A system is disclosed including an electronic device with an analog output which is connectable to an analog input amplifier of a vehicle. In at least one embodiment, the system includes a wireless standard first transceiver which can convert and send digital audio signals using digital audio streaming system to an analog audio output; and a navigation device with a wireless standard second transceiver which can send together audio and voice instructions corresponding to a current navigation as digital audio signal using digital audio streaming.
SYSTEM COMPRISING A NAVIGATION DEVICE AND AN ELECTRONIC DEVICE

FIELD OF THE INVENTION

[0001] The present invention relates to a system comprising a navigation device and an electronic device connectable to an audio system of the vehicle.

BACKGROUND

[0002] GPS based navigation devices are well known and are widely employed as in-car navigation devices. Software that, when running e.g. on a PDA connected to an external GPS receiver, enables a user to input to the PDA a start and destination address. The software then calculates the best route between the two end-points and displays instructions on how to navigate that route. By using the positional information derived from the GPS receiver, the software can determine at regular intervals the position of the PDA (typically mounted on the dashboard of a vehicle) and can display the current position of the vehicle on a map and display (and speak) appropriate navigation instructions (e.g. ‘turn left in 100 m’).

[0003] Graphics depicting the actions to be accomplished (e.g. a left arrow indicating a left turn ahead) can be displayed in a status bar and also be superimposed over the applicable junctions/turnings etc in the roads shown in the map itself. Reference may also be made to devices that integrate a GPS receiver into a computing device programmed with a map database and that can generate navigation instructions on a display. These integrated devices are often mounted on or in the dashboard of a vehicle. The term ‘navigation device’ refers to a device that enables a user to navigate to a pre-defined destination. The device may have an internal system for receiving location data, such as a GPS receiver, or may merely be connectable to a receiver that can receive location data.

[0004] The device is a portable device and hence has to be securely mounted onto a dock that is itself firmly attached to the dashboard or windscreen, usually with a suction cup. The device is connected to an external antenna to pick up GPS signals (the term GPS covers not only US Navstar but other similar GNSS—Global Navigation Satellite Systems such as Galileo). The RF signals from the external antenna (mounted on the roof or on the dashboard but with better external visibility, i.e. line of sight to GPS satellites) are routed along a coaxial cable that has to be plugged directly into the navigation device. This means that, to use an external antenna, a user has to first dock the device and then connect the RF cable to the device.

[0005] Outside the field of GPS navigation systems, it is known to connect a mobile telephone to a dock mounted on a car dashboard and for that dock to automatically connect the mobile telephone to an external antenna. Mobile telephones are of course used by ordinary individuals with no specialist training; because of this, all aspects of the use of a mobile telephone are kept as simple as possible. Hence, that docks automatically connect a mobile telephone to an external antenna.

A GPS navigation system of the WO 2005/090919 A1 comprises dock for a portable navigation device that comprises a RF connector designed to automatically interface with a RF connector in the device in order to feed GPS RF signals from an external antenna to the device when the device is correctly mounted on the dock. RF signals from an external antenna are routed along a co-axial cable that is plugged directly into the navigation device. A user has to first dock the device and then hook up the RF cable. Using the teaching of the WO 2005/090919 A1 a user merely has to dock the navigation device onto the platform for an automatic connection to any external antenna connected to the dock to be made. Additionally an optional Bluetooth transceiver is disclosed.

SUMMARY

[0006] It may be desirable to provide a system comprising a navigation device and an electronic device that interacts with the electronic equipment of a vehicle.

[0007] This need may be met by a system according to the independent claim.

[0008] In one embodiment of the invention a system comprises an electronic device and a navigation device. Said electronic device comprises an analog output connectable to an analog input of an audio amplifier of a vehicle. The audio amplifier can be a integral part of the audio or entertainment system of the vehicle. Alternatively the amplifier could be an additional one. The analog input could be an auxiliary input, an input of a CD-changer or the like.

[0009] Said electronic device further comprises a first transceiver operable to transmit (to send and to receive) using a wireless standard. In a further refinement said wireless standard is Bluetooth standard. Said Bluetooth standard could have a version number of 1.0, 1.0B, 1.1, 1.2, 2.0, 2.1 or 3.0 or any future Bluetooth standard. Bluetooth is also known as the standard IEEE 802.15.1. For Bluetooth standard a Bluetooth-transceiver is used.

[0010] Said electronic device is operable to convert digital audio signals using a digital audio streaming system into an analog audio signal. In a further refinement said digital audio streaming system is an Advanced Audio Distribution Profile (A2DP). Said analog audio signal is sent to said analog output which is connectable to the audio amplifier for the analog audio signal to be amplified. Said Advanced Audio Distribution Profile (A2DP) is a profile defined in Bluetooth standard to stream audio signals at high quality via the Bluetooth connection.

[0011] Said navigation device comprises a second transceiver operable to transmit (to send and to receive) using the same wireless standard. Preferably said navigation devices comprises an integrated GPS receiver and a computing device programmed with a map database, so that said navigation device is operable to generate navigation instructions on a display.

[0012] Said navigation device is operable to send together audio and voice instructions as digital audio signals using said digital audio streaming system (e.g. Advanced Audio Distribution Profile (A2DP)) to said electronic device. The voice instructions correspond to a current navigation.

[0013] The following describes exemplary features and refinements of the system in accordance with the invention.

[0014] In a refinement a digital electronic signal transmission between said electronic device and said navigation device uses Serial Port Profile (SPP) of Bluetooth or L2CAP encapsulation.

[0015] In one exemplary embodiment said electronic device comprises at least one of an input and an output compatible with protocols used to communicate with an electronic equipment of said vehicle. Said electronic device is
operative to convert a signal from said navigation device into a form supported by said electronic equipment of said vehicle.

[0016] In another exemplary embodiment said electronic device comprises at least one of an input and an output compatible with protocols used to communicate with an electronic equipment of said vehicle. Said electronic device is operable to convert a signal from said electronic equipment of said vehicle into a form supported by said navigation device.

[0017] In another exemplary embodiment said navigation device is operable to send, receive and interpret signals used to communicate with an electronic equipment of said vehicle, converted by said electronic device.

[0018] In one exemplary embodiment said electronic device is operable to send a muting signal to a muting output. Said muting output is connectable to a muting input of the audio amplifier of the vehicle. Said electronic device is operable to send said voice instructions as analog audio signal to the audio amplifier of the vehicle. Said muting signal mutates all audio sources of the audio amplifier beside said voice instructions. This is done to force the audio amplifier (e.g. of a car radio) to an external input even if the user does not use an analog audio input (line-in) functionality. For example the voice instructions are sent to an input, which becomes open as a response to the muting signal.

[0019] In another exemplary embodiment said electronic device comprises a signal input connectable to an interface of the vehicle’s electronic. Said interface could be a bus, like I2C (Local Interconnect Network), CAN (Controller Area Network) or MOST (Media Oriented Systems Transport) or a cable connection e.g. to a central control unit of the vehicle. Said signal is specific to said vehicle and contains information about at least one of measuring data, control data and parameters of the vehicle.

[0020] In a further refinement of said embodiment said electronic device is operable to convert a signal from said signal input into a text information and to send said text using said first transceiver. For example a text information is written in ASCII (American Standard Code for Information Interchange).

[0021] In a further refinement of said embodiment said navigation device is operable to receive said text information using said second transceiver. Said navigation device is operable to convert said text information into a command to control a function or several functions of said navigation device.

[0022] In a refinement of said embodiment said signal depends on the status of the headlights of the vehicle. Depending on said received text information using said command the display of the navigation devices is turned to night colors, when the headlights are switched on.

[0023] In one exemplary embodiment said navigation device is operable to connect to a mobile phone using said second transceiver.

[0024] Further said navigation device is operable to transmit a phone call signal received from the mobile phone to said electronic device. Preferably the phone call signal received uses Hands Free Profile (HFP).

[0025] In another further refinement of said embodiment said navigation device is operable to switch from said digital audio streaming system (Advanced Audio Distribution Profile (A2DPS)) to a Hands Free Profile (HFP) for example. Therefore the signal flow from the navigation device to the electronic device does not need to be interrupted. Hence, a voice instruction is not aborted and can be transmitted concurrently.

[0026] In another refinement said navigation device is operable to beep near the point of maneuver, while transmitting said phone call signal to said electronic device.

[0027] In another refinement said navigation device is operable to announce the voice instructions using internal speakers or wired line-out of said navigation device, while transmitting said phone call signal to said electronic device.

[0028] In another exemplary embodiment said navigation device is operable to connect to a mobile phone using said second transceiver. Said navigation device is operable to receive a phone call signal from the mobile phone. In a further refinement said navigation device is operable to mix said phone call signal and said digital audio signal to a mixed signal. Said navigation device is operable to send said mixed signal to said electronic device via said (Bluetooth-) connection or internal speaker or wired line-out. In further refinements said navigation device is operable to send said mixed signal using at least one of said digital audio streaming system and a Hands Free Protocol (HFP).

[0029] In one embodiment of the invention at least one of said electronic device and said navigation device further comprises at least one microphone. Said at least one microphone could be external outside the housing of the electronic device or internal the housing of the navigation device.

[0030] In a further refinement at least one of said electronic device and said navigation device is operable to transmit a microphone signal using said first or second transceiver respectively. Said microphone signal can be transmitted to the navigation device and further to the mobile phone.

[0031] In a further refinement at least one of said electronic device and said navigation device is operable to cancel an echo signal received from said microphone caused by said phone call signal e.g. received from the mobile phone via said navigation device.

[0032] In another embodiment said system comprises at least two microphones. At least one of said navigation device and electronic device is operable to process at least two signals from said at least to microphones using echo cancellation. This improves overall voice quality.

[0033] These and other aspects of the present invention will become apparent from and elucidated with reference to the embodiment described hereinafter.

BRIEF SUMMARY OF THE DRAWINGS

[0034] FIG. 1 illustrates a first schematic view of functions of a navigation device and an electronic device.
[0035] FIG. 2 illustrates a second schematic view of functions of a navigation device and an electronic device.
[0036] For clarity, previously identified features retain their reference indicia in subsequent drawings.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0037] FIG. 1 illustrates a schematic view of a system, comprising a navigation device 10 and an electronic device 20. In FIG. 1 only functions of these devices 10, 20 are shown. The electronic device 20 is operable of sending 22 and receiving 21 using a first transceiver and a Bluetooth-antenna 221. The navigation device 10 is as well operable of sending 12 and receiving 11 using a second transceiver and a Bluetooth-
antenna 112. Therefore the electronic device 20 and the navigation device 10 are operable to establish a Bluetooth-connection 1020 with each other using the Bluetooth-Protocol. In FIG. 1 Bluetooth corresponding to the standard IEEE 802.15.1 is used. Alternatively any other suitable wireless standard could be used.

[0038] The navigation device 10 generates voice instructions 15 telling the driver navigation issues. These voice instructions 15 are transmitted wirelessly to the electronic device 20 using Advanced Audio Distribution Profile (A2DP) of Bluetooth. Additionally a muting command is send to mute other audio sources of the vehicle’s audio system 30. These voice instructions 15 are received by the receiving function 21 of the transceiver of the electronic device 20. The electronic device 20 is operable to convert the Advanced Audio Distribution Profile (A2DP) into an analog audio signal using a conversion function 23. This analog audio signal is send to the audio output of the electronic device 20 and further to an audio input and/or to a telephone input of the vehicle’s audio system 30. In another embodiment audio sensitivity settings with variance power and signal boost adjustments are controllable via the Bluetooth-connection 1020 using the navigation device 10.

[0039] In case the vehicle’s audio system 30 is mutable and comprises a non-mutable audio input, the audio output of the electronic device is send to said non-mutable audio input of the vehicle’s audio system 30. In this case a mute-signal at the muting output of the electronic device 20 is send to the muting input of the vehicle’s audio system 30 to mute a radio audio signal or the like. In case the vehicle’s audio system 30 does not comprise a mute input, the voice instructions could be heard form the speakers 31 only if the vehicle’s audio system 30 is switched to its analog audio input connected to said analog audio output of said electronic device 20.

[0040] In an alternative embodiment the vehicle’s audio system 30 comprises an additional stereo amplifier connected to the speakers as well (not shown in FIG. 1) and a switching (e.g. relay) stage, to switch the relevant speaker feeds between the regular amplifier of the vehicle’s audio system 30 and the additional stereo amplifier depending said analog audio signal for example. Installation of such additional amplifier is simpler, because it can be used independent from a specific configuration of the vehicle’s audio system 30, which is in some vehicle types differing between each vehicle type.

[0041] In a further embodiment the navigation device 10 is operable to send a digital audio signal from a compressed audio source 14, like a mp3 file storage. The digital audio signal is transmitted wirelessly using the Advanced Audio Distribution Profile (A2DP) of Bluetooth. Also Advanced Audio Distribution Profile (A2DP) uses a compression although unlike mp3. Said electronic device is operable to convert said digital audio signal into said analog audio signal and to send said analog audio signal to said analog audio output. In a further refinement the navigation device 10 is operable to switch between the voice instructions and the digital audio signal. In an alternative refinement the navigation device 10 is operable to mix the voice instructions and the digital audio signal.

[0042] To set the “mute vehicle” status, a sentence is sent. When the connection is made initially, “mute vehicle” is assumed to be off (its default value), so if the navigation device 10 wants to have the vehicle’s audio system 30 muted from the start, it will send such a sentence to the electronic device 20 via the wireless Bluetooth-connection 1020. In the embodiment of FIG. 1 the electronic device comprises an input for an input signal S_{SP} corresponding to a status of the vehicle. This input can be a simple one cable connection to a harness 32 or a knot of a bus system of the vehicle, for example CAN or MOST. Using the function of converting 24 to convert said input signal S_{SP} to a text, for example ASCII code, gives text information T_{SP}, transmitted to the navigation device 10 using the sending function 22 and receiving function 11 of the first and second transceiver. At the side of the navigation device 10, using a function of conversion 16 said text information T_{SP} is converted into a command C_{SP}, that enables the navigation device 10 to analyze the input signal S_{SP} and to control a function 17 of the navigation device 10 depending on said input signal S_{SP}. For example a change between night and day colors 17 depending on said input signal S_{SP} could be controlled.

[0043] In other embodiments at least on input signal of a current vehicle speed, a vehicle acceleration, a yaw rate (gyro), a status of the vehicle turn signals, a GPS-position signal (GPS: Global Position System), a RDS-TMC signal (Radio Data System—Traffic Message Channel), a destination using coordinates (longitude/latitude) and a remote control signal for controlling functions of the navigation device 10 remotely using a button or switch of the vehicle (not shown in FIG. 1) is evaluated. For example the buttons on the steering wheel (not shown) are used to remotely control a navigation device function 17.

[0045] In one embodiment a signal corresponding to the on/off status of the vehicle headlights is received at the signal input of the electronic device. To communicate the status of the vehicle lights to the navigation device 10 a sentence is used. The default value is set for the lights been switched off. If the vehicle lights are on, the electronic device 20 has to start by sending this sentence with the value set for “lights on”. Also binary could be used as well; the protocol of this embodiment will simulate a simple command protocol. That means that the sentence will be pure ASCII. ASCII is more verbose than binary. So only little bandwidth is taken from the A2DP channel.

[0046] Another embodiment is illustrated in FIG. 2 comprising functions of the navigation device 10 and the electronic device 20 connected via a Bluetooth-connection 1020. Additionally the navigation device 10 is connected via a Bluetooth-connection 1040 to a mobile phone 40. This enables hand free outbound speaker functions with the vehicle audio system 30. Only in case the power of the navigation device 10 is switched off, a direct Bluetooth-connection 2040 between the mobile phone 40 and the electronic device 20 is established.

[0047] In another embodiment illustrated in FIG. 2 a switching function 19 between two profiles is implemented. When a phone call is indicated, the protocol is changed from Advanced Audio Distribution Profile (A2DP) 13 to Hands Free Profile (HFP) 18. Also the electronic device 20 changes its conversion 23 from Advanced Audio Distribution Profile (A2DP) to Hands Free Profile (HFP).

[0048] In another embodiment the signals of the voice instructions 15 and the mobile phone 40 in Hands Free Profile (HFP) are mixable (not shown in FIG. 2) to a mixed signal. In a further refinement at least two signals of the mobile phone signal the digital audio signal 14 and the voice instructions 15 are mixed and sent to the electronic device 10 to the analog output. The mixing is processed on the navigation device 10 instead of the switching function 19.
In another embodiment the electronic device comprises a microphone located external, for example facing the driver's position in the vehicle. To suppress echoes the electronic device comprises the function of echo cancelling. This results in that the call signal sent back to the mobile phone contains significantly reduced echo effects. In a further refinement also audio signals or voice instructions mixed to the received call signal are cancelled out before sending to the mobile phone.

In another embodiment the electronic device comprises two or more microphones to improve sound quality by mixing both microphone signals. Alternatively or in combination also a signal of an internal microphone of the mobile phone is mixed with the signal of said microphone of said electronic device. Alternatively or in combination a signal of an internal microphone of said navigation device is mixed with the signal of said microphone of said electronic device improving sound quality.

It has to be noted that the functions of the navigation device can be integrated into a single integrated circuit for example on a single die or on multiple dies without limiting the scope of the claims. It has to be further noted that the functions of the navigation device can be integrated into a single integrated circuit for example on a single die or on multiple dies without limiting the scope of the claims.

Alternatively to the use of the microphone in the embodiment of FIG. 2 the microphone of the mobile phone or the internal speakers of the navigation device could be used as a microphone for the phone call.

It should be noted that the term “comprising” does not exclude other features, and the definite article “a” or “an” does not exclude a plurality, except when indicated. It is to be further noted that elements described in association with different embodiments may be combined. It is also noted that reference signs in the claims shall not be construed as limiting the scope of the claims.

The foregoing description has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed, and obviously many modifications and variations are possible in light of the disclosed teaching. The described embodiments were chosen in order to best explain the principles of the invention and its practical application to thereby enable others skilled in the art to best utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined solely by the claims appended hereto.

1. A system comprising:
an electronic device comprising an analog output connectable to an analog input of an audio amplifier of a vehicle;
a first transceiver operable to transmit using a wireless standard; said electronic device being operable to convert digital audio signals using digital audio streaming system into an analog audio signal and to send said audio signal to said analog output; and

2. A system according to claim 1, wherein said wireless standard is Bluetooth, wherein said digital audio streaming system is an Advanced Audio Distribution Profile (AADP) of Bluetooth, and wherein said first transceiver and said second transceiver are Bluetooth-transceivers.

3. A system according to claim 2, wherein a digital electronic signal transmission uses Serial Port Profile (SPP) of Bluetooth or 1.2CAP encapsulation.

4. A system according to claim 1, wherein said electronic device comprises at least one of an input and an output compatible with protocols used to communicate with an electronic equipment of said vehicle, and wherein said electronic device is operable to convert a signal from said navigation device into a digital audio signal using said digital audio streaming system to said electronic device.

5. A system according to claim 1, wherein said electronic device comprises at least one of an input and an output compatible with protocols used to communicate with an electronic equipment of said vehicle, and wherein said electronic device is operable to convert a signal from said navigation device into a form supported by said electronic equipment of said vehicle.

6. A system according to claim 1, wherein said navigation device is operable to send, receive and interpret signals used to communicate with an electronic equipment of said vehicle, converted by said electronic device.

7. A system according to claim 1, wherein said electronic device is operable to send a muting signal to a muting output connectable to a muting input of the audio amplifier of the vehicle and to send said voice instructions as analog audio signal to the audio amplifier of the vehicle.

8. A system according to claim 1, wherein said electronic device comprises a signal input connectable to an interface of a vehicle's electronic; wherein said electronic device is operable to convert a signal from said signal input into a text information and to send said text using said first transceiver; and wherein said navigation device is operable to receive said text information using said second transceiver and to convert said text information into a command to control a function of said navigation device.

9. A system according to claim 1, wherein said navigation device is operable to connect to a mobile phone using said second transceiver; wherein said navigation device is operable to transmit a phone call signal received from the mobile phone to said electronic device; and wherein said navigation device is operable to switch from said digital audio streaming system to a Hands Free Profile (HFP).

10. A system according to claim 1, wherein said navigation device is operable to connect to a mobile phone using said second transceiver; wherein said navigation device is operable to receive a phone call signal from the mobile phone; and wherein said navigation device is operable to mix said phone call signal and said digital audio signal to a mixed signal and to send said mixed signal to said electronic device.

11. A system according to claim 10, wherein said mixed signal is at least one of said digital audio streaming system, said phone call, another voice signal and Hands Free Profile (HFP).

12. A system according to claim 1, wherein at least one of said electronic device and said navigation device is operable to cancel an echo signal received from a microphone caused by a phone call signal.
13. A system according to claim 1, wherein at least one of said electronic device and said navigation device further comprises at least one microphone; and wherein at least one of said electronic device and said navigation device is operable to transmit a microphone signal using at least one of said first and second transceivers.

14. A system according to claim 1, wherein said system comprises at least two microphones, and wherein at least one of said navigation device and electronic device is operable to process at least two signals from said at least two microphones using echo cancellation.

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