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### **METHOD FOR SIMULTANEOUSLY PERFORMING VEHICLE AND SMARTPHONE FUNCTIONS USING A HARD KEY ON VEHICLE**

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#### **Abstract**

A computer-implemented method and computer program product for simultaneously controlling vehicle functions and mobile device functions. The method includes the steps of: (a) connecting a mobile software application to an in-vehicle network; (b) configuring, in the mobile software application, a plurality of user-configurable functions, at least one first user-configurable function being associated with at least one vehicle function of a plurality of vehicle functions and at least one second user-configurable function being associated with an operation external to the vehicle that is performed by the mobile software application; and (c) controlling each of the at least one first and second user-configurable functions simultaneously with a hard key arranged within a vehicle interior. The computer program is configured to perform the aforementioned steps.

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## Background/Summary

### TECHNICAL FIELD

[0001] The present subject matter relates to a system and method for simultaneously performing vehicle and mobile device (e.g., smartphone) functions using a single hard key within the vehicle interior.

### BACKGROUND

[0002] The modern automobile in recent years has seen a massive expansion in the number of internal electronic control and driving assistance systems. The use of mobile and wearable electronic devices also continues to increase. Most automobiles are capable of communicating with a smartphone carried by, or a smartwatch worn by, a driver or a passenger in the vehicle. For example, a smartphone is configured to communicate with an Apple CarPlay software system within the vehicle. With the rapid development of mobile technologies, users have higher demands for the convenience of use of in-vehicle control systems and software applications (e.g., “apps”). Currently, users can either use an original in-vehicle application provided by the vehicle manufacturer or connect a smartphone to the vehicle onboard computer, and then project an app installed on the smartphone onto the vehicle display screen through Apple CarPlay, Android Auto, CarLife, or other software connectivity protocols.

[0003] As is described in U.S. patent application Ser. No. 18/219,933, which is incorporated by reference herein in its entirety, vehicle functions (e.g., vehicle audio and video, vehicle window control, climate control, vehicle lighting, etc.) are integrated within the CarPlay app to create an innovate, personalized experience for the vehicle driver and passengers. Accordingly, the driver and passengers can control various in-vehicle functions via a connected smartphone because the smartphone is connected to the in-vehicle CarPlay app, the CarPlay app is integrated within the vehicle infotainment system, and the vehicle infotainment system is interconnected with the in-vehicle network of controllers, sensors and computers.

[0004] Existing in-vehicle electronic control systems do not offer much flexibility in terms of simultaneous control of multiple functions related to the operation of the vehicle and apps on the smartphone unrelated to the operation of the vehicle. For example, drivers or passengers of a vehicle may prefer to simultaneously perform multiple vehicle functions and smartphone functions that are unrelated to the vehicle, such as, for example: activating a specific driving mode, controlling the window shades in the vehicle, locking the house front door, checking whether the house front door is locked, sending a text message, etc. However, existing in-vehicle electronic control systems do not interact with the smartphone such that the vehicle electronic control system can also control an app on the smartphone to perform a specific “external” function that is unrelated to operation of the vehicle (e.g., locking the house door). And, smartphones are typically unable to control vehicle functions.

[0005] Described herein is a system which can allow the user of a vehicle to configure and simultaneously control multiple in-vehicle functions as well as functions performed by a smartphone that are unrelated and external to the vehicle, thereby enhancing the in-vehicle user experience, without much effort or distraction from driving.

### SUMMARY OF INVENTION

[0006] Described herein are a method and a computer program product for enabling simultaneous control of multiple vehicle functions and mobile device functions, thereby enhancing the user's in-vehicle experience. The method includes the steps of: (a) connecting a mobile software application

to an in-vehicle network; (b) configuring, in the mobile software application, a plurality of user-configurable functions, at least one first user-configurable function of said plurality of user-configurable functions being associated with at least one vehicle function of a plurality of vehicle functions that are performed exclusively by the in-vehicle network and at least one second user-configurable function of said plurality of user-configurable functions being associated with at least one operation external to the vehicle of a plurality of operations external to the vehicle that are performed exclusively by the mobile software application; and (c) activating the at least one first user-configurable function and the at least one second user-configurable function in response to a user selection of a hard key arranged within a vehicle interior.

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## Description

### BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The drawing figures depict one or more implementations, by way of example only, not by way of limitations. In the figures, like reference numerals refer to the same or similar elements.

[0008] FIG. 1 depicts a schematic diagram of a vehicle and a mobile device connected to the vehicle.

[0009] FIG. 2 is a schematic diagram of a computer program according to an embodiment.

[0010] FIG. 3 depicts a schematic diagram of a system including a vehicle and a mobile device for simultaneously controlling vehicle functions and mobile device functions.

[0011] FIG. 4 is a flowchart depicting an overall method for simultaneously controlling vehicle functions and mobile device functions.

### DETAILED DESCRIPTION

[0012] In the following detailed description, numerous specific details are set forth by way of examples in order to provide a thorough understanding of the relevant teachings. However, it should be apparent to those skilled in the art that the present teachings may be practiced without such details. In other instances, well known methods, procedures, components, and/or circuitry have been described at a relatively high-level, without detail, in order to avoid unnecessarily obscuring aspects of the present teachings.

[0013] FIG. 1 depicts an exemplary vehicle **100**. The vehicle **100** can be an electric vehicle having a rechargeable battery **101**, a charging port **103** used for charging the battery **101**, and one or more electric motors **105**, for example. In certain embodiments, the vehicle **100** can be an autonomous driving vehicle or a semi-autonomous driving vehicle.

[0014] Regardless of the type of vehicle **100**, vehicle **100** has a computer **102** for controlling functions related to the operations of vehicle **100**. An electronic mobile device **200** (otherwise referred to herein as a smartphone) is connected to vehicle computer **102** via a wired or wireless connection (e.g., Wi-Fi, cellular or Bluetooth connection). It is noted that components that are shown in broken lines in FIG. 1 are optional.

[0015] Vehicle computer **102** includes a processor, a visual display **114** having means for both inputting data and displaying data (e.g., touchscreen), and a transmitter/receiver for communicating with mobile device **200** in a conventional manner. For example, vehicle computer **102** may send and receive data via Wi-Fi or 4G/LTE radios built into vehicle **100**, by way of example. Mobile device **200** includes a processor, a visual display having means for both inputting data and displaying data (e.g., touchscreen), and a transmitter/receiver for communicating with vehicle **100** in a conventional manner.

[0016] At least one physical button (i.e., hard key) **116** is arranged in the interior **109** of the vehicle **100**. For example, the button **116** can be arranged on the steering wheel of the vehicle **100**.

Alternatively, the button **116** can be arranged on the information panel or on the center console of the vehicle **100**. Although only one button **116** is illustrated in FIG. 1, several physical buttons **116**

can be arranged in the interior **109** of the vehicle **100**.

[0017] A computer program **104** or a software application (e.g., “app”) is downloaded to, installed on, and stored in, either electronic mobile device **200** or computer **102** of vehicle **100** (or both). According to one embodiment, program **104** is stored within the mobile device **200**; information can be inputted into program **104** via the display of mobile device **200**; and information can be outputted from program **104** via the display of vehicle computer **102** (e.g., via Apple CarPlay or Android Auto). According to another embodiment, program **104** is stored within the vehicle computer **102**; information can be inputted into program **104** via the touchscreen display **114** of vehicle computer **102**; and information can be outputted from program **104** via the display of vehicle computer **102** (e.g., via Apple CarPlay or Android Auto). According to yet another embodiment, program **104** is a mobile application stored within the mobile device **200**; information can be inputted into program **104** via the display of mobile device **200**; and information can be outputted from program **104** via the display of mobile device **200**. According to still another embodiment, program **104** is stored within the mobile device **200**; information can be inputted into program **104** via the display of mobile device **200**; and information can be outputted from program **104** via both the display of mobile device **200** and the display of vehicle computer **102**.

[0018] Program **104** can be displayed on the touchscreen display **114** of vehicle computer **102**. The functionality of program **104** can be enabled or disabled by user input on the touchscreen display **114** of vehicle computer **102**.

[0019] In certain embodiments, users of the vehicle **100** may be identified by program **104** based on paired device data maintained in the memory **112** of program **104**. The paired device data can indicate, for example, unique device identifiers of mobile devices that were previously paired with program **104** of the vehicle **100**, such that program **104** may automatically reconnect previously connected mobile devices without user intervention.

[0020] Program **104** can be connected to receive and transmit information from/to a GPS device **110** (e.g., a GPS chip) that uses the Global Positioning System (GPS). GPS device **110** is configured to determine the location of vehicle **100** or mobile device **200** within vehicle **100** in a conventional manner. GPS device **110** may form part of vehicle computer **102** or mobile device **200**, or both. This locational data can be stored in memory **112**. Memory **112** may also form part of vehicle computer **102** or mobile device **200**, or both.

[0021] Program **104** can be designed and configured to connect directly to the network of the vehicle **100** and/or a third-party software applications (e.g., other “apps”) or devices via a direct connection application programming interface (API). For example, program **104** can be configured to interact with other apps installed on mobile device **200**, such as different apps for social media, messaging, providing maps and navigation, playing music or podcasts, apps for controlling “smart” devices external to vehicle **100** (e.g., front door of a house, garage door, lights, heating or cooling, etc.), etc., that may be installed on, and be available via the display of, mobile device **200**. Alternatively, program **104** can be configured to interact with other apps installed on vehicle computer **102**, such as different apps for social media, messaging, providing maps and navigation, playing music or podcasts, etc., that may be installed on, and be available via the display of, vehicle computer **102** (e.g., via Apple CarPlay or Android Auto), for example. In these situations, because these apps are integrated with program **104**, program **104** can use each specific app's API to perform an action specified by the user.

[0022] In certain embodiments, program **104** can appear as a selectable icon within Apple CarPlay. Program **104** can be configured to connect the network of the vehicle **100** with the Apple ecosystem (e.g., with the different Apple devices, such as iPhone, iPad, MacBook, Apple Watch, AirPods, Apple TV, Apple CarPlay, etc.) that may be connected and integrated with each other, and that may be accessible within the vehicle **100**. Once connected to the Apple ecosystem, program **104** can run in the background of Apple CarPlay, for example.

[0023] The network of the vehicle **100** can include one or more of a vehicle controller area network

(“CAN”) or an Ethernet network, for example. The network of the vehicle **100** can allow, after proper and successful authentication, program **104** to communicate, via button **116**, for example, with various systems or components of vehicle **100**, such as a vehicle modem (if available), GPS device **110** and various electronic control units (“ECUs”) configured to interface with program **104**. For example, the vehicle ECUs may include a vehicle interior control module configured to monitor and control power control functions, such as interior lighting or window shades, for example; a radio transceiver module configured to provide radio services and communicate with mobile devices inside vehicle **100**; and a climate control module configured to provide control and monitoring of heating, cooling, and ventilation system components (e.g., compressor clutch and blower fan control, temperature sensor information, etc.).

[0024] Program **104** can be configured to include different components to facilitate access to one or more features of vehicle **100** that may be provided with a default configuration by the manufactures of vehicle **100** and may be configured for changes or customization by the user of vehicle **100**.

[0025] For example, program **104** can include a Data Manager, a Connection Manager, an API Controller, and a Change Manager, as illustrated in FIG. 2, for example. It should be understood that the invention is not limited to the schematic diagram shown in FIG. 2. The schematic diagram is shown merely as an example. In FIG. 2, the Data Manager can be configured, for example, to provide, process, and update an RSI Request-Response Interface authorization and RSI resource mapping. The Connection Manager can be configured, for example, to check network conditions through a network controller, re-check connection when network conditions change, search for an infotainment web interface protocol, such as the Volkswagen Infotainment Web Interface (“VIWI”) RSI service, for example, handle authentication, collect initial information (e.g., vehicle data) about different components of the vehicle **100**, and process updates to vehicle data requested by the user of vehicle **100**.

[0026] Program **104** can be configured to access, on the mobile device **200**, a list of first user-configurable functions of the vehicle **100** associated with at least one preferred vehicle mode of a plurality of vehicle modes. The list of first user-configurable functions of the vehicle **100** can include, but is not limited to, initial or default functions of the vehicle **100**, before allowing the user of vehicle **100** access to modify or customize the available first user-configurable functions of the vehicle **100**. Once program **104** has gathered and parsed the initial vehicle data, program **104** can monitor for any changes to the initial vehicle data. For example, program **104** can open a WebSocket API as a two-way interactive communication session between the user's interface of program **104** and a server connected to a two-way interactive communication session between the user's browser and a server to observe, process, and store any and all changes by the user to the initial vehicle data. After the user's modifications to any of the available first user-configurable functions of the vehicle **100** are processed and stored in the memory **112** of program **104**, program **104** can be configured to synchronize the modified first user-configurable functions of the vehicle **100** with the corresponding system or component of the vehicle **100**.

[0027] In certain embodiments, program **104** can auto-subscribe or self-subscribe to receive a notification message for each user's modification to a user-configurable function of the vehicle **100**, including but not limited to changes to elements included within a vehicle function (e.g., in the case of a complex, compound vehicle function related to more than one setting of a vehicle component or to multiple settings of multiple vehicle components), in addition to changes to the function of the vehicle **100** itself. For example, when the user's modification relates to a vehicle function affecting climate or ventilation control in the interior **109** of the vehicle **100**, program **104** can be configured to be notified when any of the fan settings or the temperature values has been changed by the user.

[0028] In addition, program **104** can be configured to auto detect any smart devices (e.g., smart phones, smart watches, tablets, etc.) that are compatible with program **104**, and that may be accessible within the vehicle **100**, and auto connect with these devices as soon as they are set up, without the necessity for the user to set up these devices each time. As another example, program

**104** can connect to a smart device via a direct connection application programming interface (API). [0029] Program **104** can be configured to access, on the mobile device **200**, a list of second user-configurable functions of the mobile device **200** associated with an operation external to the vehicle **100** that is performed by program **104**. The list of second user-configurable functions of the mobile device **200** can include, but is not limited to, initial or default functions of the mobile device **200**, before allowing the user of mobile device **200** access to modify or customize the available user-configurable functions of the mobile device **200**. Once program **104** has gathered and parsed the initial mobile device data, program **104** can monitor for any changes to the initial mobile device data. For example, program **104** can open a WebSocket API as a two-way interactive communication session between the user's interface of program **104** and a server connected to a two-way interactive communication session between the user's browser and a server to observe, process, and store any and all changes by the user to the initial mobile device data. After the user's modifications to any of the available user-configurable functions of the mobile device **200** are processed and stored in the memory **112** of program **104**, program **104** can be configured to synchronize the modified user-configurable functions of the mobile device **200** with the corresponding external system or component controlled by the mobile device **200**.

[0030] Program **104** can aggregate vehicle data obtained from the vehicle network and the vehicle systems with mobile device data obtained from the mobile device **200** network and external systems or components controlled by the mobile device **200**, and offer to the user combinations for simultaneously (e.g., at the same time) controlling or adjusting vehicle functions and mobile device functions that do not necessarily share a specific attribute by controlling different in-vehicle systems and components (e.g., lighting, climate, ventilation, radio, sound system, etc.) and different external systems or components controlled by the mobile device **200**, with the press of a single button **116**, for example. As a specific example, the user may utilize button **116** and program **104** running on smartphone **200** or on vehicle computer **102** to simultaneously adjust multiple vehicle-related settings related to ambient lighting, cabin temperature, user of the vehicle **100**, settings related to lowering the cabin temperature, cabin ventilation, or playing a custom audio soundtrack on the sound system of the vehicle **100**, as well as multiple mobile device-related settings associated with an operation external to the vehicle that is performed by the software application. Examples of mobile device-related settings associated with an operation external to the vehicle that is performed by the software application **104** can include, but are not limited to, locking or unlocking a house front door, checking whether the house front door is locked, opening or closing a garage door, turning on or off house lights, house heating or cooling systems, or house security or alarm systems, and sending a pre-set text message by the user to an external party (e.g., "On my way" to friend or relative, etc.).

[0031] Program **104** can be configured to associate the button **116** with a subset of the simultaneously controlled user-configurable vehicle and external functions (e.g., lighting, climate, ventilation, radio, sound system, locking or unlocking a house front door, checking whether the house front door is locked, opening or closing a garage door, turning on or off house lights, house heating or cooling systems, or house security or alarm systems, and sending a pre-set text message, etc.). The button **116** can be associated with at least one preferred vehicle mode (e.g., sports mode) among a plurality of vehicle modes.

[0032] In certain embodiments, multiple buttons **116** can be arranged within the vehicle interior **109**. Each of the buttons **116** can be associated, in program **104**, with a corresponding subset of the simultaneously controlled user-configurable vehicle and external functions (e.g., lighting, climate, ventilation, radio, sound system, locking or unlocking a house front door, checking whether the house front door is locked, opening or closing a garage door, turning on or off house lights, house heating or cooling systems, or house security or alarm systems, and sending a pre-set text message, etc.). Each button **116** can be associated with a different vehicle mode (e.g., sports mode, mountain mode, snow mode, etc.) among a plurality of vehicle modes.

[0033] Program **104** can be configured to connect to various interconnected smart devices located in the user's home and/or in vehicle **100** either directly or through various aggregators, hubs (e.g., HomeKit, Samsung SmartThings), and connectors (e.g., Yonomi), for example. These aggregators, hubs, and connectors allow the user to select one or more connected devices through aggregation of the data (e.g., application and/or device information). Initially, each aggregator, hub, or connector may prompt the user to log into devices through applications into applications, such as accounts, logins, or the like that are relevant to one or more selected-by-the-user devices. In other words, program **104** can provide the user with the ability to add devices across a number of hubs or aggregators, such as SmartThings, Yonomi, HomeKit, etc., or directly to a third-party app or device via a direct connection application programming interface (API).

[0034] The button **116** can be programmed to work with program **104**, as well as across a number of third party apps, as such apps become available. For example, an applet such as If This Then That (IFTTT), Canon/Nikon for remote camera control, as well as any app with a button-press function to trigger an action, can be programmed on the button **116** if the user has access to the API of the third party app. For example, the button **116** can be programmed to access Nexx Home to control Nexx Home smart garage doors and other Nexx home devices through the respective app.

[0035] The vehicle-related settings and the mobile device-related settings can be associated with at least one preferred vehicle mode, such as sports mode, for example, of a plurality of vehicle modes. Specifically, the vehicle interface (e.g., VIWI) can facilitate the ability to issue one command via a single push of button **116** (e.g., "sports mode") based on the user's request to simultaneously control multiple in-vehicle systems and components (e.g., window shades, temperature, air ventilation direction, currently playing soundtrack, etc.) and multiple mobile device-related settings (e.g., locking a house front door, checking whether the house front door is locked, or sending a pre-set text message to an external party). The multiple in-vehicle systems and components control requests are terminated in different ECUs in the vehicle (e.g., climate controller for temperature, audio system for soundtrack, etc.). The multiple external to the vehicle control requests are terminated in different ECUs of the controlled, by the mobile device **200**, external systems or components (e.g., locks of house front door, status of garage door, house lights, house heating or cooling systems, or house security or alarm systems, pre-set text messages, etc.).

[0036] Program **104** can be configured to allow the user to access and change which, or how many of, the first user-configurable functions that are associated with a preferred vehicle mode of a plurality of vehicle modes and which, or how many of, the second user-configurable functions that are associated with an operation external to the vehicle that is performed by the software application can be included in each set of the plurality of user-configurable functions. The user can configure, e.g., in advance, in the program **104**, on the mobile device **200**, multiple user-configurable functions using the user interface of the program **104**. For example, the user can configure in, and save in the memory **112** of, the program **104** a plurality of user-configurable functions, each of which can be associated with a preferred vehicle mode (e.g., sports mode) of a plurality of vehicle modes.

[0037] After the user's modifications to any of the available user-configurable functions are processed and stored in the memory **112** of program **104**, program **104** can be configured to synchronize the modified user-configurable functions with the corresponding vehicle system or external system controlled by the mobile device **200**.

[0038] FIG. 3 depicts the interaction between mobile device **200** and the vehicle **100**. Mobile device **200** communicates with vehicle infotainment system **118** (or other system) of vehicle **100** via CarPlay or other system. Vehicle infotainment system **118** includes the smartphone mirroring app (e.g., CarPlay). CarPlay (for example) mirrors the mobile device **200** apps on the display or touchscreen **114** of vehicle **100**. As is described in U.S. patent application Ser. No. 18/219,933, which is incorporated by reference herein in its entirety, vehicle functions (e.g., vehicle audio and video, vehicle window control, climate control, vehicle lighting, etc.) are integrated within the

CarPlay app to create an innovate, personalized experience for the vehicle driver and passengers. Accordingly, the driver and passengers can control various in-vehicle functions via a connected smartphone because the smartphone is connected to the in-vehicle CarPlay app, the CarPlay app is integrated within the vehicle infotainment system **118**, and the vehicle infotainment system **118** is interconnected with the in-vehicle network of controllers, sensors and computers.

[0039] Vehicle infotainment system **118** is also connected to one or more in-vehicle hard keys or buttons **116**. Depressing button **116** causes program **104** to (i) activate one or more in-vehicle functions (e.g., activate vehicle seat heaters, activate vehicle sport mode, etc.) and (ii) cause one or more apps in mobile device **200** to perform functions external to the vehicle (e.g., send text message, lock house door, etc.). This can be accomplished because the mobile device **200** is connected to the vehicle infotainment system **118**.

[0040] FIG. **4** is a flowchart depicting an overall method **400** for simultaneously controlling vehicle functions and mobile device functions. It is noted at the outset that the method **400** is not limited to any particular step or order of steps, and various steps may be omitted or modified within the scope or spirit of the invention. The user of the vehicle **100** can be a driver of the vehicle **100** or a passenger in the vehicle **100**.

[0041] It is also noted that method **400** uses mobile device **200** along with vehicle **100** to accomplish method **400**, however, it should be understood that vehicle computer **102** of vehicle **100** may be omitted and the steps of method **400** may be completed using only mobile device **200**. Alternatively, mobile device **200** may be omitted and the steps of method **400** may be completed using only vehicle computer **102** of vehicle **100**.

[0042] At step **410** of method **400**, mobile device **200** connects to vehicle **100** in either a wired or wireless manner, as described above. If the steps of method **400** are completed by vehicle **100** itself (and without the assistance of mobile device **200**), then this step may be omitted.

[0043] Optionally, after the connection between the mobile device **200** and the vehicle **100** is established, program **104** can initiate an authentication of the mobile device **200** and/or the vehicle **100**. The authentication can be performed using known methods, such as Transport Layer Security (“TLS”) 1.2 security protocol, public pinning hash, local certificate pinning, PIN numbers that can be entered by the user or QR codes that can be scanned by the mobile device **200**, for example. Further functionality of program **104** can be disabled until after the mobile device **200** and/or the vehicle **100** successfully complete the authentication process (e.g., the mobile device **200** confirms that the saved user and vehicle information is stored in the vehicle **100**).

[0044] At step **412**, the user (e.g., driver or passenger of vehicle **100**) launches program **104** on mobile device **200** or on vehicle computer **102**. Step **412** may occur either prior to a vehicle trip or during the vehicle trip.

[0045] At step **414**, program **104** displays one or more in-vehicle functions associated with at least one preferred vehicle mode of a plurality of vehicle modes of vehicle **100** and one or more external functions associated with an operation external to vehicle **100** performed by the program **104**. The in-vehicle functions can include, but are not limited to, activating a vehicle sport mode, controlling vehicle window shades, lighting, climate, ventilation, radio, sound system, etc., for example. The external functions can include, but are not limited to, locking or unlocking a house front door, checking whether the house front door is locked, opening or closing a garage door, turning on or off house lights, house heating or cooling systems, or house security or alarm systems, and sending a pre-set text message by the user to an external party (e.g., “On my way” to friend or relative, etc.), for example.

[0046] The vehicle functions and the external functions may be saved in the memory **112** of the mobile device **200** or vehicle computer **102**, for example.

[0047] Before displaying, to the user, the internal listing of vehicle functions and external functions in step **414**, the listing may be sorted, arranged and organized in a certain fashion. As one example for sorting the listing, program **104** checks for the most recently used or the most often used



vehicle function(s) and external function(s), and automatically organizes the vehicle function(s) and the external function(s) such that the most recently used or the most often used vehicle function(s) and external function(s) appear at the top of the list.

[0048] As another example, program **104** can recognize the user of the vehicle **100** (e.g., in case multiple users use the same vehicle **100**) and can automatically display the vehicle functions and external functions that were most recently used or are most often used by the recognized user.

[0049] At step **416**, program **104** receives from the user (e.g., driver or passenger) of the vehicle **100** user input configuring, in program **104**, at least one vehicle function and at least one external function among the vehicle functions and the external functions that were displayed to the user at step **414**. The at least one vehicle function can be associated with at least one preferred vehicle mode (e.g., “sport mode”) of a plurality of vehicle modes and can include multiple vehicle-related settings related to ambient lighting, cabin temperature, user of the vehicle **100**, settings related to lowering the cabin temperature, cabin ventilation, seat massage, seat ventilation, or playing a custom audio soundtrack on the sound system of the vehicle **100**. The at least one external function can be associated with an operation external to the vehicle (e.g., locking or unlocking a house front door, checking whether the house front door is locked, opening or closing a garage door, turning on or off house lights, house heating or cooling systems, or house security or alarm systems, and sending a pre-set text message by the user to an external party, etc.) that is performed by the program **104**. The user input in step **416** of configuring, in program **104**, at least one vehicle function and at least one external function, can be in the form of the user selecting an icon or pressing a button on the touchscreen of the mobile device **200** within the user interface of program **104**. Alternatively, the user input can be in the form of a voice command by the user over an audio system of the mobile device **200**. In certain embodiments, for example, Apple Siri can be expanded to enable user input, selection, and modification of vehicle functions and external functions through the program **104**.

[0050] The user's selection can be saved in memory **112** of mobile device **200** for either current use or later use. The user's selection saved in memory **112** is made available for use by program **104**. Once saved, the saved vehicle functions and the external functions may be presented to the user as selectable icons (e.g., icons named “sports mode,” etc.), for example, on the display of mobile device **200** or vehicle computer **102**. Each icon may be in the form of a single softkey button on the display and within the user interface of program **104**, for example.

[0051] In certain embodiments, program **104** can receive from the user (e.g., driver or passenger) of the vehicle **100** user input selecting a category or a type of the vehicle functions and the external functions that the user is interested in controlling or adjusting, such as vehicle-related settings related to ambient lighting, cabin temperature, user of the vehicle **100**, settings related to lowering the cabin temperature, cabin ventilation, seat massage, seat ventilation, or playing a custom audio soundtrack on the sound system of the vehicle **100**, as well as mobile device-related settings associated with an operation external to the vehicle that is performed by the software application (e.g., locking or unlocking a house front door, checking whether the house front door is locked, opening or closing a garage door, turning on or off house lights, house heating or cooling systems, or house security or alarm systems, and sending a pre-set text message by the user to an external party, etc.), for example.

[0052] Turning back to FIG. **4**, at step **418**, program **104** presents the information about the configured vehicle functions and external functions to the user of the vehicle **100** (e.g., driver, passengers). For example, the information about the configured vehicle functions and external functions can be presented to the user via the touchscreen display of the mobile device **200**. Alternatively, the information about the configured vehicle functions and external functions can be presented to the user via the touchscreen display **114** of vehicle computer **102** (e.g., via Apple CarPlay or Android Auto) of the vehicle **100**. Alternatively, the information about the configured vehicle functions and external functions can be presented to the user via a Text-to-Speech (“TTS”)

technology over the audio system of the vehicle **100**.

[0053] Step **418** of presenting to the user the information about the configured vehicle functions and external functions can include, for example, vehicle features and ecosystem features grouped in three main categories: a default category of actions called essentials, for example, including daily or most used features, quick actions (allowing the user to select and configure quick actions from a predetermined list of features), and specialty actions, such as entertainment (for media), for example. For example, the daily features can include radio favorites, vehicle climate modes, vehicle air distribution, destinations, weather, air quality index (AQI), music, etc.

[0054] In certain embodiments, program **104** can aggregate vehicle data obtained from the vehicle network and the vehicle systems and offer to the user combinations for controlling or adjusting vehicle functions that share a specific attribute by controlling a certain in-vehicle component (e.g., lighting, climate, ventilation, radio, sound system, etc.). As a specific example, the user may utilize program **104** running on smartphone **200** to turn on all vehicle interior lights, but at a low intensity level.

[0055] In other embodiments, program **104** can aggregate external components and systems data obtained from external systems or components controlled by the mobile device **200**, and offer to the user combinations for controlling or adjusting external functions that share a specific attribute by controlling a certain external system or component (e.g., lighting, etc.). As a specific example, the user may utilize program **104** running on smartphone **200** to turn on all house interior lights, but at a low intensity level.

[0056] In other embodiments, program **104** can aggregate vehicle data obtained from the vehicle network and the vehicle systems, and the external components and systems, and offer to the user combinations for controlling or adjusting vehicle functions and external functions that do not necessarily share a specific attribute by controlling different in-vehicle systems and components (e.g., lighting, climate, ventilation, radio, sound system, locks, security system, garage door, lighting, climate, ventilation, sound system, etc.) at the same time, with the press of a single button **116** or with a selection of a single icon, for example. As a specific example, the user may utilize program **104** running on smartphone **200** to adjust multiple settings related to vehicle ambient lighting, cabin temperature, user of the vehicle **100**, settings related to lowering the cabin temperature, cabin ventilation, seat massage, seat ventilation, or playing a custom audio soundtrack on the sound system of the vehicle **100** and external systems settings, such as locking or unlocking a house front door, checking whether the house front door is locked, opening or closing a garage door, turning on or off house lights, house heating or cooling systems, or house security or alarm systems, and sending a pre-set text message by the user to an external party, for example.

Specifically, the vehicle interface (e.g., VIWI) can facilitate the user's ability to issue one command via a single push of button **116** (e.g., "sports mode") based on the user's request to simultaneously control multiple in-vehicle systems and components (e.g., seat massage, temperature, air ventilation direction, currently playing soundtrack, etc.) and external systems or components controlled by the mobile device **200** (e.g., house door lock, garage door status, house security system, etc.). These multiple control requests are terminated in different ECUs in the vehicle (e.g., seat controller for massage, audio system for soundtrack, etc.) or in different ECUs of the controlled, by the mobile device **200**, external systems or components (e.g., locks of house front door, status of garage door, house lights, house heating or cooling systems, or house security or alarm systems, pre-set text messages, etc.).

[0057] Regardless of the type or category of the configured vehicle functions and external functions, the displayed information about the configured vehicle functions and external functions is contextually relevant in-vehicle information and contextually local vehicle function information, as well as contextually relevant external systems or components information for the audience in the vehicle **100** (e.g., driver, passengers).

[0058] Turning back to FIG. **4**, in order to present the information about the configured vehicle

functions and external functions to the user of the vehicle **100** (e.g., driver, passengers) in step **418**, program **104** accesses the network of the vehicle **100** and external systems or components controlled by the mobile device **200**, and obtains in-vehicle data and external systems or components data related to the configured, by the user, vehicle functions and external functions. [0059] At step **420**, program **104** can receive from the user (e.g., driver or passenger) of the vehicle **100** user input simultaneously controlling, by the user of the vehicle **100**, the configured vehicle functions and external functions. As described above, the user input can be in the form of the user pressing button **116** arranged within the vehicle interior **109**. Alternatively, the user input can be in the form of the user selecting an icon on the touchscreen **114** of vehicle computer **102**.

Alternatively, the user input can be in the form of a voice command by the user over an audio system of the vehicle **100**. According to this embodiment, the user selection is accomplished using the input device (e.g., touch screen, stylus, mouse pad, keyboard, etc.) of vehicle **100**, however, it should be understood that the selection could be accomplished using the input device (e.g., touch screen) of mobile device **200**.

[0060] Because settings related to the vehicle functions and the external functions can be pre-defined or pre-programmed and saved in the memory of mobile device **200** or vehicle computer **102**, multiple adjustable vehicle function settings and external function settings can be controlled and adjusted with one press by the user of button **116** on the steering wheel or dashboard of the vehicle **100**, or on the touchscreen **114** of the vehicle **100**.

[0061] It should be understood that method **400** is not limited to any particular step or sequence of steps.

[0062] The available user-configurable functions can be personalized to the specific user's preferences and can be adjusted according to predefined options. Alternatively, the user can adjust the predefined options to further suit the user's preferences.

[0063] The step of personalizing the selected user-configurable functions based on the user's preferences can be executed by program **104** running on the smartphone **200**, in real time between the smartphone **200** and the infotainment system **118** of the vehicle **100**.

[0064] In certain embodiments, step **418** of presenting to the user the information about the selected vehicle function can include, for example, a step of accessing the vehicle network and obtaining vehicle data related to the selected vehicle function of the vehicle **100**.

[0065] It should be understood that method **400** is not limited to the particular examples of vehicle and external functions described herein. For example, method **400** can be applied in a similar manner to present information to the user of vehicle **100** and enable control of a vehicle-related function or external function, or anything related to the in-vehicle user's experience, such as a current street the vehicle **100** is driving on, the current city or area the vehicle **100** is driving through, currently playing music, news, or podcasts, etc. The information can be conveniently presented to the user via the touchscreen **114** of the vehicle **100** or via text-to-speech technology, using Apple CarPlay, Android Auto, Microsoft SYNC, or over the vehicle audio system, for example. In other words, the steps of method **400** can be used to enhance the in-vehicle user's experience with any of the vehicle systems or software apps that are installed and running on vehicle's computer **102** or on a mobile device **200** connected to vehicle **100**.

[0066] Also, although it has been described that program **104** on mobile device **200** performs the steps described herein, it should be understood that program **104** on vehicle computer **102** may perform these steps in lieu of mobile device **200**.

[0067] In the context of the present description, the functions of program **104** may be carried out by a processor. The processor can be understood to mean a machine or an electronic circuit, for example. In particular, a processor can be a central processing unit (CPU), a microprocessor or microcontroller, for example an application-specific integrated circuit or digital signal processor, possibly in combination with a data storage unit for storing program commands, etc. Additionally, a processor can be understood to be a virtual processor, a virtual machine or soft CPU. The program

104 may be stored in the memory of the machine.

[0068] It will be understood that the operational steps are performed by the computers or processors described herein upon loading and executing software code or instructions which are tangibly stored on a tangible, non-transitory computer readable storage medium, such as on a magnetic medium, e.g., a computer hard drive, an optical medium, e.g., an optical disc, solid-state memory, e.g., flash memory, or other storage media known in the art. Thus, any of the functionality performed by the computers or processors described herein is implemented in software code or instructions which are tangibly stored on a tangible, non-transitory computer readable storage medium. Upon loading and executing such software code or instructions by the computers or processors, the computers or processors may perform any of the functionality of the computers or processors described herein, including any steps of the methods described herein.

[0069] The term “software code” or “code” used herein refers to any instructions or set of instructions that influence the operation of computers or processors. They may exist in a computer-executable form, such as machine code, which is the set of instructions and data directly executed by a computer's central processing unit or by a controller, a human-understandable form, such as source code, which may be compiled in order to be executed by a computer's central processing unit or by a controller, or an intermediate form, such as object code, which is produced by a compiler. As used herein, the term “software code” or “code” also includes any human-understandable computer instructions or set of instructions, e.g., a script, that may be executed on the fly with the aid of an interpreter executed by a computer's central processing unit or by a controller.

[0070] It will also be understood that the terms and expressions used herein have the ordinary meaning as is accorded to such terms and expressions with respect to their corresponding respective areas of inquiry and study except where specific meanings have otherwise been set forth herein. The terms “comprises,” “comprising,” “includes,” “including,” or any other variation thereof, are intended to cover a non-exclusive inclusion, such that a process, method, article, or apparatus that has, comprises or includes a list of elements or steps does not include only those elements or steps but may include other elements or steps not expressly listed or inherent to such process, method, article, or apparatus. An element preceded by “a” or “an” does not, without further constraints, preclude the existence of additional identical elements in the process, method, article, or apparatus that comprises the element.

[0071] While the foregoing has described what are considered to be the best mode and/or other examples, it is understood that various modifications may be made therein and that the subject matter disclosed herein may be implemented in various forms and examples, and that they may be applied in numerous applications, only some of which have been described herein. It is intended by the following claims to claim any and all modifications and variations that fall within the true scope of the present concepts.

## Claims

1. A computer-implemented method for simultaneously controlling vehicle functions and mobile device functions, said method comprising the steps of: (a) connecting a mobile software application to an in-vehicle network; (b) configuring, in the mobile software application, a plurality of user-configurable functions, at least one first user-configurable function of said plurality of user-configurable functions being associated with at least one vehicle function of a plurality of vehicle functions that are performed exclusively by the in-vehicle network and at least one second user-configurable function of said plurality of user-configurable functions being associated with at least one operation external to the vehicle of a plurality of operations external to the vehicle; and (c) activating the at least one first user-configurable function and the at least one second user-configurable function in response to a single user selection of a hard key that is arranged within a

vehicle interior and connected to the in-vehicle network.

2. The computer-implemented method of claim 1, wherein the plurality of vehicle functions comprise at least two of activating a sports mode, controlling vehicle window shades, controlling vehicle windows, and controlling a vehicle heating or climate control system, and wherein the plurality of operations external to the vehicle comprise at least two locking a house front door, checking whether the house front door is locked, opening or closing a garage door, and sending a text message to an external party by the user.

3. The computer-implemented method of claim 1, wherein the mobile software application is installed on a mobile device and the configuring in the mobile software application of the plurality of user-configurable functions is performed on the mobile device.

4. The computer-implemented method of claim 1, further comprising associating, in the software application, the hard key with at least one subset of said plurality of user-configurable functions.

5. The computer-implemented method of claim 1, wherein a plurality of hard keys are arranged within the vehicle interior and the method further comprises associating, in the software application, each hard key of said plurality of hard keys with different subsets of said plurality of user-configurable functions.

6. The computer-implemented method of claim 5, wherein each hard key of said plurality of hard keys is associated with different vehicle functions among the plurality of vehicle functions.

7. The computer-implemented method of claim 1, further comprising displaying the software application on a screen of the vehicle.

8. The computer-implemented method of claim 7, further comprising one of enabling or disabling of the software application on the screen of the vehicle.

9. The computer-implemented method of claim 1, wherein the configuring in the software application of the plurality of user-configurable functions is performed on a mobile device and the activating step is performed based on a control signal from the software application in response to selection of the hard key.

10. The computer-implemented method of claim 9, wherein the controlling each of the plurality of user-configurable functions simultaneously is performed by the software application via a vehicle network application programming interface ("API").

11. A computer program product for simultaneously controlling vehicle and non-vehicle functions, the computer program product being stored in a non-transitory computer-readable recording medium, wherein the computer program product is configured for: activating a plurality of user-configurable functions, at least one first user-configurable function of said plurality of user-configurable functions being associated with at least one vehicle function of a plurality of vehicle functions that are performed exclusively by an in-vehicle network and at least one second user-configurable function of said plurality of user-configurable functions being associated with at least one operation external to the vehicle of a plurality of operations external to the vehicle in response to a single user selection of a hard key that is arranged within a vehicle interior and connected to the in-vehicle network.

12. A vehicle comprising the computer program product of claim 11.

13. A smartphone comprising the computer program product of claim 11.

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