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(54) **IN-VEHICLE COMPONENT USER INTERFACE**

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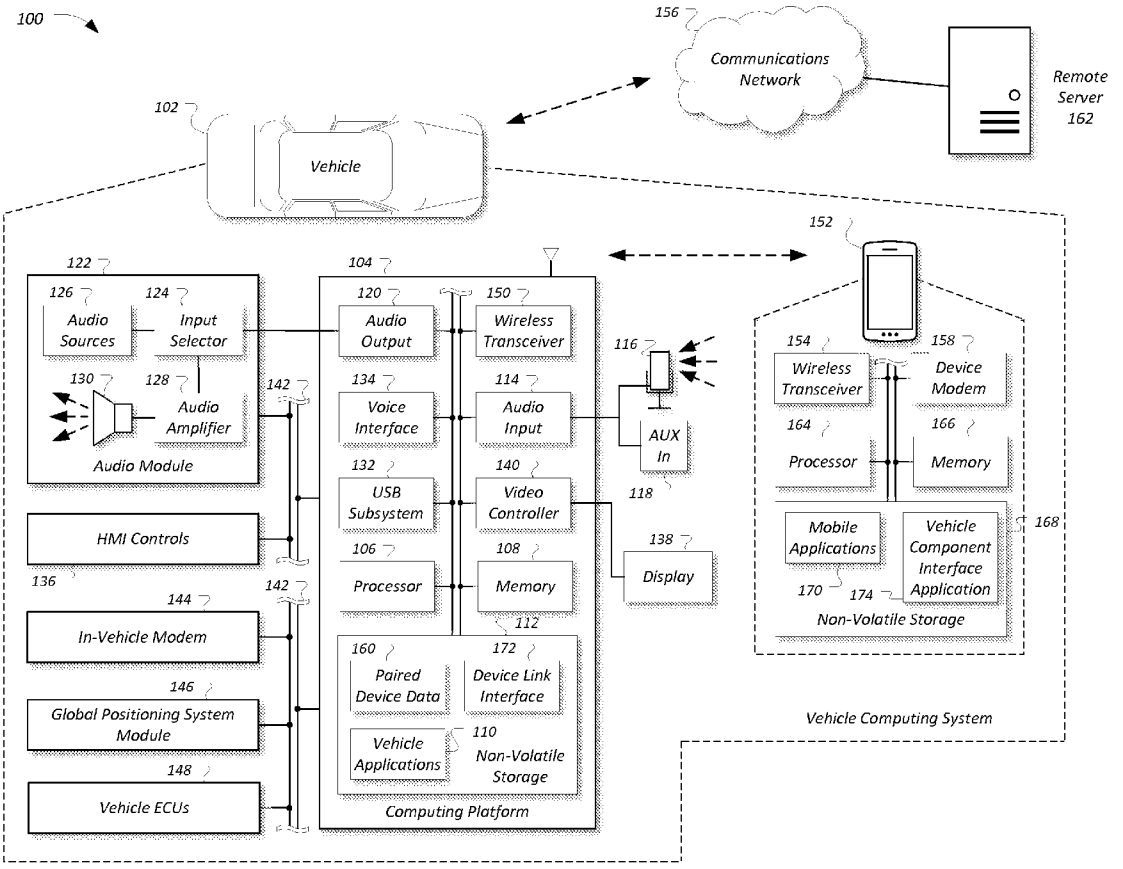
(57) **ABSTRACT**

A system may include an in-vehicle component, including a first control set to configure the component, configured to identify a device associated with a user approach to the component; and send an interaction request to the device to cause the device to display a user interface for the component including a second control set to configure the component, the second control set including at least one function unavailable in the first control set. A personal device may receive, from an in-vehicle component including a first control set to configure the component, a user interface definition descriptive of a second control set to configure the component; and receive, from the component, a request to display a user interface for the component including the second control set to configure the component, the second control set including at least one function unavailable in the first control set.



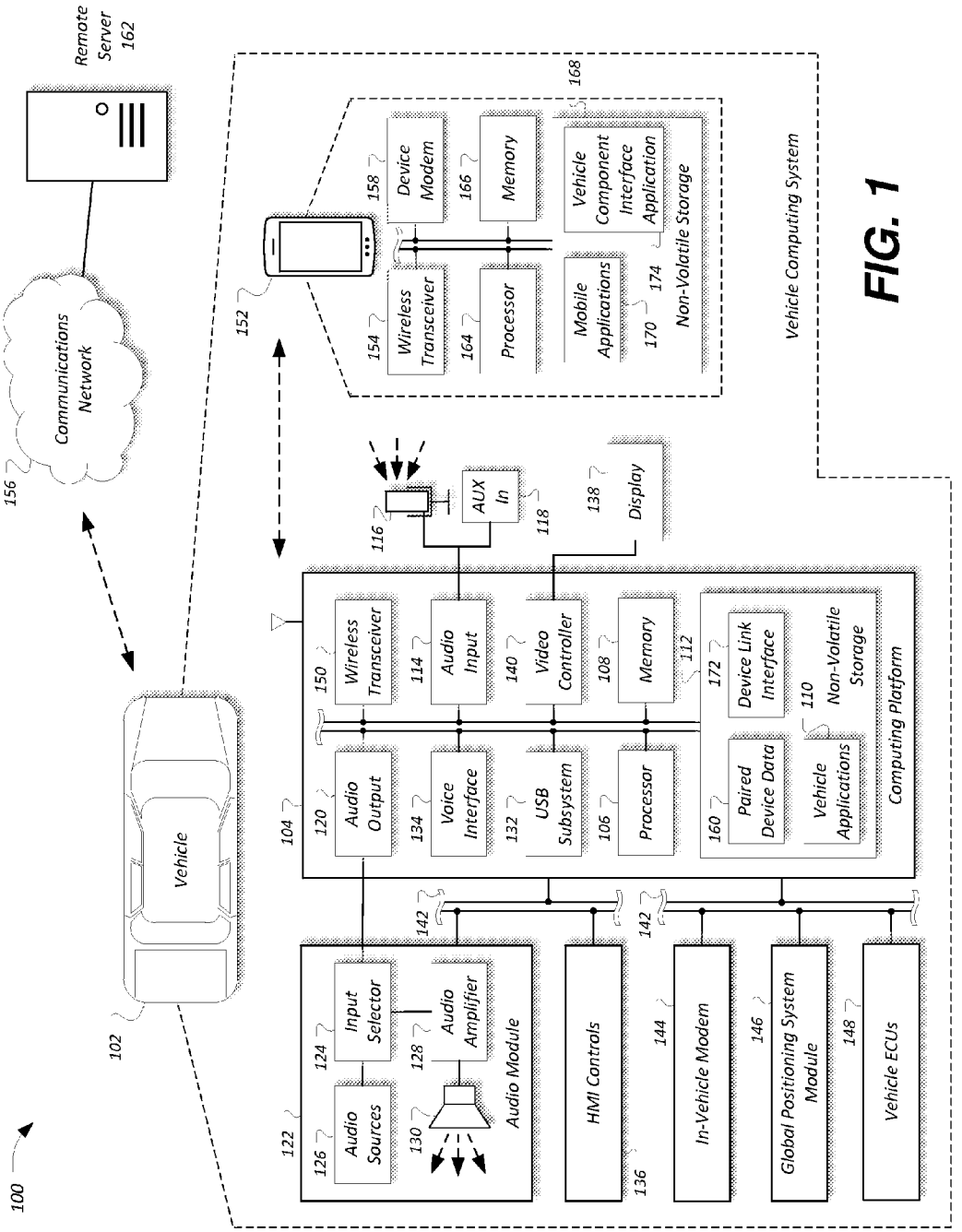

100
Remote Server 162
Communications Network
156
Vehicle
102
152
Vehicle Computing System
168
Device Modem
158
Memory
166
Vehicle Component Interface Application
Wireless Transceiver
154
Processor
164
Mobile Applications
170
174
Non-Volatile Storage
116
AUX In
118
138
Display
104
Wireless Transceiver
150
Audio Input
114
Video Controller
140
Memory
108
112
Device Link Interface
172
Non-Volatile Storage
110
Audio Output
120
Voice Interface
134
USB Subsystem
132
Processor
106
Paired Device Data
160
Vehicle Applications
Computing Platform
142
142
Input Selector
124
Audio Amplifier
128
Audio Sources
126
130
Audio Module
122
HMI Controls
136
In-Vehicle Modem
144
Global Positioning System Module
146
Vehicle ECUs
148

FIG. 1

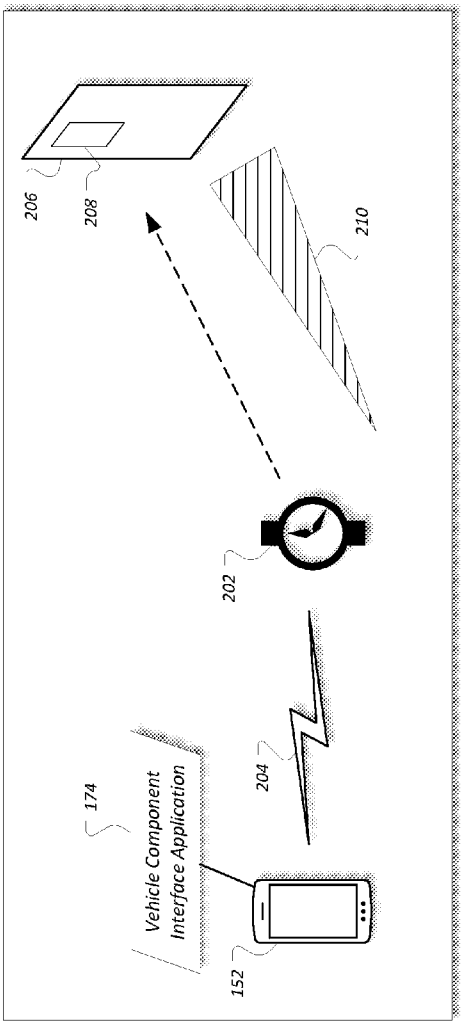

200-A
206
208
210
202
204
174
Vehicle Component Interface Application
152

FIG. 2A

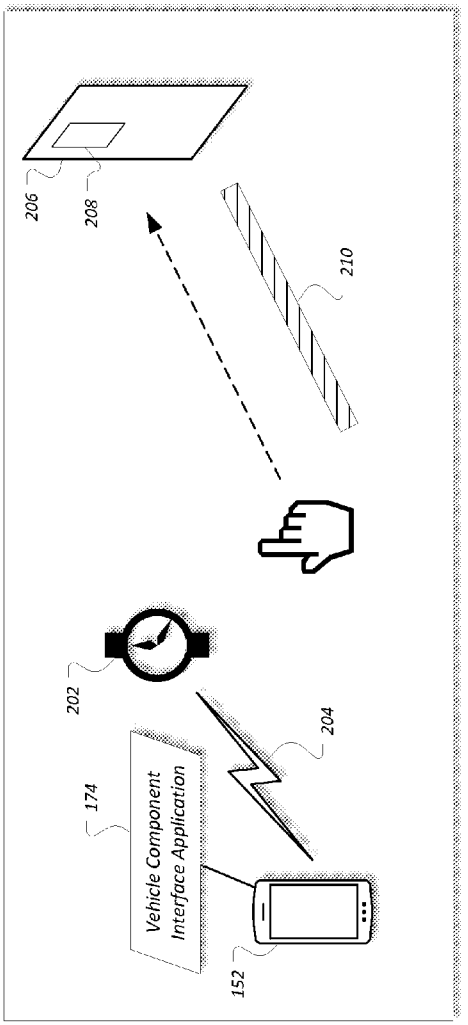

200-B
206
208
210
202
204
174
Vehicle Component Interface Application
152

FIG. 2B

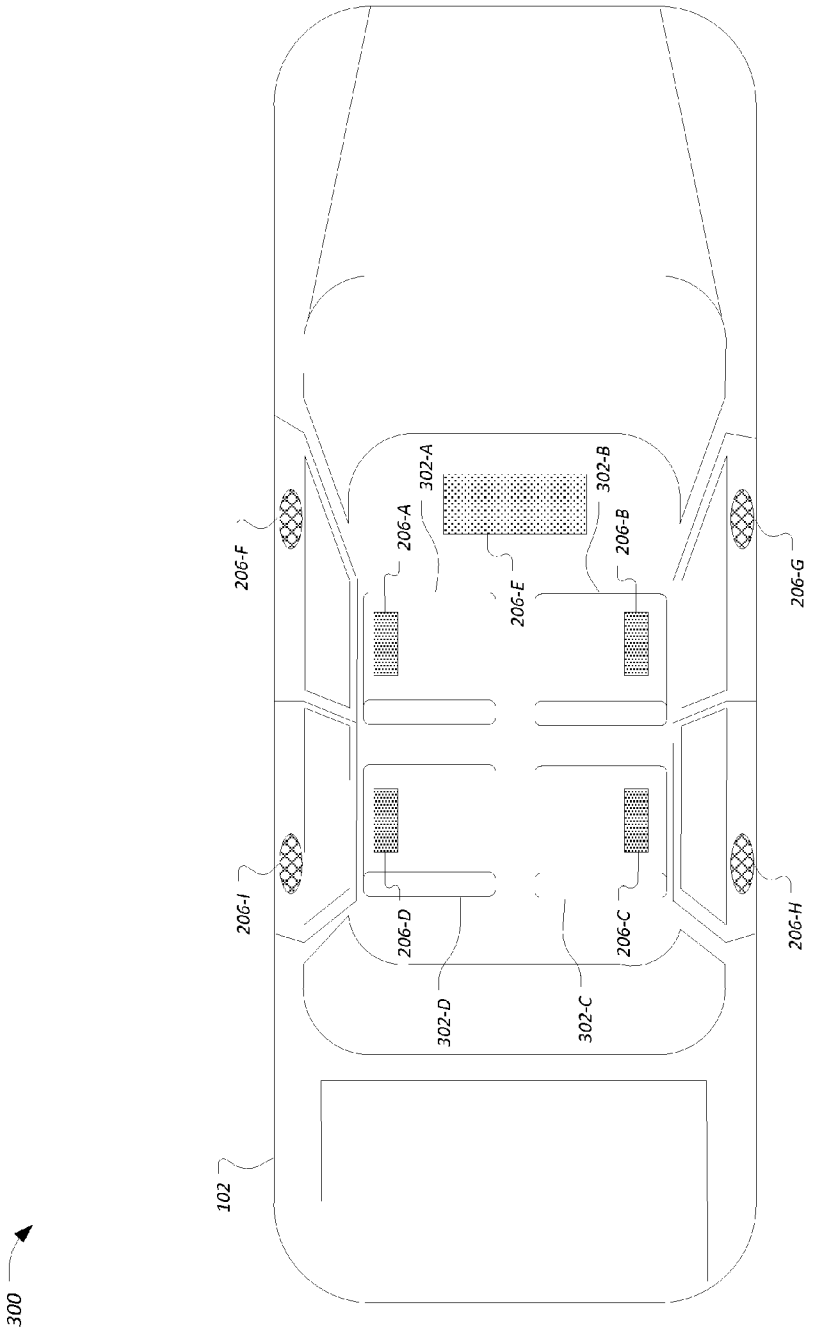

300
102
206-A
302-A
302-B
206-B
206-E
206-F
206-G
206-I
206-D
206-C
206-H
302-D
302-C

FIG. 3

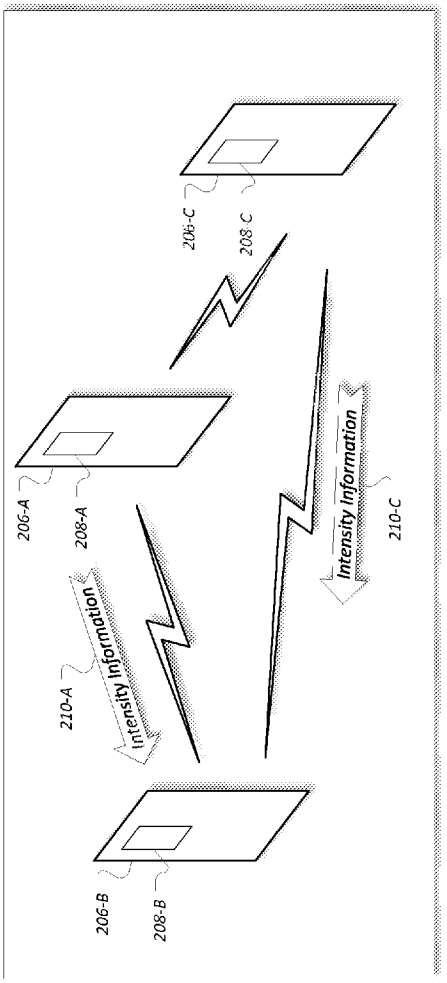

400-A
206-A
208-A
206-B
208-B
206-C
208-C
210-A
Intensity Information
210-C
Intensity Information

FIG. 4A

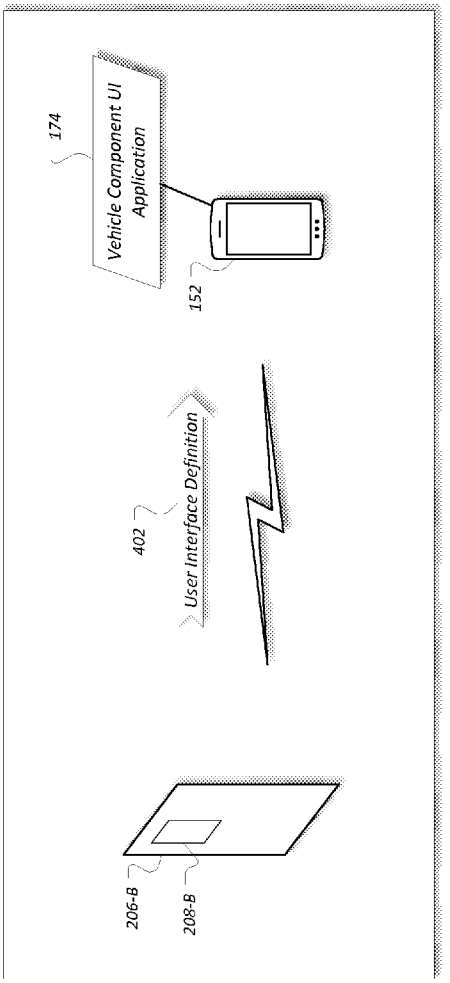

400-B
174
Vehicle Component UI Application
152
402
User Interface Definition
206-B
208-B

FIG. 4B

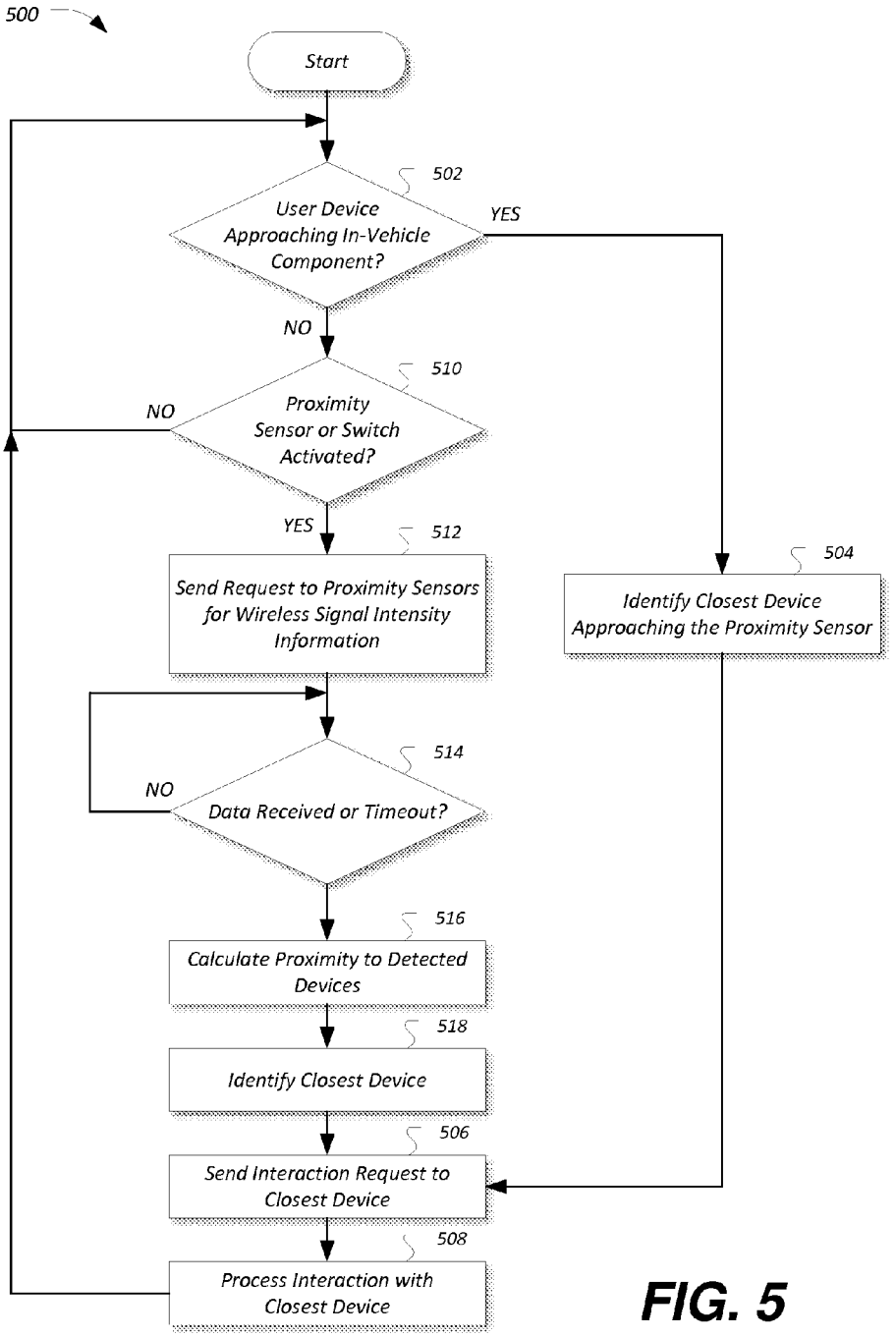

500
Start
502
User Device Approaching In-Vehicle Component?
YES
NO
510
Proximity Sensor or Switch Activated?
NO
YES
512
Send Request to Proximity Sensors for Wireless Signal Intensity Information
504
Identify Closest Device Approaching the Proximity Sensor
514
Data Received or Timeout?
NO
516
Calculate Proximity to Detected Devices
518
Identify Closest Device
506
Send Interaction Request to Closest Device
508
Process Interaction with Closest Device

FIG. 5

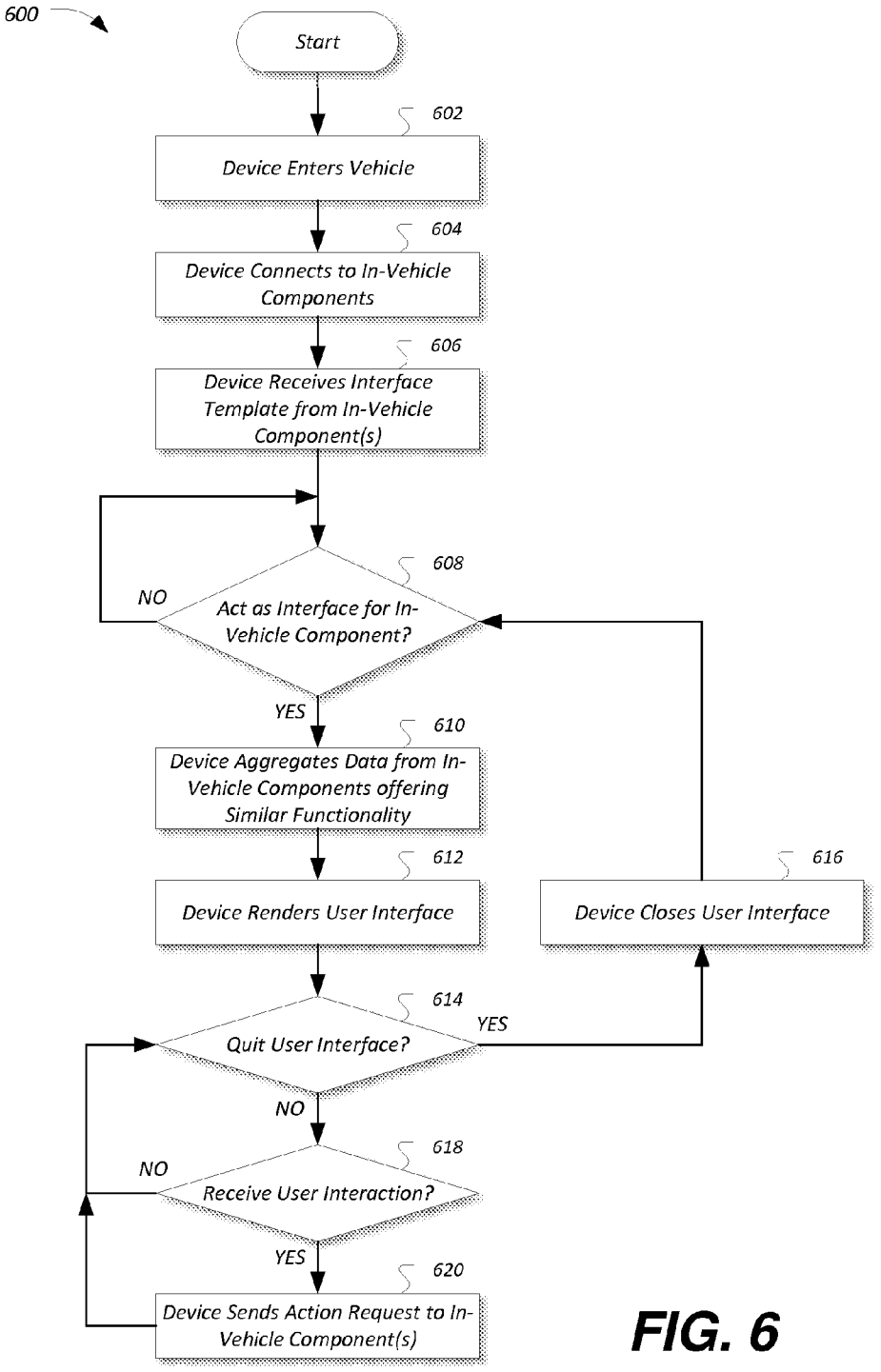

600
Start
602
Device Enters Vehicle
604
Device Connects to In-Vehicle Components
606
Device Receives Interface Template from In-Vehicle Component(s)
608
Act as Interface for In-Vehicle Component?
NO
YES
610
Device Aggregates Data from In-Vehicle Components offering Similar Functionality
612
Device Renders User Interface
614
Quit User Interface?
YES
NO
616
Device Closes User Interface
618
Receive User Interaction?
NO
YES
620
Device Sends Action Request to In-Vehicle Component(s)

FIG. 6

IN-VEHICLE COMPONENT USER INTERFACE

TECHNICAL FIELD

[0001] Aspects of the disclosure generally relate to deployment of a user interface for interior vehicle component configuration by way of a personal user device.

BACKGROUND

[0002] Smartphone and wearable device sales volumes continue to increase. Thus, more such devices are brought by users into the automotive context. Smartphones can already be used in some vehicle models to access a wide range of vehicle information, to start the vehicle, and to open windows and doors. Additionally, some wearable devices are capable of providing real-time navigation information to the driver.

SUMMARY

[0003] In a first illustrative embodiment, a system includes an in-vehicle component, including a first control set to configure the component, configured to identify a device associated with a user approach to the component; and send an interaction request to the device to cause the device to display a user interface for the component including a second control set to configure the component, the second control set including at least one function unavailable in the first control set.

[0004] In a second illustrative embodiment, a personal device is configured to receive, from an in-vehicle component including a first control set to configure the component, a user interface definition descriptive of a second control set to configure the component; and receive, from the component, a request to display a user interface for the component including the second control set to configure the component, the second control set including at least one function unavailable in the first control set

[0005] In a third illustrative embodiment, a computer-implemented method includes receiving, by a personal device from an in-vehicle component including a first control set to configure the component, a user interface definition descriptive of a second control set to configure the component; and receiving, from the component, a request to display a user interface for the component including the second control set to configure the component, the second control set including at least one function unavailable in the first control set.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** illustrates an example diagram of a system that may be used to provide telematics services to a vehicle;

[0007] FIG. **2**A illustrates a diagram of a request by a user to configure an in-vehicle component via the user's mobile device;

[0008] FIG. **2**B illustrates an alternate diagram of a request by a user to configure an in-vehicle component via the user's mobile device;

[0009] FIG. **3** illustrates an example vehicle including a plurality of in-vehicle components and a plurality of vehicle seats from which the in-vehicle components are accessible;

[0010] FIG. **4**A illustrates an example in-vehicle component receiving wireless signal intensity data from other in-vehicle components;

[0011] FIG. **4**B illustrates an example in-vehicle component the in-vehicle component providing the identified mobile device with a user interface definition;

[0012] FIG. **5** illustrates an example process for identifying a mobile device associated with a user in the vehicle requesting an action; and

[0013] FIG. **6** illustrates an example process for displaying a user interface on the identified mobile device.

DETAILED DESCRIPTION

[0014] As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention that may be embodied in various and alternative forms. The figures are not necessarily to scale; some features may be exaggerated or minimized to show details of particular components. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a representative basis for teaching one skilled in the art to variously employ the present invention.

[0015] A system may be configured to allow vehicle occupants to seamlessly interact with their vehicle or with any other framework-enabled vehicle. The system may include a vehicle configured to detect a user approach to a proximity sensor of an in-vehicle component to be configured, and further to identify a personal device of the approaching user on which to display a user interface for the in-vehicle component. As used herein, a personal device may generally refer to a mobile device such as a smartphone, or a wearable device such as a smart watch or smart glasses. The personal device of the user may be configured to communicate with the vehicle to receive the user interface to display, provide the user interface to the user, and forward any commands entered via the user interface to the vehicle for configuration of the in-vehicle component. It should be noted that the user interaction with the in-vehicle component may be performed despite the personal device not having been paired with or being in communication with the vehicle head unit. Thus, the system may be configured to determine which occupant of the vehicle desires to interact with a specific function, i.e., which device should interact with the in-vehicle component to be configured, and further to communicate, to the identified device, which user interface information is to be displayed.

[0016] In an example, a user may reach for a light switch within the vehicle cabin, e.g., located on the vehicle headliner near a lamp or on a seat armrest. When the light switch is touched by the user, it may provide some basic functionality to allow for the configuration of the light, such as turning the light off or on. Moreover, as the user approaches the light switch, his or her mobile device may be configured to automatically display a more in-depth interface for the light switch. The in-depth user interface may accordingly enable the user to setup additional lighting features, such as tone, mood, intensity, etc., which may be unavailable via the direct physical user interface of the light.

[0017] In another example, a user may request a taxi, a shared car, or another type of public transportation vehicle. As the user enters the vehicle, the user may desire to perform customization to the local experience within the vehicle by adjusting lighting, climate, and sound attributes for the user's seat location. The user may also desire to be made aware of the specific features of the user's seat, such as whether the seat has cooling or massage features or some other feature available. If such features are available, the user may wish to be able to craft a customized experience without having to learn a vehicle-specific or application-specific user interface. Accordingly, when the user approaches one of the controls of

the vehicle to configure, the vehicle may be configured to provide a user interface definition to the user's personal device including the specifics of the particular vehicle control.

[0018] In yet another example, the user may perform the same customization on a first vehicle, and may desire that the user's vehicle settings would automatically be applied to a second vehicle supporting the customizations in which the user may travel. For example, the user's personal device may maintain lighting, climate, infotainment, and seat position settings from the first vehicle, and may attempt to set user defaults accordingly based on the available features of the second vehicle. Further aspects of the system are discussed in detail below.

[0019] FIG. **1** illustrates an example diagram of a system **100** that may be used to provide telematics services to a vehicle **102**. The vehicle **102** may be one of various types of passenger vehicles, such as a crossover utility vehicle (CUV), a sport utility vehicle (SUV), a truck, a recreational vehicle (RV), a boat, a plane or other mobile machine for transporting people or goods. Telematics services may include, as some non-limiting possibilities, navigation, turn-by-turn directions, vehicle health reports, local business search, accident reporting, and hands-free calling. In an example, the system **100** may include the SYNC system manufactured by The Ford Motor Company of Dearborn, Mich. It should be noted that the illustrated system **100** is merely an example, and more, fewer, and/or differently located elements may be used.

[0020] The computing platform **104** may include one or more processors **106** configured to perform instructions, commands and other routines in support of the processes described herein. For instance, the computing platform **104** may be configured to execute instructions of vehicle applications **110** to provide features such as navigation, accident reporting, satellite radio decoding, and hands-free calling. Such instructions and other data may be maintained in a non-volatile manner using a variety of types of computer-readable storage medium **112**. The computer-readable medium **112** (also referred to as a processor-readable medium or storage) includes any non-transitory medium (e.g., a tangible medium) that participates in providing instructions or other data that may be read by the processor **106** of the computing platform **104**. Computer-executable instructions may be compiled or interpreted from computer programs created using a variety of programming languages and/or technologies, including, without limitation, and either alone or in combination, Java, C, C++, C#, Objective C, Fortran, Pascal, Java Script, Python, Perl, and PL/SQL.

[0021] The computing platform **104** may be provided with various features allowing the vehicle occupants to interface with the computing platform **104**. For example, the computing platform **104** may include an audio input **114** configured to receive spoken commands from vehicle occupants through a connected microphone **116**, and auxiliary audio input **118** configured to receive audio signals from connected devices. The auxiliary audio input **118** may be a physical connection, such as an electrical wire or a fiber optic cable, or a wireless input, such as a BLUETOOTH audio connection. In some examples, the audio input **114** may be configured to provide audio processing capabilities, such as pre-amplification of low-level signals, and conversion of analog inputs into digital data for processing by the processor **106**.

[0022] The computing platform **104** may also provide one or more audio outputs **120** to an input of an audio module **122** having audio playback functionality. In other examples, the computing platform **104** may provide the audio output to an occupant through use of one or more dedicated speakers (not illustrated). The audio module **122** may include an input selector **124** configured to provide audio content from a selected audio source **126** to an audio amplifier **128** for playback through vehicle speakers **130** or headphones (not illustrated). The audio sources **126** may include, as some examples, decoded amplitude modulated (AM) or frequency modulated (FM) radio signals, and audio signals from compact disc (CD) or digital versatile disk (DVD) audio playback. The audio sources **126** may also include audio received from the computing platform **104**, such as audio content generated by the computing platform **104**, audio content decoded from flash memory drives connected to a universal serial bus (USB) subsystem **132** of the computing platform **104**, and audio content passed through the computing platform **104** from the auxiliary audio input **118**.

[0023] The computing platform **104** may utilize a voice interface **134** to provide a hands-free interface to the computing platform **104**. The voice interface **134** may support speech recognition from audio received via the microphone **116** according to grammar associated with available commands, and voice prompt generation for output via the audio module **122**. In some cases, the system may be configured to temporarily mute or otherwise override the audio source specified by the input selector **124** when an audio prompt is ready for presentation by the computing platform **104** and another audio source **126** is selected for playback.

[0024] The computing platform **104** may also receive input from human-machine interface (HMI) controls **136** configured to provide for occupant interaction with the vehicle **102**. For instance, the computing platform **104** may interface with one or more buttons or other HMI controls configured to invoke functions on the computing platform **104** (e.g., steering wheel audio buttons, a push-to-talk button, instrument panel controls, etc.). The computing platform **104** may also drive or otherwise communicate with one or more displays **138** configured to provide visual output to vehicle occupants by way of a video controller **140**. In some cases, the display **138** may be a touch screen further configured to receive user touch input via the video controller **140**, while in other cases the display **138** may be a display only, without touch input capabilities.

[0025] The computing platform **104** may be further configured to communicate with other components of the vehicle **102** via one or more in-vehicle networks **142**. The in-vehicle networks **142** may include one or more of a vehicle controller area network (CAN), an Ethernet network, and a media oriented system transfer (MOST), as some examples. The in-vehicle networks **142** may allow the computing platform **104** to communicate with other vehicle **102** systems, such as a vehicle modem **144** (which may not be present in some configurations), a global positioning system (GPS) module **146** configured to provide current vehicle **102** location and heading information, and various vehicle ECUs **148** configured to cooperate with the computing platform **104**. As some non-limiting possibilities, the vehicle ECUs **148** may include a powertrain control module configured to provide control of engine operating components (e.g., idle control components, fuel delivery components, emissions control components, etc.) and monitoring of engine operating components (e.g., status of engine diagnostic codes); a body control module configured to manage various power control functions such as

exterior lighting, interior lighting, keyless entry, remote start, and point of access status verification (e.g., closure status of the hood, doors and/or trunk of the vehicle **102**); a radio transceiver module configured to communicate with key fobs or other local vehicle **102** devices; and a climate control management module configured to provide control and monitoring of heating and cooling system components (e.g., compressor clutch and blower fan control, temperature sensor information, etc.).

[0026] As shown, the audio module **122** and the HMI controls **136** may communicate with the computing platform **104** over a first in-vehicle network **142**-A, and the vehicle modem **144**, GPS module **146**, and vehicle ECUs **148** may communicate with the computing platform **104** over a second in-vehicle network **142**-B. In other examples, the computing platform **104** may be connected to more or fewer in-vehicle networks **142**. Additionally or alternately, one or more HMI controls **136** or other components may be connected to the computing platform **104** via different in-vehicle networks **142** than shown, or directly without connection to an in-vehicle network **142**.

[0027] The computing platform **104** may also be configured to communicate with mobile devices **152** of the vehicle occupants. The mobile devices **152** may be any of various types of portable computing device, such as cellular phones, tablet computers, smart watches, laptop computers, portable music players, or other devices capable of communication with the computing platform **104**. In many examples, the computing platform **104** may include a wireless transceiver **150** (e.g., a BLUETOOTH module, a ZIGBEE transceiver, a Wi-Fi transceiver, an IrDA transceiver, an RFID transceiver, etc.) configured to communicate with a compatible wireless transceiver **154** of the mobile device **152**. Additionally or alternately, the computing platform **104** may communicate with the mobile device **152** over a wired connection, such as via a USB connection between the mobile device **152** and the USB subsystem **132**.

[0028] The communications network **156** may provide communications services, such as packet-switched network services (e.g., Internet access, VoIP communication services), to devices connected to the communications network **156**. An example of a communications network **156** may include a cellular telephone network. Mobile devices **152** may provide network connectivity to the communications network **156** via a device modem **158** of the mobile device **152**. To facilitate the communications over the communications network **156**, mobile devices **152** may be associated with unique device identifiers (e.g., mobile device numbers (MDNs), Internet protocol (IP) addresses, etc.) to identify the communications of the mobile devices **152** over the communications network **156**. In some cases, occupants of the vehicle **102** or devices having permission to connect to the computing platform **104** may be identified by the computing platform **104** according to paired device data **160** maintained in the storage medium **112**. The paired device data **160** may indicate, for example, the unique device identifiers of mobile devices **152** previously paired with the computing platform **104** of the vehicle **102**, such that the computing platform **104** may automatically reconnected to the mobile devices **152** referenced in the paired device data **160** without user intervention.

[0029] When a mobile device **152** that supports network connectivity is paired with the computing platform **104**, the mobile device **152** may allow the computing platform **104** to use the network connectivity of the device modem **158** to communicate over the communications network **156** with the remote telematics services **162**. In one example, the computing platform **104** may utilize a data-over-voice plan or data plan of the mobile device **152** to communicate information between the computing platform **104** and the communications network **156**. Additionally or alternately, the computing platform **104** may utilize the vehicle modem **144** to communicate information between the computing platform **104** and the communications network **156**, without use of the communications facilities of the mobile device **152**.

[0030] Similar to the computing platform **104**, the mobile device **152** may include one or more processors **164** configured to execute instructions of mobile applications **170** loaded to a memory **166** of the mobile device **152** from storage medium **168** of the mobile device **152**. In some examples, the mobile applications **170** may be configured to communicate with the computing platform **104** via the wireless transceiver **154** and with the remote telematics services **162** or other network services via the device modem **158**. The computing platform **104** may also include a device link interface **172** to facilitate the integration of functionality of the mobile applications **170** into the grammar of commands available via the voice interface **134** as well as into display **138** of the computing platform **104**. The device link interfaced **172** may also provide the mobile applications **170** with access to vehicle information available to the computing platform **104** via the in-vehicle networks **142**. Some examples of device link interfaces **172** include the SYNC APPLINK component of the SYNC system provided by The Ford Motor Company of Dearborn, Mich., the CarPlay protocol provided by Apple Inc. of Cupertino, Calif., or the Android Auto protocol provided by Google, Inc. of Mountain View, Calif. The vehicle component interface application **174** may be once such application installed to the mobile device **152**.

[0031] The vehicle component interface application **174** of the mobile device **152** may be configured to facilitate access to one or more vehicle **102** features made available for device configuration by the vehicle **102**. In some cases, the available vehicle **102** features may be accessible by a single vehicle component interface application **174**, in which case such the vehicle component interface application **174** may be configured to be customizable or to maintain configurations supportive of the specific vehicle **102** brand/model and option packages. In an example, the vehicle component interface application **174** may be configured to receive, from the vehicle **102**, a definition of the features that are available to be controlled, display a user interface descriptive of the available features, and provide user input from the user interface to the vehicle **102** to allow the user to control the indicated features. As exampled in detail below, an appropriate mobile device **152** to display the vehicle component interface application **174** may be identified, and a definition of the user interface to display may be provided to the identified vehicle component interface application **174** for display to the user.

[0032] Systems such as the system **100** described above may require mobile device **152** pairing with the computing platform **104** and/or other setup operations. However, as explained in detail below, a system may be configured to allow vehicle occupants to seamlessly interact with user interface elements in their vehicle or with any other framework-enabled vehicle, without requiring the mobile device **152** or wearable device **202** to have been paired with or be in communication with the computing platform **104**.

[0033] FIG. **2**A illustrate a diagram **200**-A of a request by a user to configure an in-vehicle component **206** via the user's mobile device **152**. As shown in FIG. **2**A, a wearable device **202** associated with the user's mobile device **152** being moved toward an in-vehicle component **206** having a proximity sensor **208**.

[0034] The wearable device **202** may include a smartwatch, smart glasses, fitness band, control ring, or other personal mobility or accessory device designed to be worn and to communicate with the user's mobile device **152**. In an example, the wearable device **202** may communicate data with the mobile device **152** over a wireless connection **204**. The wireless connection **204** may be a Bluetooth Low Energy (BLE) connection, but other types of local wireless connection, such as Wi-Fi or Zigbee may be utilized as well. Using the connection **204**, the mobile device **152** may provide access to one or more control or display functions of the mobile device **152** to the wearable device **202**. For example, the mobile device **152** may enable the wearable device **202** to accept a phone call to the mobile device **152**, enable a mobile application of the mobile device **152** to execute, receive and present notifications sent to the mobile device **152**, and/or a combination thereof.

[0035] The in-vehicle component **206** may include various elements of the vehicle **102** having user-specific configurable settings. As shown in FIG. **3**, an example vehicle **102** includes a plurality of in-vehicle components **206**-A through **206**-I (collectively **206**) and a plurality of vehicle seats **302**-A through **302**-D (collectively **302**) from which the in-vehicle components **206** are accessible. These in-vehicle components **206** may include, as some examples, overhead light in-vehicle components **206**-A through **206**-D, overhead compartment in-vehicle component **206**-E, and speaker in-vehicle components **206**-F through **206**-I. Other examples of in-vehicle components **206** are possible as well, such as power seats or climate control vents. In many cases, the in-vehicle component **206** may expose controls such as buttons, sliders, and touchscreens that may be used by the user to configure the particular settings of the in-vehicle component **206**. As some possibilities, the controls of the in-vehicle component **206** may allow the user to set a lighting level of a light control, set a temperature of a climate control, set a volume and source of audio for a speaker, and set a position of a seat control. It should be noted that the illustrated portion of the vehicle **102** in FIG. **3** is merely an example, and more, fewer, and/or differently located elements may be used.

[0036] Referring back to FIG. **2**A, each in-vehicle component **206** may be equipped with a proximity detection sensor **208** configured to facilitate detection of the wearable device **202**. In an example, the proximity detection sensor **208** may include a wireless device, such as an Apple iBeacon device or a Google altBeacon device configured to enable low energy Bluetooth signal intensity as a locator, to determine the proximity of the wearable device **202** or mobile device **152**. Detection of proximity of the wearable device **202** or mobile device **152** by the proximity detection sensor **208** may cause the vehicle component interface application **174** of the mobile device **152** to be activated. In an example, a wearer of the wearable device **202** may reach his or her hand toward the in-vehicle component **206**. As the wireless signal intensity **210** of the approaching wearable device **202** to the proximity detection sensor **208** crosses a minimum threshold intensity, the intensity shift of the wireless connection **204** strength may be detected by the proximity detection sensor **208**, and a handshake may be established between the proximity detection sensor **208** and the approaching wearable device **202**. This connection functionality of the mobile device **152** may accordingly be utilized as a trigger to invoke the vehicle component interface application **174** on the mobile device **152**.

[0037] As another possibility, the proximity detection sensor **208** may include a near field communication (NFC) tag that may be detected by the wearable device **202** or mobile device **152**. Accordingly, as the wearable device **202** or mobile device **152** is moved into proximity to the in-vehicle component **206**, the vehicle component interface application **174** on the mobile device **152** may be activated. However, the use of NFC tags may require a controlled, slow motion of the approaching device to close proximity to the proximity detection sensor **208**. As a further possibility, the proximity detection sensor **208** may include a static image such as a quick response (QR) code or other information-encoded image that may be captured via a camera of the wearable device **202** or mobile device **152**. In such a case, the vehicle component interface application **174** on the mobile device **152** may be activated responsive to the user pointing a camera of the wearable device **202** or mobile device **152** at the QR code or other image. The use of QR codes or other image representations may require the approaching device to keep its camera on, and further requires the user to orient the approaching device to acquire the image.

[0038] In general, each in-vehicle component **206** may include a set of controls configured to receive input from the user with respect to basic or core functions of the in-vehicle component **206** (e.g., turn light on/off, turn speaker on/off, etc.), and a proximity detection sensor **208** configured to identify proximity of wearable device **202** or mobile device **152**. It should be noted that the user interaction with the in-vehicle component **206** may be performed despite the mobile device **152** or wearable device **202** not having been paired with or being in communication with the computing platform **104**.

[0039] FIG. **2**B illustrates an alternate diagram **200**-B of a request by a user to configure an in-vehicle component **206** via the user's mobile device **152**. As compared to the diagram **200**-A, in the diagram **200**-B the user is approaching and may touch the proximity detection sensor **208** of the in-vehicle component **206** with a "naked" hand, i.e., a hand that is not wearing a wearable device **202** or holding a mobile device **152**. Thus, as no increase in wireless signal intensity **210** is available to be detected, the vehicle **102** may be unable to detect which device to utilize based on the wireless signal intensity **210**. In such a situation, instructing all mobile devices **152** in the vehicle **102** to launch the vehicle component interface application **174** or sending to all of them a notification that the interface is available would be an inelegant solution.

[0040] Instead, triangulation may be used to detect which mobile device **152** is that of the passenger requesting interaction with the in-vehicle component **206**. Referring again to FIG. **3**, if a user located in seat **302**-B reaches for the overhead light in-vehicle component **206**-B, by triangulation the vehicle **102** may determine that a mobile device **152** located in seat **302**-B is the device of the user in proximity to the in-vehicle component **206**-B. As shown in FIG. **3**, each of the in-vehicle controls **206**-A through **206**-D is located closest to one of the seats **302**-A through **302**-D, respectively. Addition-

ally, similar to as shown in FIGS. **2**A and **2**B, each of the in-vehicle controls **206**-A through **206**-D includes a respective proximity sensor **208**.

[0041] In the example in which a proximity sensor **208** of the in-vehicle component **206** detects an approach or touch of the user's hand to the in-vehicle component **206**, a preliminary action may be performed by the in-vehicle component **206**, such as toggling the on-off state of a light of the in-vehicle component **206**. Additionally or alternately, as shown in FIG. **4**A, the in-vehicle component **206**-B may broadcast or otherwise send a request for intensity information **210** to the other in-vehicle components **206** of the vehicle **102** (e.g., **206**-A and **206**-C as illustrated). This request may cause the other in-vehicle components **206** to return wireless signal intensity **210** data identified by their respective proximity sensors **208** for whatever devices they detect (e.g., intensity data **210**-A identified by the proximity sensor **308**-A, intensity data **210**-C identified by the proximity sensor **208**-C).

[0042] Continuing with the example of the user in seat **302**-B approaching the in-vehicle component **206**-B, the in-vehicle component **206**-B may user the wireless signal intensity **210**-B from its own proximity sensor **308**-B as well as data from the other proximity sensors **208** (e.g., proximity sensors **208**-A and **208**-C) to determine a mobile device **152** of the approaching user. Thus, the proximity detection sensors **208** may be configured to share device wireless signal intensity **210** data with one other to allow for triangulation and identification of which of the wearable devices **202** or mobile devices **152** are closest to a given in-vehicle component **206**.

[0043] For instance, a mobile device **152** may be detected as being the only mobile device **102** that has a highest measured wireless signal intensity **210** at the in-vehicle component **206**-B as compared to that measured at the in-vehicle component **206**-A and the in-vehicle component **206**-C. That device may therefore be determined to be the mobile device **152** most likely located in seat **302**-B. Notably, such an approach facilitates device identification despite the various devices potentially having different baseline signal intensities, since the triangulation relies on differences in relative wireless signal intensity **210** levels for each device as measured by the various proximity sensors **208** of the in-vehicle components **206**, not on a determination of which device has a highest overall intensity level at one particular proximity sensor **208**.

[0044] In some examples, the proximity detection sensors **208** may additionally be utilized to enable in-cabin gesture interfaces for users wearing capable wearable devices **202** (e.g., BLE devices in the case of BLE proximity detection sensors **208**), such as one of the new smart-watches, fitness bands or control rings. Based on the aforementioned triangulation techniques, the network of proximity detection sensors **208** may be able to perform in-cabin location tracking of the wearable devices **202**, in order to detect a gesture action performed by a user in the air, such as to open a window with a simple swipe of the hand, or to control the volume with an up-down hand motion.

[0045] The in-cabin tracking may also be extended to passengers not wearing wearable devices **202**. In an example, electrical field distortions may be measurable with sufficiently sensitive proximity detection sensors **208** based on the field generated by the wireless components inside the vehicle **102**. If different communication technologies are used, such as 60 GHz modulation, in addition to increasing the bandwidth of data communicable between devices, in some cases the vehicle **102** may be able to detect in-cabin tracking to detect gestures and other motions at a high resolution.

[0046] The integration of proximity detection sensors **208** with the configurable in-vehicle components **206**, as well as the triangulation method or wireless signal intensity **210** threshold techniques, may accordingly allow the vehicle **102** to determine which mobile device **152** belongs to the user engaging the configurable in-vehicle component **206**.

[0047] As shown in FIG. **4**B, once the mobile device **152** of the requesting user is identified, the vehicle **102** may be configured to provide the identified mobile device **152** with a user interface definition **402** regarding what functionality is available to perform on the in-vehicle component **206**. In an example, to keep the in-vehicle component **206** functionality self-contained, the in-vehicle component **206** may be configured to communicate the user interface definition **402** to the mobile devices **152** or wearable devices **202** identified to display the user interface.

[0048] To provide the interface specified by the user interface definition **402** on the located mobile device **152**, in an example, the in-vehicle component **206** may be configured to request the mobile device **152** to launch a vehicle component interface application **174** previously installed to the mobile device **152**. If the vehicle component interface application **174** is not already installed on the personal device, the in-vehicle component **206** may be configured to offer to sideload to it or to offer a link from which the in-vehicle component **206** may be installed to the personal device (e.g., from the Google Application Store or the Apple AppStore, as some possibilities).

[0049] The interface definition **402** may be encoded in a data interchange format, such as hypertext markup language (HTML), extensible markup language (XML) or JavaScript Object Notation (JSON). As one specific example, the user interface definition **402** may be encoded in a markup similar to that of the view and viewgroup user interface definitions utilized by the Google Android operating system. One advantage of using a data exchange commonly used on the web is that user devices (e.g., mobile devices **152**, wearable devices **202**, etc.) may be able to render the user interface definition **402** to display the user interface using existing or downloadable functionality of the device (e.g., a web browser plugin).

[0050] As one possibility, responsive to a user entering the vehicle **102**, a personal device of the user may be configured to utilize the vehicle component interface application **174** to connect to the vehicle **102** to receive the user interface definition **402**. In an example, the personal device may connect to the in-vehicle components **206** to receive the user interface definition **402** via available wireless protocols (e.g., BLE, etc.) provided by the proximity sensors **208**. The received user interface definition **402** may be descriptive of the functions available in each in-vehicle component **206**, variables that may be controlled, and current state of the variables. Thus, as the vehicle component interface application **174** may retrieve the user interface definition **402** descriptive of the user interface to present from the vehicle **102**, a universal vehicle component interface application **174** may be utilized across various brands/makes/models of vehicle **102**.

[0051] In an example, an user interface definition **402** template for an in-vehicle light fixture having a single lamp may be described as an XML element with two attributes as follows:

```
<Lighting
        intensity_max="100"
        color_tone_max="360"/>
```

[0052] For a more complex interface, a more complex user interface definition **402** template would accordingly be utilized, such as that used to control seat functions (e.g., forward, back, tilt, recline, lumbar, etc.). In such an example, the user interface definition **402** template may be defined to include attributes descriptive of the available functions, their names for presentation in the user interface, their allowed range of values (e.g., min, max, step size, default, etc.), and potentially layout information descriptive of grouping, ordering, or suggested controls (e.g., toggle control, slider control, knob control, etc.) of how to render the interface controls to change these attributes.

[0053] As the mobile device **152** or wearable device **202** is requested by the in-vehicle component **206** to act as a user interface for the in-vehicle component **206**, the mobile device **152** or wearable device **202** accordingly receives functionalities are available from the module, but also what other modules offering similar functionalities are available in the vehicle as well as their locations (e.g., from triangulation as discussed above). The vehicle component interface application **174** may be configured to aggregate the data and offer to the user combinations for controlling interior lighting or other vehicle functions by controlling the in-vehicle component **206** sharing that attribute. As a specific example, the user may utilize their mobile device **152** to invoke interior lights of all interior lights, but at a low intensity level. It should be noted that in other examples, aggregation of the user interface definition **402** may be performed by the in-vehicle components **206**, such that the aggregated user interface definition **402** may be communicated to the personal device by the specific in-vehicle component **206** requesting for the user's device to display a user interface.

[0054] FIG. **5** illustrates an example process **500** for identifying a mobile device **152** associated with a user in the vehicle **102** requesting an action. The process **500** may be performed, for example, by one or more in-vehicle components **206** of the vehicle **102**.

[0055] At operation **502**, the in-vehicle component **206** determines whether a personal device of a user (e.g., a mobile device **152**, a wearable device **202**, etc.) is approaching the in-vehicle component **206**. In an example, the in-vehicle component **206** may be equipped with a proximity detection sensor **208** configured to facilitate detection of a wearable device **202**, such that as the wireless signal intensity **210** of the approaching wearable device **202** to the proximity detection sensor **208** crosses a minimum threshold intensity, the intensity shift of the wireless connection **204** strength may be detected by the proximity detection sensor **208**, and a handshake may be established between the proximity detection sensor **208** and the approaching wearable device **202**. If a personal device is detected as approaching the in-vehicle component **206**, control passes to operation **504**. Otherwise, control passes to operation **510**.

[0056] At operation **504**, the in-vehicle component **206** identifies the mobile device **152** of the user to use to display a user interface for the in-vehicle component **206**. In an example, the approaching wearable device **202** may be paired with or otherwise associated with a mobile device **152** configured to execute the vehicle component interface application **174**, and the wearable device **202** may be configured to provide to the in-vehicle component **206** (or the in-vehicle component **206** may request) the identity of the associated mobile device **152**. In another example, if the approaching device is a mobile device **152** or other device configured to execute the vehicle component interface application **174**, then the in-vehicle component **206** may identify the approaching mobile device **152** as the device to display the user interface.

[0057] At operation **506**, the in-vehicle component **206** sends an interaction request to the identified device. In an example the in-vehicle component **206** may be configured to request the identified device to launch a vehicle component interface application **174**, or to provide a link for the vehicle component interface application **174** to be downloaded if the vehicle component interface application **174** is not yet installed. Once invoked or installed, control passes to operation **508**.

[0058] At operation **508**, the in-vehicle component **206** processes the interaction request using the identified device. An example interaction is described below with respect to the process **600**. After operation **508**, control passes to operation **502**.

[0059] At operation **510**, the in-vehicle component **206** may determine whether the in-vehicle component **206** detects an approach but no personal device. In an example, electrical field distortions of the in-vehicle component **206** may be measured by the proximity detection sensor **208** of the in-vehicle component **206** based on the field generated by the wireless components inside the vehicle **102**. In another example, the in-vehicle component **206** may detect a user touch via a selection of a control of the built-in user interface of the in-vehicle component **206**. If an approach is detected control passes to operation **512**. Otherwise, control passes to operation **502**.

[0060] At operation **512**, the in-vehicle component **206** requests the other in-vehicle components **206** of the vehicle **102** to send wireless signal intensity **210** data identified by their respective proximity sensors **208** for whatever devices they detect. This may be done to allow the in-vehicle component **206** to perform triangulation to detect which mobile device **152** is that of the user requesting interaction with the in-vehicle component **206**.

[0061] At operation **514**, the in-vehicle component **206** determines whether the wireless signal intensity **210** data or whether a timeout occurred. For example, if at least a predetermined amount of time has passed since sending the request in operation **502**, control passes to operation **516**. Or, if the in-vehicle component **206** receives the requested wireless signal intensity **210**, control passes to operation **516**. Otherwise, control remains at operation **514**.

[0062] At operation **516**, the in-vehicle component **206** calculates proximity to the detected devices. In an example, the in-vehicle component **206** may use the received wireless signal intensities **210** from its proximity sensor **308** as well as data from the other proximity sensors **208**, to determine which devices have what wireless signal intensities **210** at the various in-vehicle component **206**.

[0063] At operation **518**, the in-vehicle component **206** identifies a closest device. In an example, in-vehicle component **206** may identify a mobile device **152** having a higher wireless signal intensity **210** by in-vehicle component **206** than by the other in-vehicle components **206**. This device may accordingly be identified as being the most likely the mobile

device **152** of the user approaching the in-vehicle component **206**. After operation **518**, control passes to operation **506**.

[0064] FIG. **6** illustrates an example process **600** for displaying a user interface on the identified mobile device **152**. The process **600** may be performed, for example, by a personal device (e.g., a mobile device **152**, a wearable device **202**, etc.) in communication with one or more in-vehicle components **206** of the vehicle **102**.

[0065] At operation **602**, the personal device enters the vehicle **102**. In an example, the personal device may be carried by a user entering the vehicle **102**.

[0066] At operation **604**, the personal device connects to the in-vehicle components **206**. In an example, responsive to a user entering the vehicle **102**, a personal device of the user may be configured to utilize the vehicle component interface application **174** to connect to the available wireless protocols (e.g., BLE, etc.).

[0067] At operation **606**, the personal device receives complex user interface definition **402** template information from the in-vehicle components **206**. In an example, the personal device may receive tagged user interface definition **402** information descriptive of the functions available in each in-vehicle component **206**, variables that may be controlled, and current state of the variables.

[0068] At operation **608**, the personal device determines whether to act as a user interface for the in-vehicle components **206**. In an example, such as the process **500** discussed above, the personal device may be requested by the in-vehicle component **206** to act as a user interface for the in-vehicle component **206**.

[0069] At operation **610**, the personal device aggregates data from the in-vehicle components **206** offering similar functionality. In an example, the user may utilize their mobile device **152** to invoke interior lights of all interior lights, but at a low intensity level. It should be noted that in other examples, aggregation of the user interface definition **402** may be performed by the in-vehicle components **206**, such that the aggregated user interface definition **402** may be communicated to the personal device by the specific in-vehicle component **206** requesting for the user's device to display a user interface.

[0070] At operation **612**, the personal device renders a user interface. The personal device may accordingly display a user interface defined according to the received and aggregated tagged user interface definition **402**.

[0071] At operation **614**, the personal device determines whether the user requests to quit the user interface. In an example, the personal device may receive user input requesting for the user interface to be dismissed. If such input is received, control passes to operation **616**. Otherwise, control passes to operation **618**.

[0072] At operation **616**, the personal device closes the user interface. After operation **616**, control passes to operation **608**.

[0073] At operation **618**, the personal device determines whether a user interaction with the user interface is received. In an example, the personal device may receive user input requesting for a change to be made to the settings for one or more of the in-vehicle components **206**.

[0074] At operation **620**, the personal device sends an action request to the in-vehicle component(s) **206**. In an example, the user may utilize the personal device to invoke interior lights of all interior lights, but at a low intensity level. After operation **620**, control passes to operation **614**.

[0075] While exemplary embodiments are described above, it is not intended that these embodiments describe all possible forms of the invention. Rather, the words used in the specification are words of description rather than limitation, and it is understood that various changes may be made without departing from the spirit and scope of the invention. Additionally, the features of various implementing embodiments may be combined to form further embodiments of the invention.

What is claimed is:

1. A system comprising:

an in-vehicle component, including a first control set to configure the component, configured to

identify a device associated with a user approach to the component; and

send an interaction request to the device to cause the device to display a user interface for the component including a second control set to configure the component, the second control set including at least one function unavailable in the first control set.

2. The system of claim **1**, wherein the second control set is a superset of the first control set.

3. The system of claim **1**, wherein the in-vehicle component includes a proximity sensor, and the device associated with the user approach to the component is detected according to an increasing wireless signal intensity of the device detected according to the proximity sensor.

4. The system of claim **1**, wherein the in-vehicle component includes a proximity sensor, and the device associated with the user approach to the component is detected according to an increasing wireless signal intensity of a wearable device paired to the device detected according to the proximity sensor.

5. The system of claim **1**, wherein the in-vehicle component includes a sensor configured to identify the user approach despite no increasing wireless signal intensity from the device.

6. The system of claim **5**, wherein the sensor is one of a touch sensor and a proximity sensor.

7. The system of claim **5**, wherein the in-vehicle component is further configured to, responsive to the user approach with no increasing wireless signal intensity:

receive wireless signal intensity information for in-vehicle devices from other proximity sensors of the vehicle; and

identify the device from the one of the in-vehicle devices as the one of the in-vehicle devices having a highest wireless signal strength at the in-vehicle component compared to the wireless signal strength for the identified device at the other proximity sensors of the vehicle.

8. A system comprising:

a personal device, configured to

receive, from an in-vehicle component including a first control set to configure the component, a user interface definition descriptive of a second control set to configure the component; and

receive, from the component, a request to display a user interface for the component including the second control set to configure the component, the second control set including at least one function unavailable in the first control set.

9. The system of claim **8**, wherein the personal device is further configured to:

display the user interface;

receive a user interaction to the user interface requesting a function from the second control set; and

send a request to the component to perform the function from the second control set.

10. The system of claim **9**, wherein the personal device is further configured to:

receive, from a second in-vehicle component including a first control set to configure the second component, a second user interface definition descriptive of a second control set to configure the second component; and

aggregate the user interface definition and the second user interface definition to combine, in the user interface, functions in common between the user interface definition and the second user interface definition.

11. The system of claim **8**, wherein the personal device is further configured to request the user interface definition descriptive of the second control set from the in-vehicle component, responsive to connection of the personal device to the in-vehicle component.

12. The system of claim **8**, wherein the personal device is further configured to receive the request to display the user interface for the component responsive to at least one of: (i) a user approach to the component detected, by the component, according to an increasing wireless signal intensity of the device, and (ii) a user approach to the component detected, by the component, according to an increasing wireless signal intensity of a wearable device paired to the device; and (iii) a user approach to one of a touch sensor and a proximity sensor of the component, despite no increasing wireless signal intensity from the device or the wearable device detected by the component.

13. The system of claim **8**, wherein the user interface definition is encoded using at least one of: (i) hypertext markup language (HTML), (ii) extensible markup language (XML), (iii) JavaScript Object Notation (JSON), and (iV) view and viewgroup user interface definitions.

14. The system of claim **8**, wherein the user interface definition includes at least two of: (i) attributes descriptive of available control functions, (ii) names for presentation of attributes of the functions in the user interface, (iii) allowed ranges of values for the attributes, (iv) layout information descriptive of grouping and ordering of the control functions, and (v) suggested controls to use to display the control functions in the user interface.

15. A computer-implemented method comprising:

receiving, by a personal device from an in-vehicle component including a first control set to configure the component, a user interface definition descriptive of a second control set to configure the component; and

receiving, from the component, a request to display a user interface for the component including the second control set to configure the component, the second control set including at least one function unavailable in the first control set.

16. The method of claim **15**, further comprising:

displaying the user interface;

receiving a user interaction to the user interface requesting a function from the second control set; and

sending a request to the component to perform the function from the second control set.

17. The method of claim **15**, further comprising:

receiving, from a second in-vehicle component including a first control set to configure the second component, a second user interface definition descriptive of a second control set to configure the second component; and

aggregating the user interface definition and the second user interface definition to combine, in the user interface, functions in common between the user interface definition and the second user interface definition.

18. The method of claim **15**, further comprising requesting the user interface definition descriptive of the second control set from the in-vehicle component, responsive to connection of the personal device to the in-vehicle component.

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