a car audio function and car navigation function. The auto-changer reads sound data (audio data) from a music CD and reads also digital data such as car navigation program data and map data.

[0004] Hitherto, the connection between the main unit of the automotive information system and the auto-changer required, besides an electric power cable and control cables, an analog cable corresponding to a LINE-OUT terminal and an optical fiber for digital output that are used for transmission of audio data acquired from a music CD, as well as a digital signal cable which is used exclusively for digital data read from a CD-ROM and which is adapted to, for example, an ATAPI interface.

[0005] Despite the sophisticated and complicated wir-

ing layout, the audio function and car navigation function of the known automotive information system are available only on an automobile and, therefore, have limited use.

5 [0006] Automotive information systems are also known of the type that has a microcomputer incorporated in the main unit of the system or in each of the devices constituting the system. Such microcomputers, however, are of a low grade that is intended only for controlling mechanical motions of the system or controlling display of characters. It is impossible to add new functions or modify existing functions on such microcomputers. In addition, control of supply of electrical power is possible only from the main unit to which cables and lines are concentrated. Namely, although supply of electrical power to peripheral devices is controllable from the main unit, no function is available for enabling one or more peripheral devices to turn on and off the power supply to the main unit of the system.

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SUMMARY OF THE INVENTION

[0007] Accordingly, it is a primary object of the present invention to provide an automotive information system having a simplified wiring layout and having a function to enable a peripheral device of the automotive information system to start the main unit of the system.

[0008] It is also an object of the present invention to provide an automotive information system having enhanced anti-theft or security effect.

[0009] It is also an object of the present invention to provide an automotive information system in which audio data read from a disk is output as digital data of the same form as other digital data that are dealt with in the automotive information system.

[0010] To these ends, according to the present invention, there is provided an automotive information system, comprising: a main unit having means for detecting a start signal, and means for turning on a power supply to the main unit in response to the start signal, and at least one device connected to the main unit and having means for detecting that a predetermined condition has been satisfied, and means for sending the start signal to the main unit.

45 [0011] The invention also provides a method of controlling an automotive information system having a main unit and at least one device connected to the main unit, the method comprising the steps of: enabling the device to detect that a predetermined condition has been satisfied; causing the device to send a start signal to the main unit when the satisfaction of the predetermined condition is detected; causing the main unit to detect the start signal, and enabling the main unit to turn on power supply to the main unit in response to the start signal.

55 [0012] With these features, it is possible to turn on the power supply to the main unit of the automotive information system simply by sending a start signal from one of the devices constituting the system. Thus, the autom-

tive information system can have a wider use by incorporating a system such as a telephone system and/or a security system. For instance, the power supply to the main unit of the automotive system that has been turned off can be turned on when a call is received by the telephone unit connected to the main unit, so that the system becomes alive to enable hand-free telephone conversation by means of a speaker and a microphone, with the aid of an amplifier incorporated in the main unit. Similarly, the power supply to the main unit can be turned on in response to a signal received from a security control system informing of occurrence of an extraordinary event, so that the automotive information system wakes up to inform the user of the occurrence of the extraordinary event through the functioning of the telephone system.

[0013] In accordance with the present invention, there is provided also an information processing apparatus, comprising a main unit and at least one device connected to the main unit, wherein the device includes: means for detecting that a predetermined condition has been satisfied; and means for sending a start signal to the main unit upon detection of satisfaction of the predetermined condition; and wherein the main unit includes: means for detecting the start signal; means for turning on power supply to the main unit in response to the start signal; and means for inquiring, when the power supply is turned on in response to the start signal, the device whether the device has sent the start signal; and wherein the device includes means for answering the inquiry.

[0014] With these features, the main unit can identify the source of the start signal, i.e., from which one of the devices the start signal has been received. It is therefore not necessary to employ independent start signal lines for the respective devices.

[0015] The present invention also provides an automotive information system cable for connecting main unit of an automotive information system and a device included in the automotive information system, comprising: a first power line that enables electrical power to be supplied from the main unit to the device when the power supply to the main unit has been turned on; a data line for enabling exchange of data between the main part and the device; a second power line for enabling backup power to the device at least when the power supply to the main unit has not been turned on; and a signal line for transmitting a start signal from the device to the main unit.

[0016] In accordance with these features, the main unit cannot be supplied with electrical power through the first power line when the power supply has been turned off, but can be supplied with electrical power through the second power line from a backup power supply on an automobile. It is therefore possible to send the start signal to the main unit via the signal line, under the assist of the backup power supplied through the second power line. Thus, addition of the second power

line and the signal line to a cable such as a USB (Universal Serial BUS) enables exchange of various kinds of data between the main unit and the devices, without requiring provision of an independent power cable for supplying power to the main unit when the power supply has been turned off and without necessitating any signal cable for transmitting the start signal.

[0017] The present invention also provides an automotive information system comprising a main unit, and a security control unit and a wireless telephone unit that are connected to the main unit, wherein the security control unit includes: a sensor for sensing an extraordinary event; and means for sending a start signal to the main unit: wherein the main unit includes: means for detecting the start signal; means operative to turn on power supply to the main unit in response to the start signal: and means for sending, when the power supply is turned on in response to the start signal received from the security control unit, a notification request signal to the wireless telephone unit to request the wireless telephone unit to send a notification of occurrence of the extraordinary event; and wherein the wireless telephone unit includes: means for detecting the notification request signal; and means for activating the telephone function or the wireless telephone unit in response to the notification request signal to notify a user of the occurrence of the extraordinary event.

[0018] Provided also is a method of controlling an automotive information system having a main unit, and a security control unit and a wireless telephone unit that are connected to the main unit, the method comprising the steps of: enabling the security control unit to sense an extraordinary event; causing, when the extraordinary event is sensed, the security control system to send a start signal to the main unit; enabling the main unit to detect the start signal; enabling the main unit to turn on power supply to the main unit in response to the start signal; causing, when the power supply is turned on in response to the start signal received from the security control unit, the main unit to send a notification request signal to the wireless telephone unit to request the wireless telephone unit to send a notification of occurrence of the extraordinary event; causing the wireless telephone unit to detect the notification request signal; and activating a telephone function of the wireless telephone unit in response to the notification request signal to notify a user of the occurrence of the extraordinary event.

[0019] In accordance with these features, the power supply to the main unit is turned on when an extraordinary event is detected by the security control unit, so that the main unit causes the wireless telephone unit to inform the user of the occurrence of the extraordinary event. Upon receipt of the information, the user can make haste to the place where the automobile is parked. It is thus possible to achieve higher anti-theft or security effect than that offered by mere activation of a siren or the like.

[0020] The automotive information system of the invention also permits hand-free telephone conversation. To this end, the present invention provides an automotive system comprising a main unit, a wireless telephone unit connected to the main unit, a speaker, and a microphone; wherein the wireless telephone unit includes: means for detecting receipt of a telephone call; and means for sending a start signal to the main unit upon detection of the receipt of the telephone call; wherein the main unit includes: means for detecting the start signal; means for turning on power supply to the main unit in response to the start signal; means for informing a user of the receipt of the telephone call when the power supply to the main unit is turned on in response to the start signal received from the wireless telephone unit; means for detecting a responding operation of the user for responding to the telephone call; and means for sending, when the responding operation is detected, connecting instruction to the wireless telephone unit to request the wireless telephone unit to connect the telephone call to the main unit; wherein the wireless telephone unit further includes: means for detecting the connecting instruction; and means responsive to the connecting instruction, for connecting the telephone call to the main unit; and wherein the main unit further includes means for enabling the user to communicate with the telephone caller by means of the speaker and the microphone.

[0021] The invention also provides a method of controlling an automotive system having a main unit, a wireless telephone unit connected to the main unit, a speaker, and a microphone, the method comprising the steps of: enabling the wireless telephone unit to detect receipt of a telephone call; causing the wireless telephone unit to send a start signal to the main unit upon detection of the receipt of the telephone call; enabling the main unit to detect the start signal; enabling the main unit to turn on power supply to the main unit in response to the start signal; enabling the main unit to inform a user of the receipt of the telephone call when the power supply to the main unit is turned on in response to the start signal received from the wireless telephone unit; enabling the main unit to detect a responding operation of the user for responding to the telephone call; causing the main unit to send connecting instruction to the wireless telephone unit to request the wireless telephone unit to connect the telephone call to the main unit; causing the wireless telephone unit to detect the connecting instruction; and causing the wireless telephone unit to connect the telephone call to the main unit in response to the connecting instruction; and causing the main unit to enable the user to communicate with the telephone caller by means of the speaker and the microphone.

[0022] In accordance with these features, when telephone call is received by the automotive telephone, e.g., a cellular phone, the power supply to the main unit is turned on to activate the automotive information sys-

tem. When the user wishes to be connected to the call, he conducts a predetermined operation which automatically triggers the telephone unit to connect the telephone call to the user, whereby hand-free telephone conversation is conducted by using the speaker and the microphone, with the aid of an amplifier incorporated in the automotive information system.

[0023] The present invention also provides an electronic device which is incorporated in the automotive information system and which can start the main unit of the system. Thus, the present invention provides an electronic device to be connected to a control unit of an automotive information system, comprising: means for detecting that a predetermined condition has been satisfied; means for sending a start signal to the control unit upon detection of satisfaction of the predetermined condition; and means for answering an inquiry given by the control unit as to whether the electronic device has sent the start signal.

[0024] The present invention also provides a control unit that constitutes the main unit of an automotive information system and that can be started up by a device which is one of the constituent devices of the automotive information system. Thus, the present invention provides an automotive information system control unit implementing an automotive information system in cooperation with at least one electronic device connected thereto, the automotive information system control unit comprising: means for detecting a start signal sent from the electronic device; means for turning on power supply to the main unit upon detection of the start signal; and means for inquiring, when the power supply is turned on in response to the start signal, the electronic device whether the electronic device has sent the start signal.

[0025] With these features, it is possible to implement an automotive information system by assembling together electronic devices and control unit selected from among various types of electronic devices and control units, thus offering a greater degree of freedom in the configuration of the automotive information system.

[0026] In accordance with another aspect of the present invention, there is provided a disk playback apparatus according to the present invention comprises means for reading audio data and digital data from recording mediums, and a decoder for converting both the read audio data and digital data into output data in the same protocol format.

[0027] A disk playback method of the present invention is implemented in the disk playback apparatus of the present invention, and comprises the steps of reading audio data and digital data from recording mediums, and converting both the read audio data and digital data into output data in the same protocol format.

[0028] With the above features, when any of audio data and digital data is read from a recording medium, the read data is converted into the same protocol for-

mat. Therefore, the whole or a part of processing of the audio data and the digital data can be realized with the same procedure and configuration.

[0029] In the disk playback apparatus, preferably, the audio data is read from a musical CD, and the digital data is read from a CD-ROM.

[0030] With the above features, a disk playback apparatus of the so-called compatible type reading audio data from a musical CD and digital data from a CD-ROM can be used to perform both playback of music and digital information processing required in car navigation, etc.

[0031] In the disk playback apparatus, preferably, the decoder converts both the audio data and the digital data into output data in the ATAPI format.

[0032] Also, in the disk playback method, preferably, the converting step converts both the audio data and the digital data into output data in the ATAPI format.

[0033] With the above features, the disk playback apparatus produces output data in the ATAPI format. Any of the audio data read from a musical CD and the digital data read from a CD-ROM can be therefore easily processed with the same IDE interface through communication using a command packet similarly to a SCSI.

[0034] The disk playback apparatus, preferably, further comprises a controller for outputting both the output data converted from the audio data and the output data converted from the digital data in the same interface format.

[0035] Also, the desk playback method, preferably, further comprises a step of outputting both the output data converted from the audio data and the output data converted from the digital data in the same interface format.

[0036] With the above features, the output data converted from the audio data and the output data converted from the digital data are both outputted in the same interface format. Accordingly, both the output data can be transmitted through the same cable.

[0037] The disk playback apparatus, preferably, further comprises a controller for outputting both the output data converted from the audio data and the output data converted from the digital data through the same daisy chain line.

[0038] With the above features, since a plurality of units including the disk playback apparatus are connected one after another through a daisy chain line, an automotive information system having simpler wiring can be easily constructed.

[0039] In the disk playback apparatus, preferably, the daisy chain line comprises a universal serial bus.

[0040] With the above features, since a universal serial bus (USB) is employed as the daisy chain line, a number of various units can be easily connected.

[0041] In the disk playback apparatus, preferably, the controller sends the output data converted from the audio data by isochronous transfer.

[0042] With the above features, the transfer capacity

of the daisy chain line is not affected by the availability factor of a bus unlike the case of using bulk transfer. Since the constant transfer capacity and transfer timing are always ensured, a plurality of units can transfer successive data simultaneously.

[0043] In the disk playback apparatus, preferably, the controller sends the output data converted from the digital data by bulk transfer.

[0044] With the above features, bulk transfer is employed to send digital data which does not require it to be ensured that a certain amount of data is transferred for a certain period of time. The bulk transfer provides much higher quality of transferred data than the isochronous transfer because error correction and retransmission of data are made in the bulk transfer if there occurs an error in data transfer.

[0045] The disk playback apparatus, preferably, further comprises control means for transferring the output data converted by the decoder to the controller.

[0046] Also, the disk playback method, preferably, further comprises a step of transferring the output data converted by the converting step to the outputting step with at least one of direct memory access and parallel bit-number conversion.

[0047] With the above features, the control means changes the bit width of data transferred, and controls the direct memory access (DMA) transfer. It is therefore possible to achieve increased flexibility of unit combinations and smooth data transfer between the decoder and the controller.

[0048] In the disk playback apparatus, preferably, the control means controls direct memory access.

[0049] With the above features, since data read from a disk is transferred at a high speed using DMA, even audio data read from a medium having a large amount of data and high sound quality, such as a musical CD, can also be easily processed.

[0050] In the disk playback apparatus, preferably, the control means converts the number of bits that is a unit of the output data transferred from the decoder to the controller.

[0051] With the above features, the number of bits is converted which is a unit of the output data transferred from the decoder to the controller. Therefore, a decoder and a controller employing different numbers of bits as respective units in processing, e.g., an ATAPI decoder employing 16 bits and a USB controller employing 8 bits, can be used in a combined manner.

[0052] The disk playback apparatus, preferably, further comprises a ROM storing a program to control the controller, and an address latch for accessing the ROM from the controller.

[0053] With the above features, by the operation of the address latch, a part of an address bus used for accessing the ROM from the controller can serve also as a data bus. Supposing, for example, that the controller outputs data having an address designated by 16 bits, i.e., bits 0 - 15, and the ROM sends back data of 8 bits,

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