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EUROPEAN PATENT APPLICATION

(43) Date of publication:

20.10.1999 Bulletin 1999/42

(51) Int. Cl.⁶: B60R 11/02

(21) Application number: 99105608.6

(22) Date of filing: 19.03.1999

(84) Designated Contracting States:

AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE

Designated Extension States:

AL LT LV MK RO SI

(30) Priority: 24.03.1998 JP 7611598

14.04.1998 JP 10229198

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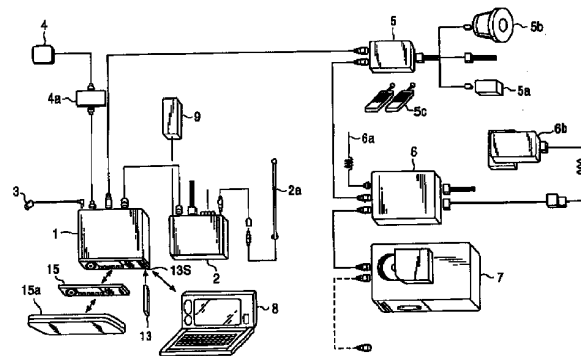
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(54) **Automotive information system, automotive computer system, and method of controlling the automotive information system**

(57) An automotive information system including a car audio system and other information units or devices is controlled by a small-sized computer that is also part of the automotive information system and that is loaded with a general-purpose OS. The automotive information system has a local BUS of a form conforming with the data form of the CPU, a PCI BUS that interconnects the units or devices of the system, and a PCI BUS boot controller that performs form conversion of data exchanged between these two types of BUSES. Audio data which may be analog or digital and other data which are inherently digital are transmitted in the form of digital signals through the PCI BUS, and these data are processed digitally by the CPU. With this arrangement, the small-sized computer and information devices such as a car audio system are combined in such a manner as not to impair the advantages of the computer and the information devices. Audio data when it is formed of analog signals is audio-to-digital-converted into audio signals in the form of digital signals. Thus, audio data and other digital data are transmitted through a common digital circuit, so that the wiring layout is simplified and audio characteristic is stabilized against noise and change in the environmental conditions.

FIG. 1



Description

Background of the Invention

1. Field of the Invention

[0001] The present invention relates to an automotive Information system which operates under the control of a small-sized computer. In this specification, the term "automotive information system" is used to mean a system that is used on a vehicle such as an automobile and that consolidates one or more of a plurality of information apparatuses such as a car audio system, a car navigation system, a voice recognition system for recognizing driver's order, a hand-free mobile telephone, a security system, and so forth. The present invention also is concerned with an automotive computer system. The invention further pertains to a method Of controlling an automotive information system.

2. Description of the Related Art

[0002] In recent years, remarkable progress has been achieved in the field of semiconductors, enabling miniaturization and sophistication of various electronic devices incorporating semiconductors. Personal computers (referred to also as "PCs", hereinafter) are typical examples of electronic devices that are experiencing reduction in sizes and improvement in performance by virtue of the progress in the field of semiconductor.

[0003] In particular, small-sized computers such as handheld-type computers and so-called palm-top computers are finding spreading use. Such small-sized computers will be inclusively referred to as a "handheld computer", hereinafter. Such handheld computers employs a basic software, i.e., an operating system (referred to also as "OS", hereinafter), typically a general-purpose OS known as Windows CE (registered trademark of Microsoft Corporation).

[0004] Such a general-purpose OS exquisitely manages CPU and memories in the computer, thereby implementing high-degree of processing ability, while providing standard user-interfaces that are easy to use and that have no dependency on the programs. The OS also permits free modification or addition of program, provided that such programs comply with predetermined forms supported by the OS, thus enabling addition or modification of functions to be performed by the computer.

[0005] Another example of electronic devices that are on their way towards reduction in size and improvement in the performance arc automotive information apparatuses such as car audio systems, car navigation systems, and so forth. The car audio system is a system which is referred to also as a "car stereo" and which consolidates various components such as a CD player, AM/FM tuners, amplifiers and speakers, The car navigation system is a system which locates the instant

position of an automobile based on the outputs of devices such as an azimuth magnet, a trip meter and a GPS, and guides the driver to a designated destination by showing the momentary positions on a map displayed on a screen.

[0006] There is a current trend that a car audio system is combined with other automotive devices or systems such as a car navigation system, hand-free mobile phones and security system. A system that consolidates these automotive devices and systems will therefore be referred to as an automotive information system, as stated before.

[0007] Conventionally, handheld personal computers having an OS of the type mentioned before and automotive information systems or the kind stated above have been designed and manufactured separately from and independently of each other. Although there have been car audio systems that incorporate a computer in general sense, such a computer is a kind of processor or a built-in system designed only for specific purposes and is fundamentally different from a handheld computer loaded with a general-purpose OS.

[0008] More specifically, such a built-in system employs a CPU having minimum required functions. Namely, the built-in system implements, by means of simple programs relying on an assembler, minimum required tasks to be performed on hardware, e.g., recognition of a switch operation, activation and deactivation off a disk playback mechanism, and so forth. Such a built-in system, unlike a handheld personal computers, cannot cope with demands for versatility or functions such as processing and storage of data, modification or addition of a program, and so on.

[0009] Meanwhile, a handheld personal computer by itself cannot perform functions such as playing a music or controlling a car audio system. Therefore, a user of a handheld computer, even when he happened to bring his computer into an automobile, cannot use the computer in relation to the car audio system that is installed on the automobile.

[0010] It is a current trend that a car audio system, having conventional components such as radio tuners, cassette tape deck, CD player and so on, are combined with other devices such as an MD player, a CD/MD auto-changer, a car navigation system, a voice recognition system for recognizing driver's order, hand-free mobile phones, a security system, and so forth, thus providing a complicated automotive information system. It is not easy for the driver to manage such a complicated automotive information system by manipulating various switches provided on individual component devices or systems of the automotive information system.

[0011] Namely, such a complicated automotive information system composed of many component devices or systems inevitably has many keys, buttons, dials and switches which are located at various positions on the dashboard or console. This heavily burdens the driver

because the driver has to understand and remember the locations of various keys, dials and switches.

[0012] In order that the car driver can easily and efficiently use a complicated automotive information system which becomes complicated more and more, it is desirable that the system is controlled by a compact computer that has a high grade of processing performance suitable for controlling the complicated system and that provides user-friendly user interface while affording addition or modification of controlling function, specifically an information processing apparatus equivalent to a handheld personal computer loaded with a general-purpose OS.

[0013] In view of the current automotive society and heavy traffic congestion, it is desirable also from the view point of computer-related industries that handheld computers find spreading use by being combined with automotive information equipment. In particular, a handheld computer when combined with an automotive information system enhances utilities of both the handheld computer and the automotive information system. For instance, operation keys and memories can be used commonly both for the handheld computer and the automotive information system. When the driver needs a certain type of information, the handheld computer provides the information by way of synthesized voice message which is output from a speaker of the car audio system, so that the driver can obtain the information by listening to the voice message. When the automotive information system includes a mobile phone, the handheld computer on the automobile can make access to an external computer network via the telephone communication line. Thus, the utility of the automotive information system, as well as that of the handheld computer, can be enhanced advantageously.

[0014] In general, a CPU adapted to use a general-purpose OS operates at a high speed. Therefore, when such a CPU is used in combination with devices or systems included in the automotive information system which may fail to operate at high speed, it is desirable that different BUSes are used for the CPU and the automotive information system, in order to accommodate the difference in the operation speed. It is also desirable that component devices and systems constituting the automotive information system are connected by a simple and neat wiring layout.

[0015] A car audio system included in the automotive information system which is controlled by a computer or which incorporates a computer-controlled electronic device essentially handles information in the form of digital data in addition to audio information such as a music. For instance, when the car audio system is operating in a playing mode or a rewinding mode, a message reading PLAY or REW is displayed on a display section such as a liquid crystal display unit. To this end, characters to be displayed are formed by digital data such as character codes or dot patterns.

[0016] In an automotive information system incorpo-

rating a car navigation system, data such as programs and maps are read from a CD-ROM and are developed into a bit map corresponding to maps and characters so that the maps and characters are displayed on the liquid crystal display screen.

[0017] In this specification, data which is inherently digital will be referred to as "digital data", while sound data such as of music will be referred to as "audio" data, regardless of whether it is in the form of analog or digital form.

[0018] In the known automotive information system having a car audio system, constructions of various parts are rendered complicated, due to the fact that audio data is handled by a circuit which is different from that used for handling digital data such as character and image data.

[0019] For instance, in an automotive information system having a CD-ROM auto changer which is capable of reading data both from a music CD and a CD-ROM and which is connected to a car audio system, the audio data read from the music CD is sent to an amplifier via an analog signal line, while digital data read from the CD-ROM is sent to the car navigation system via a digital communication line such as a BUS. It is therefore necessary that connectors are used for respective component devices or systems of the automotive information system, with the result that the construction of the whole system is complicated.

[0020] In addition, intricate connecting wiring systems having many connection cords have to be used for achieving mutual connections between the component devices or systems of the automotive information system. Consequently, laborious work is necessary for accomplishing the connection, as well as for protective maintenance and repair. This problem is becoming serious because the number of components consolidated in automotive information systems is increasing. There is a trend that the users separately purchase desired component devices or systems that are sold as option parts and requests the car dealer to assemble them together to form a consolidated system or to add a new component device or system to an existing system which has already been set up on the automobile.

[0021] It is quite difficult to determine the wiring scheme, i.e., the components to be mutually connected, connectors of each component to be used for achieving the connection, type of the cable to be used, and so forth. The number and the types of the connectors vary according to the component devices. It is also necessary to suitably select the type of the connectors and cables, e.g., conventional audio cables for analog signals, digital communication cables for digital data, optical fibers, and so forth.

[0022] After the automotive information system has safely been set up, if the user wishes to add a new component device or system, it is necessary to modify the wiring layout in which various kinds of cables are laid in an intricate manner, in order to connect the additional

component device or system.

[0023] For the purpose of modifying the wiring layout, it may become necessary to disconnect the existing cables. The connections have to be restored after connecting the new component device. To this end, it is necessary to make a memo or record concerning the positions and types of the cables before they are disconnected. Making such a memo or record alone is quite a troublesome work. This problem is encountered also when the cables are disconnected for the purpose of protective maintenance or repair.

[0024] Further, different types of cables have different natures and require different kinds of attention in handling. This also is a factor that makes it difficult to determine and execute the wiring layout. For instance, a cable designed to electrically transmit digital signals can sustain bending to some extent but is liable to be affected by electrical noises. In contrast, optical fibers are not resistant to bending, although they are less likely to be influenced by electrical noises. Cables for analog signals undesirably pick up strong electrical noises. Thus, different types of cables have to be handled and treated differently. The routing of the cables, i.e., the paths along which the cables are to be laid must be determined with deliberative consideration.

[0025] Known car audio systems have a drawback in that, when audio signals are transmitted through an analog circuit, the audio characteristic is undesirably deteriorated due to a change in environmental condition such as temperature and humidity or due to influence of noises. For instance, the signal frequency which can be best transmitted through an analog signal cable varies depending on the temperature.

[0026] The user of a car audio system can set up the best condition, e.g., tone, balance and so forth, of playback of music, by using, for example, a graphic equalizer. However, the actual playback condition tends to deviate from the set best condition due to a change in the audio characteristic caused by a variation of the environmental condition or by noise. The user therefore has to set up again the playback condition so as to cancel the deviation. Frequent change of setting is extremely troublesome. The change in the audio characteristic is serious particularly in audio systems used on automobiles, considering that automobiles are subjected to a variety of conditions of use, depending on the district, season, habits of the drivers, and so on.

[0027] Conventional automotive information system employs a wiring system in which cables or lines led from various component units are concentrated to a central unit which is also referred to as a "hub". This conventional style of wiring is quite inconvenient because all the wires and lines from various component units located at various positions on the automobile are concentrated to the hub.

[0028] This conventional wiring system requires cables and lines of greater lengths. This not only renders the wiring work troublesome but enhances the risk of

change in the audio characteristic due to noise and change in the environmental condition. In addition, concentration of many cables and lines to the central hub further impedes addition of a component unit, protective maintenance and repair, because of difficulty encountered in disconnecting and connecting the cables and lines.

SUMMARY OF THE INVENTION

[0029] Accordingly, it is a first object of the present invention to provide an automotive information system, as well as an automotive computer system and a method of controlling an automotive information system, in which a small-sized computer such as a handheld computer using a general purpose OS is combined with information devices or systems that are used on automobiles. More specifically, the combination is achieved in such a manner as to enable maximum use of the merits and functions of both the computer and the information devices and systems, thus offering advantages that could never be achieved by the known arts.

[0030] It is a second object of the present invention to provide an automotive information system, as well as an automotive computer system and a method of controlling an automotive information system, which employs a plurality of types of BUSES so as to permit both a high-speed computer and automotive information devices or systems to operate at their optimum operation speeds, thus eliminating idle time.

[0031] It is a third object of the present invention to provide an automotive information system, as well as an automotive computer system and a method of controlling an automotive information system, in which various automotive information devices and systems are connected in a manner like a sweet-potato-vine, thus achieving a rational wiring layout.

[0032] It is a fourth object of the present invention to provide an automotive information system which is arranged to permit both audio data and other inherently-digital data can be transmitted through a common digital circuit.

[0033] To this end, according to one aspect of the present invention, there is provided an automotive information system comprising a controlling computer; the computer having a CPU and an operating system; the operating system including: means for administering resources available on the computer; input/output controlling means including a user interface; and program executing means for executing a predetermined program.

[0034] In accordance with a second aspect of the present invention, there is provided an automotive computer system, comprising: an operating system that implements environment necessary for execution of a program of a predetermined form; a CPU; an automotive information system having a plurality of information devices; and controlling means for controlling the auto-

motive information system.

[0035] In accordance with a third aspect of the present invention, there is provided a method of controlling an automotive information system by using a computer having an operating system, comprising: causing the operating system to implement environment necessary for executing a program of a predetermined form; and causing the program to control the automotive information system.

[0036] In the automotive information system, automotive computer system and the method of controlling an automotive information system in accordance with first to third aspect of the present invention, the computer used for controlling the automotive information system has a general-purpose OS that administrates the resources such as a CPU and memories of the computer so as to permit full use of the ability of the computer. The general-purpose OS also provides a user-friendly standardized user interface which is easy to use and which has no dependency on the programs. Further, the general-purpose OS permits addition or modification of a program having a predetermined form, thus facilitating addition or modification of the functions to be performed by the computer. For these reasons, the general-purpose OS serves to facilitate the control of complicated automotive information system. At the same time, the computer having general-purpose OS and combined with automotive information devices enables the user to utilize various kinds of programs available on the computer and to handle various kinds of information by making use of the function of the automotive information device such as a car audio system.

[0037] In a specific form of the present invention, an automotive information system comprises: a controlling computer having a CPU; a plurality of information devices; a first BUS corresponding to the form of the CPU of the computer; and a second BUS interconnecting the information devices of the automotive information system.

[0038] In another form of the invention, an automotive information system comprises: a controlling computer having a CPU; a plurality of information device; a local BUS corresponding to the form of the CPU of the computer; and a PCI BUS interconnecting the information devices of the automotive information system.

[0039] In these forms of the present invention, the automotive information system may comprise data form converting means for converting the form of data exchanged between the BUSES,

[0040] The automotive information system of the present invention may further comprise a third BUS that connects the plurality of information devices in a daisy-chain fashion.

[0041] The present invention also provides an automotive computer system, comprising: a computer having a CPU; an automotive information system having a plurality of information devices; a first BUS corresponding to the form of the CPU of the computer; and a sec-

ond BUS interconnecting the information devices of the automotive information system.

[0042] Provided also by the present invention is an automotive computer system, comprising: a computer having a CPU; an automotive information system having a plurality of information devices; a local BUS corresponding to the form of the CPU of the computer; and a PCI BUS interconnecting the information devices of the automotive information system.

[0043] The automotive computer system of any type stated above may further comprise data form converting means for converting the form of data to be exchanged between the BUSES.

[0044] The automotive computer system may also comprise a third BUS for connecting the plurality of information devices of the automotive information system in a daisy-chain fashion.

[0045] In accordance with a fourth aspect of the present invention, there is provided a method of controlling an automotive information system including a plurality of information devices by using a computer having a CPU, comprising: causing the CPU to transmit and receive data through a first BUS corresponding to the form of the CPU; and causing the information devices to exchange data through a second BUS interconnecting the information devices.

[0046] In the controlling method of the fourth aspect, as well as in the foregoing automotive information system and automotive computer system employing different BUSES, the CPU of the computer and the information devices use BUSES that are adapted to the CPU and the information devices, respectively. When data is exchanged between these different BUSES, conversion of the form of data is executed as necessary. Therefore, the CPU having high operation speed is not required to keep pace with operation cycles of the information devices that operate at much lower speeds than the CPU. Therefore, the CPU is allowed to quickly perform complicated processings by, for example, efficiently making access to memories. Further, the risk of conflict between the data handled by the CPU and the data handled by the information devices, which may occur when a single BUS is used commonly both by the CPU and the information devices, can be avoided, whereby the computer and the information devices can operate smoothly without being interfered by each other.

[0047] It is also possible to easily conduct multi-task operation such that, for example, the CPU executes a processing by using the BUS adapted to the CPU while audio signals are being reproduced by on information device such as a car audio system using the BUS interconnecting the information devices. Further, replacement of the CPU can easily be made simply by changing the BUS to another type of BUS which is adapted to the new CPU, without requiring modification or change in the arrangement of the information devices and the BUS which interconnects these devices.

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