



(51) International Patent Classification:

G01C 21/36 (2006.01) **G06K 9/00** (2006.01)
B60K 35/00 (2006.01) **B60R 1/00** (2006.01)
B60K 37/00 (2006.01) **B60Q 1/26** (2006.01)
G02B 27/01 (2006.01) **B60Q 1/50** (2006.01)
G06F 3/01 (2006.01)

(21) International Application Number:

PCT/US2014/055752

(22) International Filing Date:

16 September 2014 (16.09.2014)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/878,898	17 September 2013 (17.09.2013)	US
14/175,862	7 February 2014 (07.02.2014)	US
14/180,563	14 February 2014 (14.02.2014)	US

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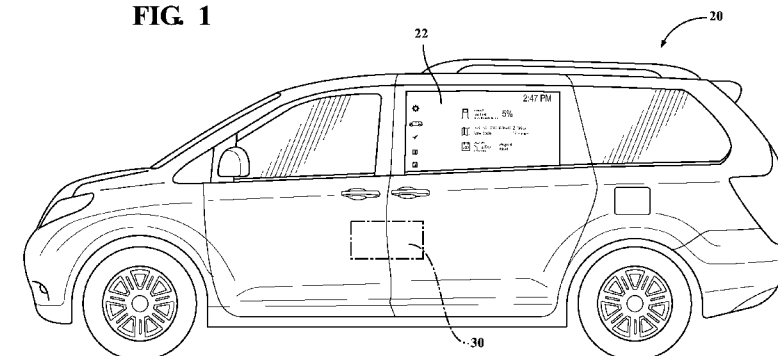
(81) **Designated States** (*unless otherwise indicated, for every
kind of national protection available*): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG,
MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM,
PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC,
SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** (*unless otherwise indicated, for every
kind of regional protection available*): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ,
TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU,
TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE,
DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,
LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) **Title:** INTERACTIVE VEHICLE WINDOW DISPLAY SYSTEM WITH USER IDENTIFICATION AND VEHICLE FUNCTION CONTROL

FIG. 1

(57) **Abstract:** A system for a vehicle includes a user identification subsystem operable to detect a user and an interactive display subsystem operable to generate output for display on a vehicle window in response to detection of the user. The system also includes a control subsystem operable to enable a user to control at least one vehicle function through the interactive display subsystem. A method of operating a system for a vehicle includes detecting a user of the vehicle and generating output for display on a vehicle window, the output being visible from outside and/or inside the vehicle in response to detection of the user. The method can also include controlling vehicle function through an interactive display subsystem operable to generate output for display on the vehicle window and executing the instructions using a control subsystem.

INTERACTIVE VEHICLE WINDOW DISPLAY SYSTEM WITH USER IDENTIFICATION AND VEHICLE FUNCTION CONTROL

BACKGROUND

[0001] The present disclosure relates to a vehicle and more particularly to systems and methods therefor.

[0002] Vehicles often include various systems such as infotainment and navigation systems. These systems are generally provided with a display around which mechanical control elements are arranged to provide a user interface mounted in a dashboard of a vehicle cabin for driver and front passenger access. Alternatively, the display combines at least some of the control elements into a touch panel display.

[0003] Conventionally, a vehicle head unit is a hardware interface located in the vehicle dash board and enabling user control of vehicle systems including, but not limited to, the vehicle's entertainment media such as AM/FM radio, satellite radio, CDs, MP3s, video; navigations systems such as GPS navigation; climate controls; communication systems such as cellular phones, text, email; and vehicle control functions such as lights, door chimes, speed control and others. As used herein, the term vehicle head unit refers to such a hardware interface, or to any control module configured to control vehicular systems.

[0004] Due to the numerous functions typically available, operation may require a relatively substantial amount of time, e.g. to find the desired mechanical control element or to browse through menus and submenus to access a desired function. Further, the dashboard mount location may limit display size and restrict the functionality thereof.

[0005] Although effective, such display and control elements necessarily require the user to be within the vehicle to operate the system and thereby increase total travel time in the vehicle. In particular, the multitude of control options presented to a driver can result in significant distraction from the driver's primary task of safely operating the vehicle. Such driver distraction can lengthen travel times and decrease the safety of the driver and any passengers. Various regulatory agencies may also require lock out of the system to prevent driver interaction when the vehicle is in motion.

SUMMARY

[0006] A system for a vehicle according to one disclosed non-limiting embodiment of the present disclosure includes a user identification subsystem which is able to detect a vehicle user and an interactive display subsystem which is able to generate output for display on a vehicle window in response to detection of the user.

[0007] A method of operating a system for a vehicle according to another disclosed non-limiting embodiment of the present disclosure includes detecting a user of a vehicle and generating output for display on a vehicle window in response to detection of the user, the output visible from at least one of outside and inside the vehicle.

[0008] A system for a vehicle according to one disclosed non-limiting embodiment of the present disclosure includes an interactive display subsystem which can generate output for display on a vehicle window and a control subsystem which can enable a user to control at least one vehicle function through the interactive display subsystem.

[0009] A method of controlling a vehicle function in a non-limiting embodiment of the present disclosure includes receiving instructions for controlling the vehicle function through an interactive display subsystem operable to generate output for display on a vehicle window and executing the instructions using a control subsystem.

[0010] A system for a vehicle according to another disclosed non-limiting embodiment of the present disclosure includes an interactive display subsystem. The interactive display subsystem includes a projection display and is operable to enable a vehicle rear-seat passenger to control at least one vehicle function.

[0011] The foregoing features and elements may be combined in various combinations without exclusivity, unless expressly indicated otherwise. These features and elements as well as the operation thereof will become more apparent in light of the following description and the accompanying drawings. It should be understood, however, the following description and drawings are intended to be exemplary in nature and non-limiting.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Various features will become apparent to those skilled in the art from the following detailed description of the disclosed non-limiting embodiment. The drawings that accompany the detailed description can be briefly described as follows:

- [0013] Figure 1 is a pictorial representation of an example vehicle for use with an interactive vehicle window display system;
- [0014] Figure 2 is a schematic block diagram of the interactive vehicle window display system according to one non-limiting embodiment;
- [0015] Figure 3 is a partial interior view of the vehicle with the interactive vehicle window display system;
- [0016] Figure 4 is a top view of the vehicle illustrating an exterior user identification subsystem of the interactive vehicle window display system;
- [0017] Figure 5 is a pictorial representation of the vehicle illustrating user identification via a skeletal joint relationship, key fob and/or user gesture;
- [0018] Figure 6 is a schematic block diagram of an algorithm for operation of the system according to one non-limiting embodiment;
- [0019] Figure 7 is a pictorial representation of an example skeletal joint relationship recognizable by the system;
- [0020] Figure 8 is an illustration of an example user gesture recognizable by the system;
- [0021] Figure 9 is an example landing page displayed by the interactive vehicle window display system;
- [0022] Figure 10 is an example route page displayed by the interactive vehicle window display system;
- [0023] Figure 11 is an example calendar page displayed by the interactive vehicle window display system;
- [0024] Figure 12 is an example weather page displayed by the interactive vehicle window display system;
- [0025] Figure 13 is an example vehicle status page displayed by the interactive vehicle window display system;
- [0026] Figure 14 is an example to-do page displayed by the interactive vehicle window display system;
- [0027] Figure 15 is a partial interior view of a vehicle cabin illustrating an interactive environment for the driver and/or passengers to utilize functionalities of a vehicle head unit;

[0028] Figure 16 is a partial interior view of the vehicle cabin illustrating discrimination of a driver and/or passenger to selectively permit utilization of functionalities of a vehicle head unit during vehicle operation;

[0029] Figure 17 is a pictorial representation of a vehicle passenger facial map for use with the system to track occupant location; and

[0030] Figure 18 is an overhead interior view of the vehicle illustrating a sensor arrangement to track occupant location within the vehicle cabin.

DETAILED DESCRIPTION

[0031] Figure 1 schematically illustrates a vehicle 20 with a window 22 and an interactive vehicle window display system 30. Although the window 22 is here shown as a driver's side passenger window of a minivan type vehicle in the disclosed, non-limiting embodiment, it should be appreciated that various vehicle types and windows will also benefit herefrom.

[0032] With reference to Figure 2, selected portions of the system 30 are schematically illustrated. The system 30 generally includes an interactive display subsystem 32, a control subsystem 34, a user input subsystem 36, a user identification subsystem 38, and a user location subsystem 39. It should be appreciated that although particular subsystems are separately defined, each or any of the subsystems may be combined or segregated via hardware and/or software of the system 30. Additionally, each or any of the subsystems can be implemented using one or more computing devices including conventional central processing units or other devices capable of manipulating or processing information.

[0033] The interactive display subsystem 32 can include any device or devices capable of displaying images on a vehicle window 22 under the control of system 30, and can be adapted for viewing from outside the vehicle, inside the vehicle, or both. In one non-limiting example the interactive display subsystem 32 can include a display device integral to the window 22, such as an LCD. Such a display can be illuminated by ambient light or by one or more light sources under the control of system 30. Such light sources can be mounted at any operable locations enabling light emission onto a window from inside or outside the vehicle, depending on whether the display is to be viewed by a user located outside or inside the vehicle. Examples of such mounting locations can include in the floor, in the vehicle headliner, within the vehicle door structure, or in the exterior door panel.

[0034] In another non-limiting example, the interactive display subsystem 32 can include a coating 40 and a projector 42. The coating 40, for example, may be a polymer dispersed liquid crystal (PDLC) film, applied to the window 22 to provide both transparency when inactive and partial or complete opacity when active. The window 22 treated with the coating 40 is thereby operable to display content as a projection page visible from outside and/or inside the vehicle 20 (Figure 1). The projector 42 can be mounted in the floor (Figure 3) or other locations within the vehicle 20, such as the vehicle headliner or within the vehicle door structure as well as in locations on the vehicle exterior such as in an exterior door panel. The illustrated shaded area extending from the projector 42 toward the window 22 schematically represents the projection of output in the form of content pages provided by the projector 42. In response to the approach of a recognized user, the coating 40 changes from transparent to opaque so that the projector 42 may project the output onto the window 22.

[0035] As will be further described, the displayed content can include personalized information or entertainment content such as videos, games, maps, navigation, vehicle diagnostics, calendar information, weather information, vehicle climate controls, vehicle entertainment controls, email, internet browsing, or any other interactive applications associated with the recognized user, whether the information originates onboard and/or off board the vehicle 20.

[0036] The control subsystem 34 generally includes a control module 50 with a processor 52, a memory 54, and an interface 56. The processor 52 may be any type of microprocessor having desired performance characteristics. The memory 54 may include any type of computer readable medium which stores the data and control algorithms described herein such as a user support system algorithm 58. The functions of the algorithm 58 are disclosed in terms of functional block diagrams (Figure 6) and representative pages (Figures 9-14), and it should be understood by those skilled in the art with the benefit of this disclosure that these functions may be enacted in either dedicated hardware circuitry or programmed software routines capable of execution in a microprocessor based electronics control embodiment.

[0037] With continued reference to Figure 2, the control module 50 may be a portion of a central vehicle control, a stand-alone unit, or other system such as a cloud-based system. Other operational software for the processor 52 may also be stored in the memory 54. The interface 56 facilitates communication with other subsystems such as the interactive display subsystem 32, the user input subsystem 36, the user identification subsystem 38, and

the user location subsystem 39. It should be understood that the interface 56 may also communicate with other onboard vehicle systems and offboard vehicle systems. Onboard systems include but are not limited to, a vehicle head unit 300 which communicates with vehicle sensors that provide, for example, vehicle tire pressure, fuel level and other vehicle diagnostic information. Offboard vehicle systems can provide information which includes but is not limited to, weather reports, traffic, and other information which may be provided via cloud 70.

[0038] The user input subsystem 36 can include one or more input sensors including onboard input sensors 60, offboard input devices, or both. Onboard input sensors 60 can include one or more motion cameras or other light sensors configured to detect gesture commands, one or more touch sensors configured to detect touch commands, one or more microphones configured to detect voice commands, or other onboard devices configured to detect user input. The user input subsystem can also include offboard input devices such as a key fob 62 and/or a personal electronic device 63 of the user, e.g. a tablet, smart phone, or other mobile device.

[0039] In some instances, at least one onboard input sensor 60 or offboard input device can be integrated into, or operate in conjunction with, the interactive display subsystem 32. In one non-limiting example, the interactive display subsystem 32 includes an LCD display integrated into a window 22 and can operate in conjunction with one or more touch sensors integrated into the window 22, causing the window to function as a touchscreen. In another non-limiting example, the interactive display subsystem 32 includes a projector 42 and coating 40 on the window 22 and can operate in conjunction with one or more motion detectors configured to detect user gesture commands, causing the window to operate as a gesture-based interactive display. Subsystem combinations involving the interactive display subsystem 32 and the user input subsystem and enabling user interaction with a display on a vehicle window 22 will be referred to herein as an interactive window display.

[0040] The user identification subsystem 38 includes one or more identification sensors 64 such as a closed-circuit television (CCTV) camera, infrared, thermal or other sensor mounted to the vehicle 20 to provide a desired field of view external to the vehicle 20 as shown in Figure 4, internal to the vehicle, or both. One example user identification subsystem 38 can recognize the driver and/or passenger based on image data captured by identification sensors 64, e.g. a skeletal joint relationship 66 and/or other user form data

(Figure 5), separate from, or along with, wireless devices such as the key fob 62 associated with that particular driver and/or passenger. Based at least in part on this identification, the system 30 provides access to interactive interfaces on the interactive display subsystem 32 associated with the particular driver and/or passenger.

[0041] The system 30 can store user profiles of known users, the user profiles including identification information relevant to individual users. For example, a user profile can contain skeleton joint relationship data or facial recognition data useable by the user identification subsystem 38 to identify or authenticate a user. A user profile can additionally contain personal interest information, such as personal calendar and event information, driving/destination history, web browsing history, entertainment preferences, climate preferences, etc. In some variations, any or all information contained in a user profile can be stored on or shared with a personal electronic device 63, remote server, or other cloud 70 based system. Such offboard storage or sharing of user profile data can facilitate utilization of user profile data in other vehicles such as any additional vehicles owned by the user, rental vehicles, etc. Such user profile data can be secured by being accessible through a password protected application running on the cloud 70 based system, by biometric authentication, or by other effective means.

[0042] In some instances, a user profile can additionally contain user access information; data pertaining to whether the user is allowed to control a given vehicle function. For example, the user profile associated with a user can indicate full user access, or function control rights for that user. This can be analogous to the control rights of the administrator of a personal computer. A user profile can alternatively indicate restricted user access. For example, the user profile associated with a child can be set to block the user from accessing certain audio or video controls, the navigation system, altering user profiles, or the like.

[0043] Registration of various user profiles with the system 30 can be completed in any manner, for example, over the internet or with a direct vehicle interface. User profiles can be based on the identities of individual users known to or registered with the system, or to user categories, such as “unknown user”, or “valet”. In different variations, a default user category such as “unknown user” or “valet” can be associated with limited, default access, or can be associated with no access, i.e. complete prohibition of access to the system 30.

[0044] The user location subsystem 39, operable to determine the location of one or more users inside or outside the vehicle, includes one or more location sensors 66 such as a

pressure sensor, temperature sensor, or camera deployed inside or outside the vehicle. In some cases, a device can serve as both an identification sensor 64 and a location sensor 66. For example, a camera mounted within the vehicle can provide information on a user's specific identity, by means described above, and on the user's location within the vehicle, such as the driver's seat or the front-row passenger's seat. In some cases, elements of the interactive display subsystem 32 can also operate as location sensors 66 within the user location subsystem 39. For example, pressure sensors within a smartscreen or motion detectors operating as part of an interactive display can be used to obtain user location information.

[0045] In some instances, user access can be based on user location as determined by the user location subsystem 39. For example, second or third row passengers can be allowed or disallowed access to various vehicle functions such as the navigation system. Optionally, a user with a user profile that is associated with unlimited access per the access information associated with the user profile can specify such settings. In some instances, user access can be based on a combination of the user profile as applied by the user identification subsystem 38, and the user location as detected by the user location subsystem 39. For example, a user with unlimited access as specified by the applied user profile can nonetheless be blocked from accessing certain vehicle functions when occupying the driver's seat of a moving vehicle.

[0046] With reference to Figure 6, operation of the system 30 according to one disclosed non-limiting embodiment generally includes a sleeper mode 100, a watcher mode 102 and a user mode 104. It should be appreciated that other modes may additionally or alternatively be provided.

[0047] If the system 30 is active but has yet to detect a user, the system 30 will be in sleeper mode 100 until awakened by the user identification subsystem 38. After detection but prior to identification by the system 30, the watcher mode 102 may be utilized to interact with authenticated as well as un-authenticated persons. For example, when a person approaches the vehicle 20, the system 30 recognizes the direction from which the person has approached then activates the interactive display subsystem 32 to display an avatar, eyes or other graphic. The graphic may be directed specifically toward the direction from which the person approaches, e.g., the graphical eyes "look" toward their approach. Alternatively, an audio capability allows the system 30 to respond to commands and initiate interaction from a blind side of the vehicle 20, i.e., a side without the interactive display subsystem 32. The

watcher mode 102 utilizes the user identification subsystem 38 to discriminate between authenticated and un-authenticated persons.

[0048] The user mode 104 allows a user with a known operator and/or passenger user profile in the system 30 to make decisions on approach to the vehicle 20 so that certain vehicle interactions need not await entry into the vehicle 20. The user mode 104 reduces distractions through the reduction of travel-associated decisions from the driver's cognitive, visual and manual workload streams once within the vehicle 20. In furtherance of this, the user is presented with an overview of information to include, for example, weather, traffic, calendar events and vehicle health. As will be further described, predictive functions of the system 30 identify likely actions, and offer optimal paths to completion, such as planning an efficient route.

[0049] A maximum range of content provision by the interactive display subsystem 32 may be associated with a maximum distance at which that content can be effectively interacted with by the user. In one disclosed non-limiting embodiment, the maximum range of each content feature is prioritized with respect to legibility range of content displayed by the interactive display subsystem 32. This range metric facilitates the determination of the order in which content appears in the walkup experience. Access to prioritized content with greater maximum range allows the walkup experience to begin further from the vehicle 20 to provide the user with more overall time to interact with the system 30.

[0050] In one disclosed non-limiting embodiment, the system 30 utilizes a multi-factor authentication for security and authorization. Example multi-factor authentication may include the key fob 62, skeleton joint relationship recognition (Figure 5), and/or a gesture password (Figure 8). The user may be provisionally identified with one of these factors, but may require a total of at least two factors to authenticate the user prior to display of certain content. That is, the user will not be granted access to all the features in user mode 104 until a multi-factor authentication is passed and the user is within a predetermine range of the vehicle 20. This authentication process ensures the security of the vehicle and the personal information embedded in the system 30. In one disclosed non-limiting embodiment, the first authentication factor is the key fob 62 and the second is the skeleton joint relationship (Figure 7) of the user. If the user does not have their key fob 62, the skeleton joint relationship may become the first authentication factor and a gesture password such as a wave or particular arm movement (Figure 8) becomes the second.

[0051] The key fob 62 in one disclosed non-limiting embodiment may be encrypted to uniquely identify each user to the system 30. Additional security protocols such as a rolling time key to ensure that even the encrypted key cannot be intercepted and re-used by unauthorized devices may additionally be utilized.

[0052] Once the key fob 62 is recognized, the user will be welcomed and pre-authenticated to allow limited access to selected content in the user mode 104. This will provide the user with enough time to cycle through multiple content features during the walkup experience, yet maintain security with respect to other content features e.g., a destination. Once the user has been fully authenticated, all content features, e.g. destination made during the pre-authenticated state, are validated for display. If the authentication fails, the user will not be granted access to the vehicle 20 or any sensitive information. The system 30 in this disclosed non-limiting embodiment allows pre-authenticated access at about 30-40 feet and full access at about 15- 25 feet from the vehicle.

[0053] With respect to Figure 7, to provide further authentication, the system 30 is operable to recognize a user by his skeleton joint relationships. Skeleton joint relationships in this disclosed non-limiting embodiment facilitate pre-authentication but not full authentication that grants full access to the vehicle 20. However, if the user has been pre-authenticated via the key fob 62, a matching skeleton joint relationship will fully authenticate the user. That is, the user identification subsystem 38 may utilize skeleton joint relationships as the second point of identification.

[0054] With reference to Figure 9, once authenticated, the “landing” or “home” page 200 provides a summary of alerts and important information to the user. The landing page 200 provides the user with a readily reviewable overview of the status of the vehicle and how it may affect his schedule and activities. In this example, the content includes time information, vehicle diagnostic information, and personal calendar information. Here shown, a low fuel warning is provided in addition to a traffic-based route update for use by the vehicle navigation system and a calendar event reminder to “Pick up Kids in 20 minutes.” In another example, the system 30 will include a fuel station as a stop during route guidance if the destination is a distance greater than the available fuel range. Notably, preferred fuel stations or other stops may be predefined in the user profile.

[0055] The landing page 200 further displays a plurality of icons to indicate additional content pages that can be viewed by the authorized user. The landing page 200 itself may be accessed on each content page as an icon such as a vehicle manufacturer mark

icon on each content page. The landing page 200 allows the authorized user to understand what vehicle systems or personal user profile items may require further attention and provides access to additional content feature details with regard to these items in the form of navigable icons that lead to additional content pages. The landing page 200 can additionally or alternatively integrate an interactive display, for example, a smart page or video game. Other interactive vehicle display page configurations are also possible.

[0056] Selection of content is accomplished with, for example, the key fob 62, user gestures, voice commands, touch inputs, etc. In one example, the user utilizes the key fob 62 to cycle through various pages displayed by the interactive display subsystem 32. In one example, the key fob 62 may include a four button directional pad and two auxiliary buttons. Alternatively, hand gestures may be used to “swipe” between pages. It should be appreciated that although particular pages are illustrated in the disclosed non-limiting embodiment, various alternative or additional pages may be provided.

[0057] With reference to Figure 10, a route page 202 defaults to the predicted best route for the user with respect to an explicit or inferred next destination. Any alternate destinations or routes that can be explicit or inferred with confidence from, for example, a user personal electronic device, are presented to permit user selection by scrolling through the options. The suggested route screen is here shown accessed using the folded-map icon, however, other icons may be utilized.

[0058] With reference to Figure 11, a calendar page 204 displays the user’s calendar. In this example, the view is near-term, and shows only the next 2-3 upcoming appointments. If the event includes location information the user is also given the option to use the event for destination selection. Here shown, the calendar page 204 provides content with respect to the next appointment highlighted for the user and provides a reminder to “Pick Up Kids.” The calendar screen is here shown accessed using a flip calendar icon, however, other icons may be utilized.

[0059] With reference to Figure 12, a weather page 206 leverages information about the route to provide relevant weather information – this may be especially effective when the user is travelling away from home. For example, the system 30 determines whether it is more valuable to present the user with local weather information, destination weather information, or both, depending on the settings selected by the user or the type of weather information available. Here shown, the weather forecast is chronological. The weather page 206 can be accessed with a sun icon, however, other icons may be utilized. In addition,

weather conditions can be utilized to generate a reminder for display on the landing screen 200 that, for example, suggests an umbrella be placed in the vehicle if rain is forecasted.

[0060] With reference to Figure 13, a vehicle status page 208 provides the user with a view of impending vehicle maintenance needs that requires attention. Notifications can include source details of the notification, severity, and options to resolve the potential issue. For example, given the notification of “Low Fuel,” the system 30 can suggest a route to a nearby fuel station within the range of the vehicle. The vehicle status page 208 is here shown accessed with a vehicle icon, however, other icons may be utilized.

[0061] With reference to Figure 14, a to-do list page 210 presents the authorized user with information from any associated to-do list available on, for example, that user’s personal electronic device 63, remote device, or web service. Here shown, the recognized user is tasked to “Send Package,” “Submit Taxes,” and “Renew Car Registration,” among other items. The to-do list page 210 can alternatively be integrated into the route selection page if location information is included in a given list item in the personal electronic device to-do list. An example of this integration includes the provision of route details to a dry cleaner if the dry cleaning pickup is on the to-do list and the current route is proximate to the location of the dry cleaner location. The to-do list page is here shown accessed using a check-mark icon, however, other icons may be utilized.

[0062] As noted above, information of this nature, which can be included in a user profile, can in some variations be stored on or shared with a personal electronic device 63, remote server, or other cloud 70 based system, facilitating utilization in more than one vehicle. Any such information can be secured by being accessible through a password protected application running on the cloud 70 based system, by biometric authentication, or by other effective means. In some such variations, a first user can be granted partial or complete access to a second user’s profile by password sharing, for example. Such sharing of access could enable a first user to write reminders or tasks from a remote location to the user profile of a second user, such as a family member, such that the reminders or tasks written by the first user will be displayed on a window when the second user approaches or enters the vehicle, or any vehicle equipped with system 30 enabled to access the user profile of the second user.

[0063] With reference to Figure 15, user access to various vehicle functions can include direct or remote access to utilize functionalities of a vehicle head unit 300.

[0064] With the interactivity between the vehicle head unit 300 and the system 30, and in particular between the vehicle head unit 300 and various interactive window displays, passengers can make selections with regard to vehicle systems typically performed by driver and in some cases only when the vehicle is stationary. Allowing only passengers to interact with certain vehicle systems while the vehicle is in motion increases safety by minimization of driver distraction. Passenger interaction can also enable greater functionality for the system 30. For example, a front-seat passenger can be offered more menu selections than the driver, while 2nd and 3rd row passengers can be offered even greater menu selections than the front-seat passenger. In these embodiments, the passengers can take over portions of the driver workload.

[0065] The vehicle passengers may, for example, interact with the system 30 and thereby the vehicle head unit 300 via an interactive window display or through a personal electronic device such as a smart phone or tablet which communicates therewith, through Bluetooth, RFID or other wireless technology standards to exchange data. Further, the system 30 may permit the formation of personal area networks (PANs) for vehicle passengers to share information. For example, a passenger's personal electronic device may include a mapping app operable to communicate with the vehicle navigation system on the vehicle head unit 300 with no features locked out such that the passenger can search destinations and selectively send to the vehicle navigation system via the vehicle head unit 300.

[0066] Interaction of the system 30 with the vehicle head unit 300 also allows the driver and/or passengers to select content for other vehicle passengers and/or the driver. For example, one of the passengers can select a destination to display on the navigation system for the driver while the vehicle is in motion. In another example, the driver can select entertainment content for display to child passengers. In yet another example, the passenger can control infotainment or climate control features controlled by the vehicle head unit 300.

[0067] With reference to Figure 16, and in one non-limiting example of the operation of the user location subsystem 39, to still further increase safety through driver distraction minimization, the system 30, by utilizing user location subsystem 39, is operable to track the location or position of the vehicle occupants within the vehicle cabin 400 (Figure 18) through skeletal position (Figure 16), facial map data (Figure 17), pressure sensors, interactive window display input sensors, or others. For a three row vehicle, for example, three distinct areas are tracked – front row, middle row and rear row. Typically, at least two sensors 402 per row are required to track a state of each occupant within the vehicle 20. In

some instances, each individual seat in the vehicle 20 can be tracked. The data from all sensors 402 may alternatively or additionally be combined to create one central map (2D or 3D) for use by the system 30. It should be appreciated that the sensors 402 may communicate with, or be a portion of, the user identification subsystem 38, the user location subsystem 39, or both.

[0068] Given that the vehicle occupants are typically seated and belted, the multi-point skeletal joint relationship and facial recognition map data provides a relatively accurate position of each occupant captured on an XYZ axis map that can track, to a desired level of precision, the state of each occupant at a specific snapshot in time. The state of each occupant facilitates further tailored operations for various vehicle functions. For example, the user location subsystem 39 detects and discriminates between a driver's hand from that of a vehicle front row passenger hand to selectively unlock various head unit functionality such as navigation route selection (Figure 16). Dependent, for example, on which user (driver or passenger) is attempting to access the system 30 and whether the vehicle is in motion, content menu items of the vehicle head unit 300 are selectively displayed. For example, certain content such as route selection may be color coded for only passenger access, while other content such as zooming and scrolling may always be available regardless of user.

[0069] Upon approach to the vehicle, the system 30 beneficially recognizes a user with a first and second point of identification to display information for that particular, authorized user. This authentication process ensures the security of the vehicle and the personal information embedded in the system 30 yet permits vehicle interaction prior to user entry into the vehicle cabin. The system 30 also beneficially discriminates passengers from the driver to selectively permit access to personalized content or specific vehicle system interfaces.

[0070] The use of the terms "a" and "an" and "the" and similar references in the context of description (especially in the context of the following claims) are to be construed to cover both the singular and the plural, unless otherwise indicated herein or specifically contradicted by context. The modifier "about" used in connection with a quantity is inclusive of the stated value and has the meaning dictated by the context (e.g., it includes the degree of error associated with measurement of the particular quantity). All ranges disclosed herein are inclusive of the endpoints. It should be appreciated that relative positional terms such as "forward," "aft," "upper," "lower," "above," "below," and the like are with reference to the normal operational attitude of the vehicle and should not be considered otherwise limiting.

[0071] Although the different non-limiting embodiments have specific illustrated components, the embodiments of this invention are not limited to those particular combinations. It is possible to use some of the components or features from any of the non-limiting embodiments in combination with features or components from any of the other non-limiting embodiments.

[0072] It should be appreciated that like reference numerals identify corresponding or similar elements throughout the several drawings. It should also be appreciated that although a particular component arrangement is disclosed in the illustrated embodiment, other arrangements will benefit herefrom.

[0073] Although particular step sequences are shown, described, and claimed, it should be understood that steps may be performed in any order, separated or combined unless otherwise indicated and will still benefit from the present disclosure.

[0074] The foregoing description is exemplary rather than defined by the limitations within. Various non-limiting embodiments are disclosed herein, however, one of ordinary skill in the art would recognize that various modifications and variations in light of the above teachings will fall within the scope of the appended claims. It is therefore to be appreciated that within the scope of the appended claims, the disclosure may be practiced other than as specifically described. For that reason the appended claims should be studied to determine true scope and content.

CLAIMS

What is claimed is:

1. A system for a vehicle, comprising:
 - a user identification subsystem operable to detect a user; and
 - an interactive display subsystem operable to generate output for display on a vehicle window based on detection of the user.
2. The system as recited in claim 1, wherein the interactive display subsystem includes a projector operable to project the output toward the vehicle window, the vehicle window being a driver side passenger window.
3. The system as recited in claim 1, wherein the output includes a visual representation of at least one of a landing page, a route page, a calendar page, a weather page, a vehicle status page, and a to-do page.
4. The system as recited in claim 1, wherein the output includes a visual representation of one or more pages, each one of the one or more pages selectable through a user input subsystem after detection of the user by the user identification subsystem.
5. The system as recited in claim 4, wherein each one of the one or more pages is selectable through a key fob in communication with the user input subsystem.
6. The system as recited in claim 4, wherein each one of the one or more pages is selectable through a gesture identified by the user input subsystem.
7. The system as recited in claim 1, wherein the user identification subsystem includes an identification sensor to provide a field of view external or internal to the vehicle.

8. The system as recited in claim 1, wherein the interactive display subsystem comprises an interactive window display.
9. The system as recited in claim 8, further comprising a user input subsystem in communication with the interactive window display.
10. The system as recited in claim 9, wherein the user input subsystem includes a key fob.
11. The system as recited in claim 1, wherein said user identification subsystem includes at least one user profile, the user profile including personal interest information related to the interests of the user.
12. The system as recited in claim 11, wherein the user identification subsystem is further operable to identify the user and match the user to a user profile.
13. The system as recited in claim 12, wherein the user identification subsystem is further operable, upon identification and match of a user to a user profile, to regulate content of the output displayed on the vehicle window according to the personal interest information contained in the matched user profile.
14. The system as recited in claim 12, wherein the user identification subsystem is further operable to match the user to a user profile in response to a skeletal joint ratio of the user.
15. The system as recited in claim 12, wherein the user identification subsystem is further operable to match the user to a user profile in response to a gesture performed by the user.

16. The system as recited in claim 12, wherein the user identification subsystem is further operable to match the user to a user profile in response to information received from a key fob.
17. The system as recited in claim 12, wherein the user is detected outside the vehicle and the display is viewable from outside the vehicle.
18. A method of operating a system for a vehicle, comprising:
 - detecting a user of a vehicle; and
 - generating output for display on a vehicle window in response to detection of the user, the output visible from at least one of outside and inside the vehicle.
19. The method as recited in claim 18, wherein the output is displayed on the outside of a vehicle window.
20. The method as recited in claim 18, further comprising matching the detected user to a user profile.
21. The method as recited in claim 20, wherein the output displayed is based, at least in part, on personal interest information in the matched user profile.
22. The method as recited in claim 18, wherein the output includes one or more pages selectable through a key fob.
23. The method as recited in claim 18, wherein the output includes one or more pages selectable through a gesture by the user.
24. The method as recited in claim 18, wherein detecting the user includes detecting a first point of identification and a second point of identification.

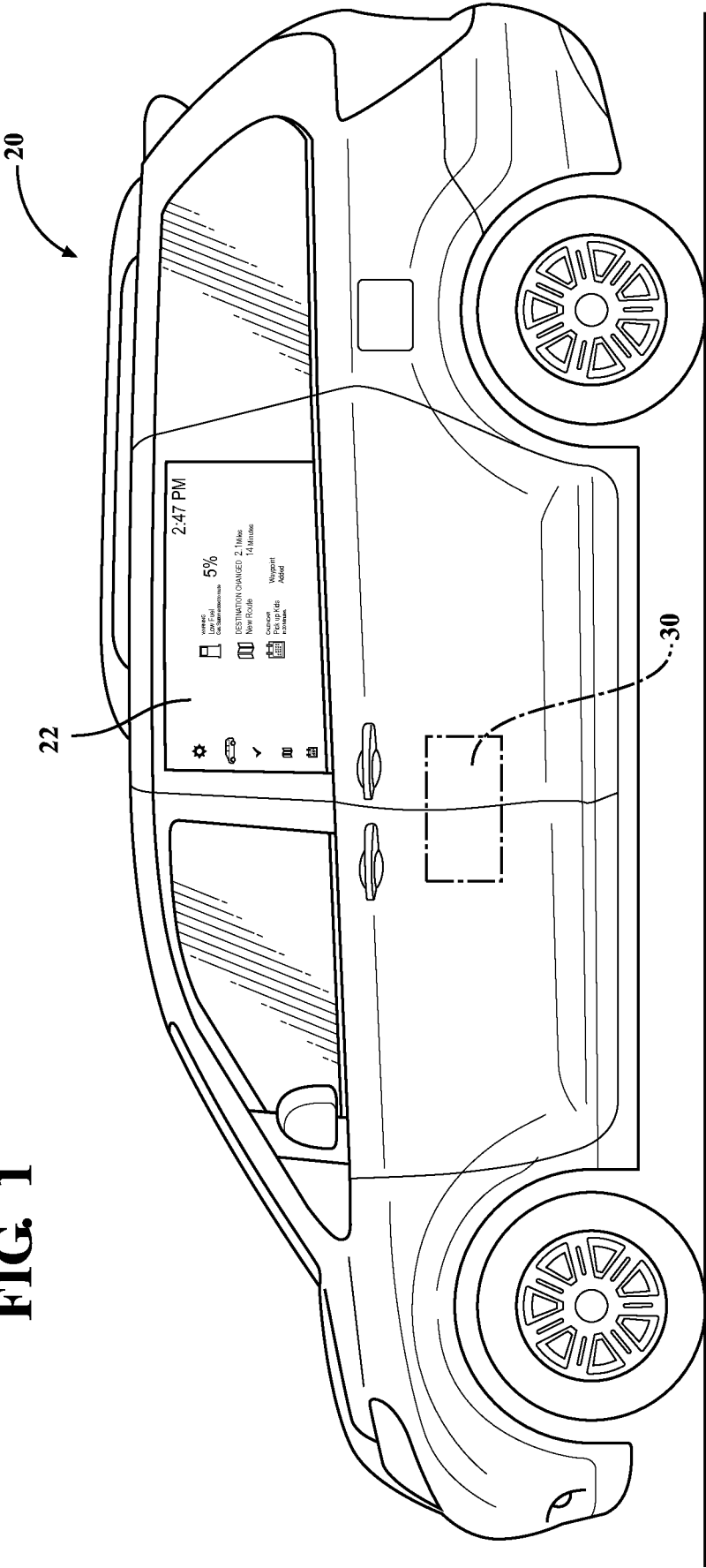
25. The method as recited in claim 24, wherein the first point of identification includes information received from a key fob.
26. The method as recited in claim 24, wherein the second point of identification includes a skeletal joint ratio of the user.
27. A system for a vehicle, comprising:
 - an interactive display subsystem operable to generate output for display on a vehicle window; and
 - a control subsystem operable to enable a user to control at least one vehicle function through the interactive display subsystem.
28. The system as recited in claim 27, wherein the vehicle function is a navigation function.
29. The system as recited in claim 27, wherein the vehicle function is an audio/video function.
30. The system as recited in claim 27, wherein the vehicle function is a climate control function.
31. The system as recited in claim 27, wherein the vehicle function is an internet access function.
32. The system as recited in claim 27, wherein the interactive display subsystem comprises motion sensors.
33. The system as recited in claim 27, further comprising a vehicle head unit in communication with the interactive display subsystem.

34. The system as recited in claim 27, further comprising:
a user location subsystem operable to detect a location of the user and in communication with the control subsystem, the control subsystem further operable to control user access to a vehicle head unit based on the location of the user.
35. The system as recited in claim 34, further comprising:
a user identification subsystem operable to identify the user and in communication with the control subsystem, the control subsystem further operable to control user access to a vehicle head unit based on the identity of the user.
36. The system as recited in claim 35, wherein the user identification subsystem includes one or more user profiles, each user profile associated with at least one user.
37. The system as recited in claim 36, wherein each user profile includes user access information.
38. The system as recited in claim 37, wherein the user access information indicates full access or restricted access.
39. The system as recited in claim 37, wherein the user access information is based on both the user location and the identity of the user.
40. A method of controlling a vehicle function, comprising:
receiving instructions for controlling the vehicle function through an interactive display subsystem operable to generate output for display on a vehicle window; and
executing the instructions using a control subsystem.
41. The method as recited in claim 40, further comprising:
determining a user location; and
regulating user access to controlling the vehicle function based on the user location.

42. The method as recited in claim 41, further comprising:
determining a user identity; and
regulating user access to controlling the vehicle function based on the user identity.
43. The method as recited in claim 40, wherein the vehicle function is a navigation function.
44. The method as recited in claim 40, wherein the vehicle function is an audio/video function.
45. The method as recited in claim 40, wherein the vehicle function is a climate control function.
46. The method as recited in claim 40, wherein the vehicle function is an internet access function.
47. The method as recited in claim 40, wherein the interactive display subsystem comprises an interactive touch screen with touch sensors.
48. The method as recited in claim 40, wherein the interactive display subsystem comprises a projection display.
49. The method as recited in claim 40, wherein the interactive display subsystem comprises motion sensors.
50. A system for a vehicle, comprising:

an interactive display subsystem including a projection display, the interactive display subsystem operable to enable a vehicle rear-seat passenger to control at least one vehicle function.

FIG. 1



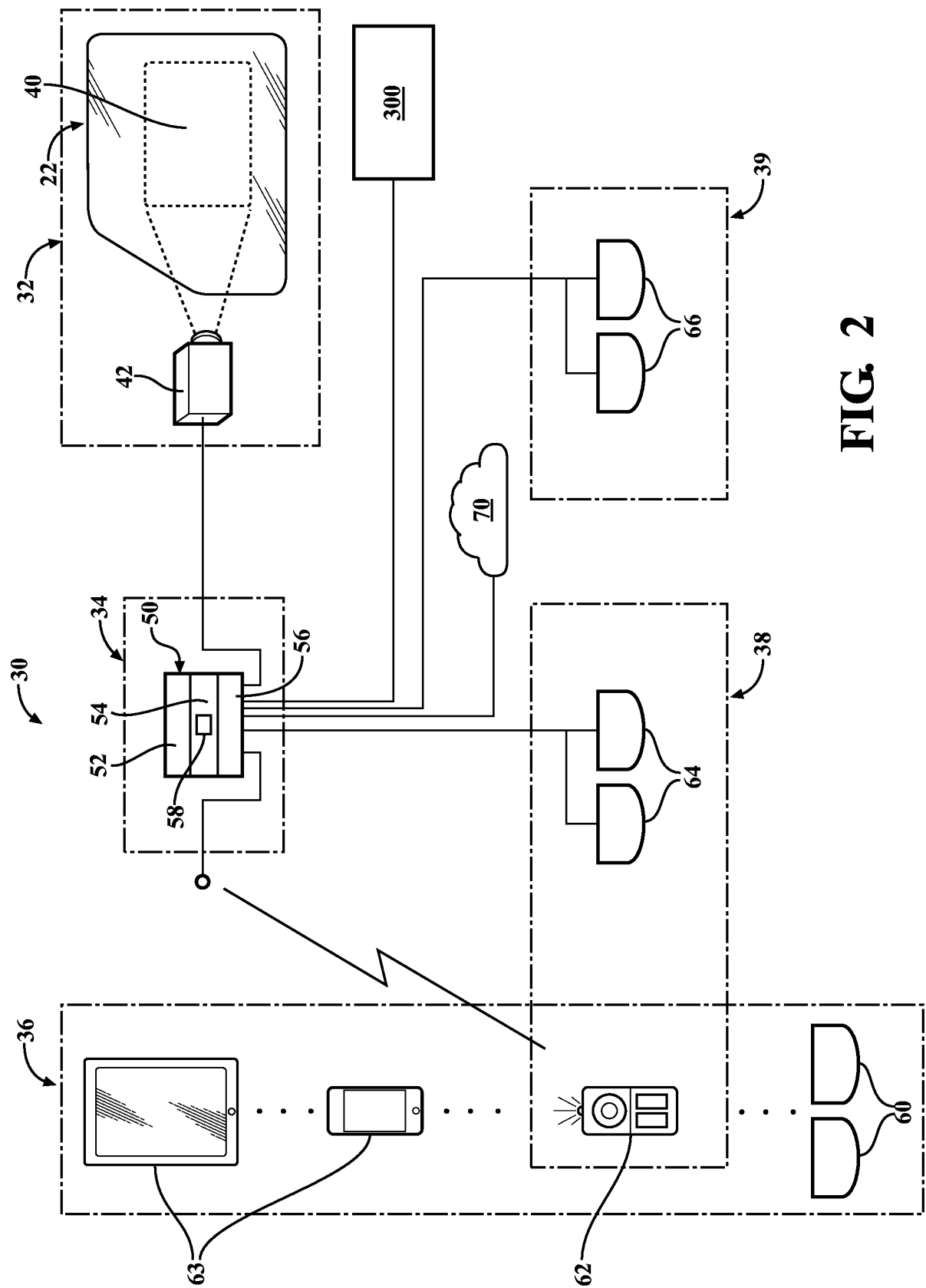
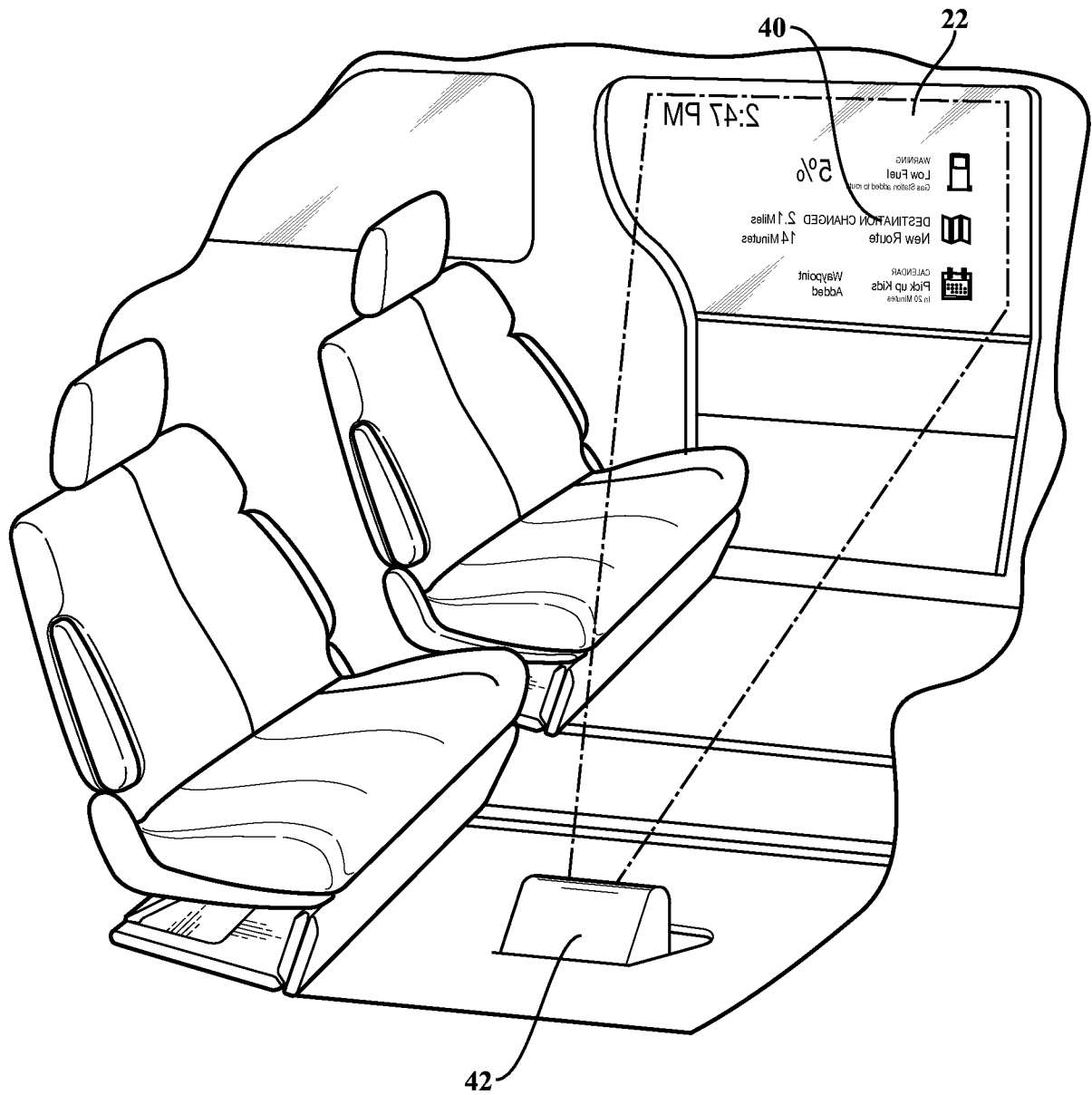


FIG. 2

FIG. 3



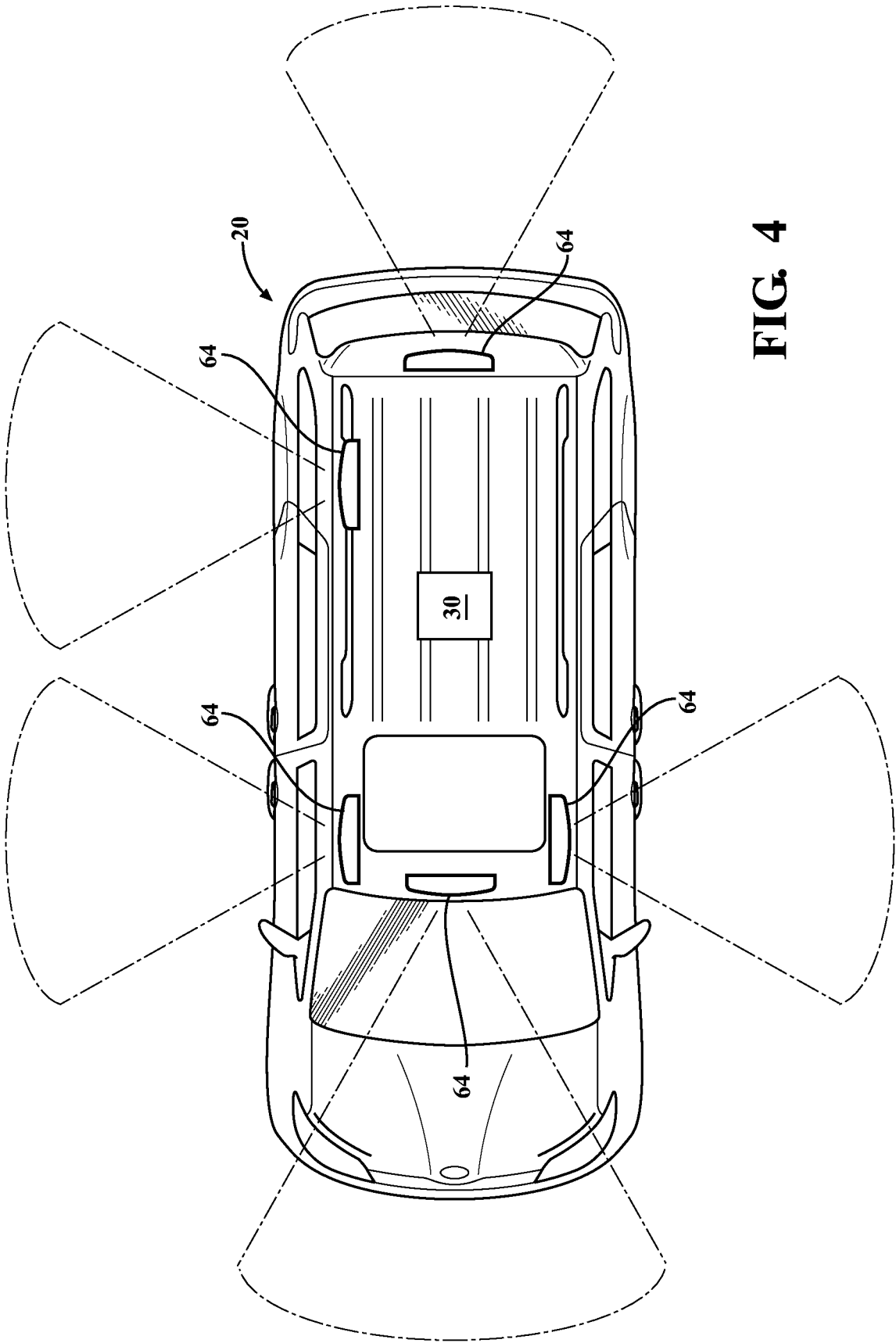


FIG. 4

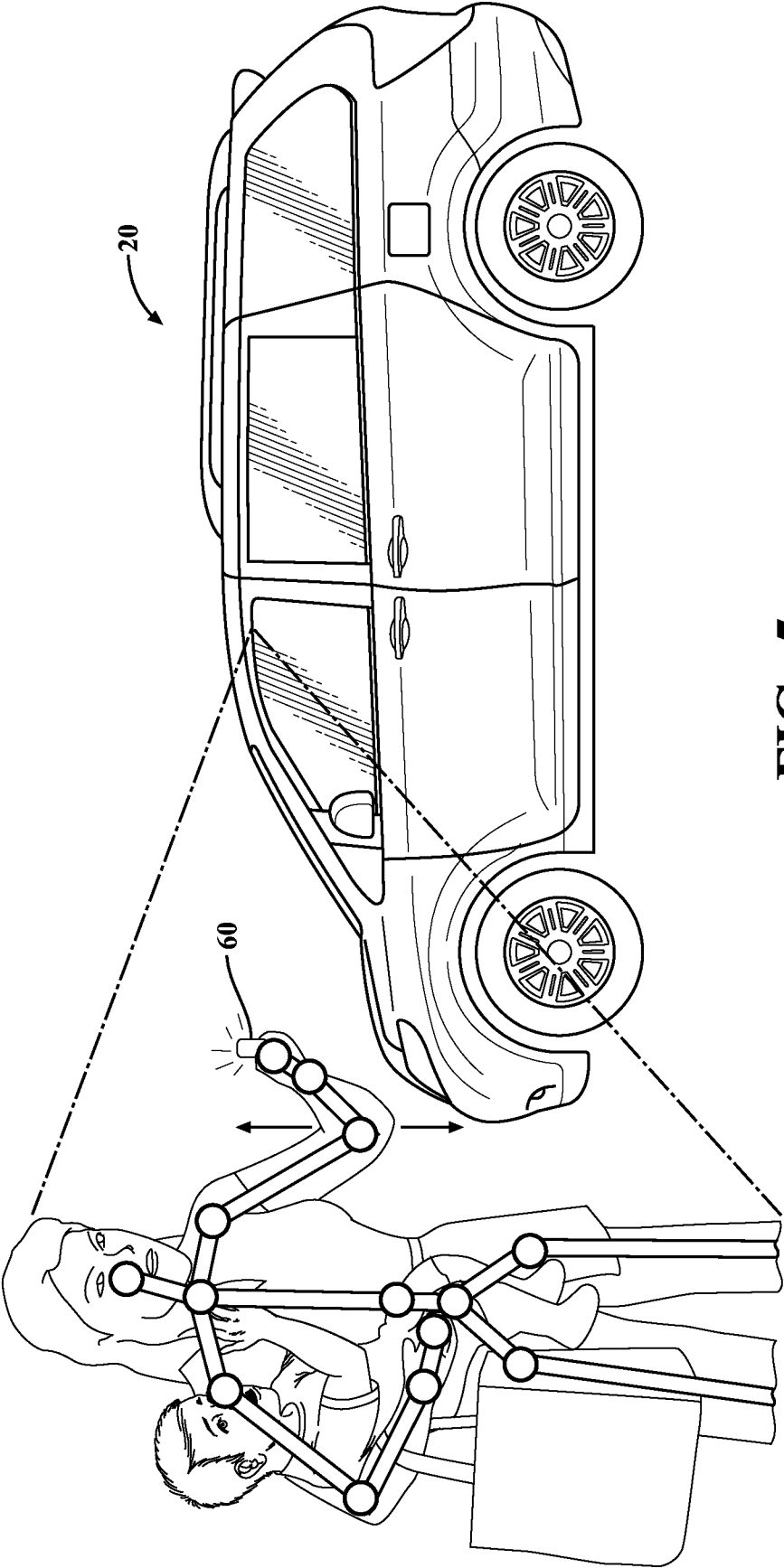


FIG. 5

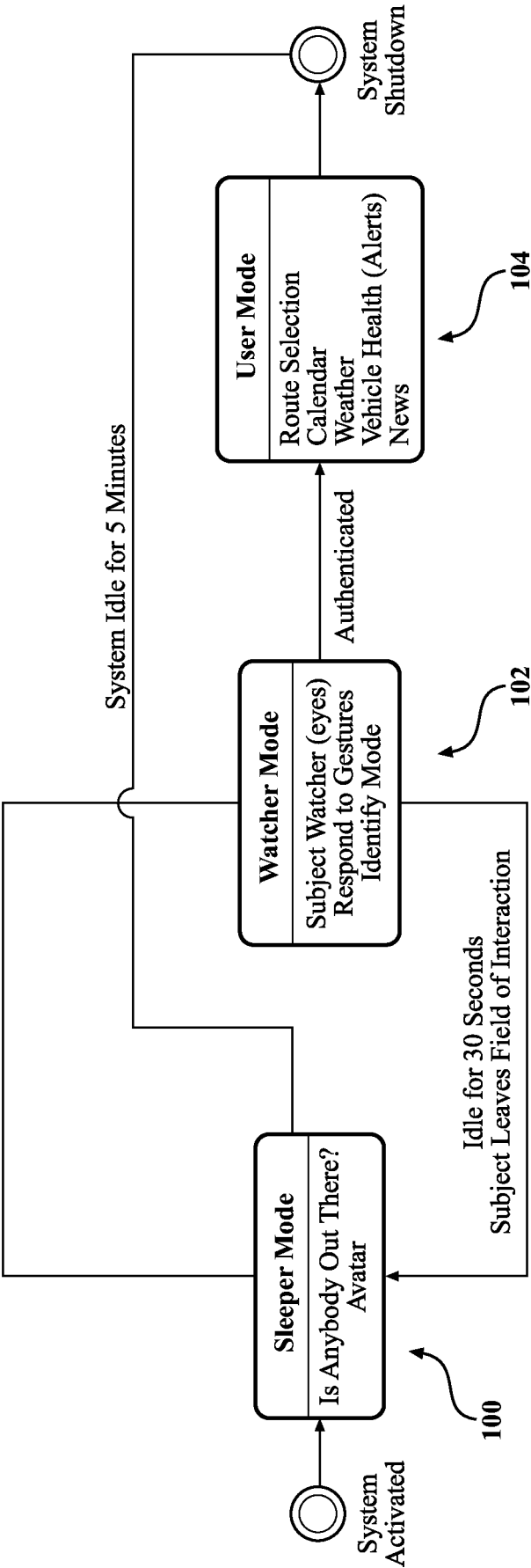


FIG. 6

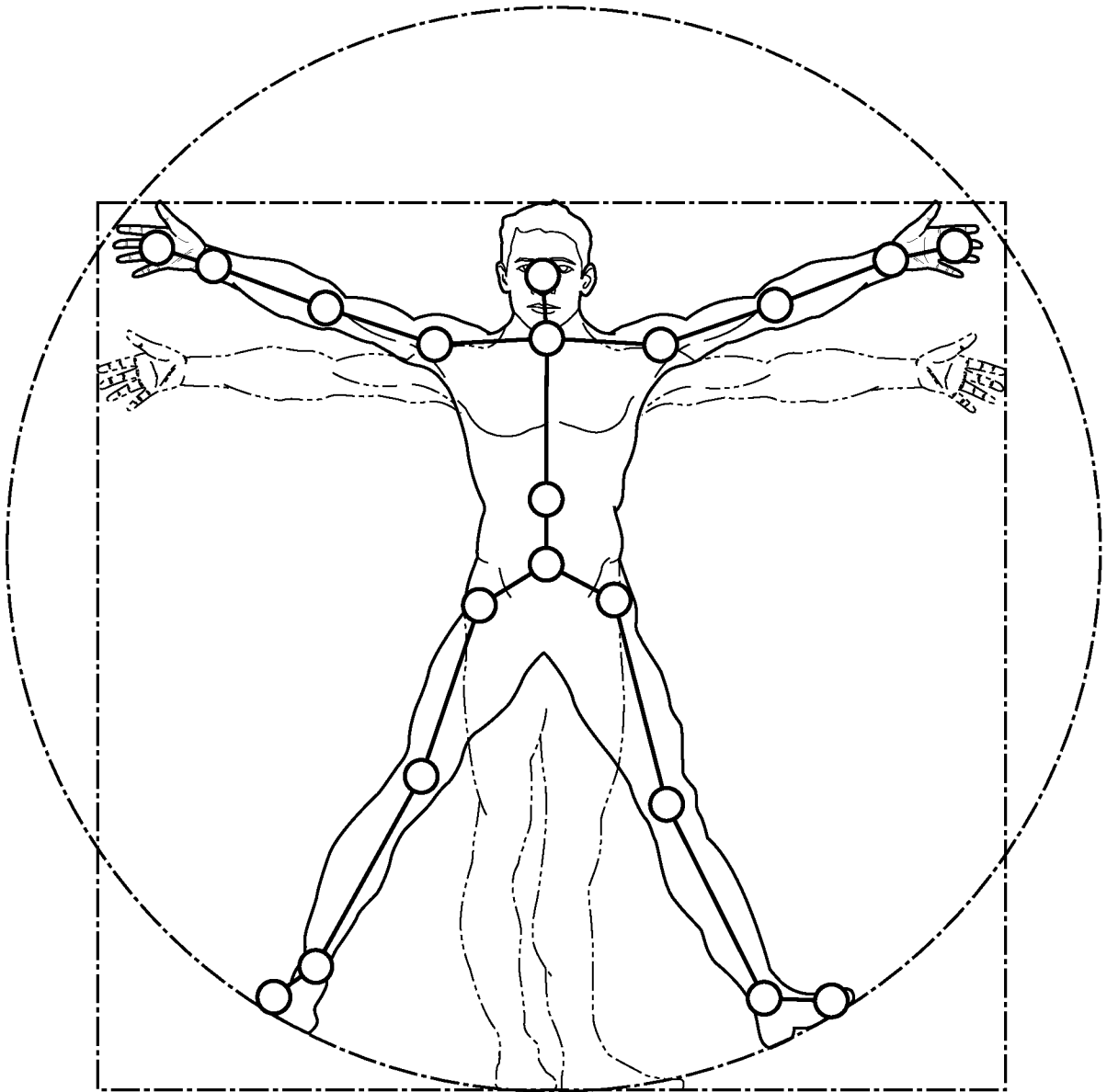


FIG. 7

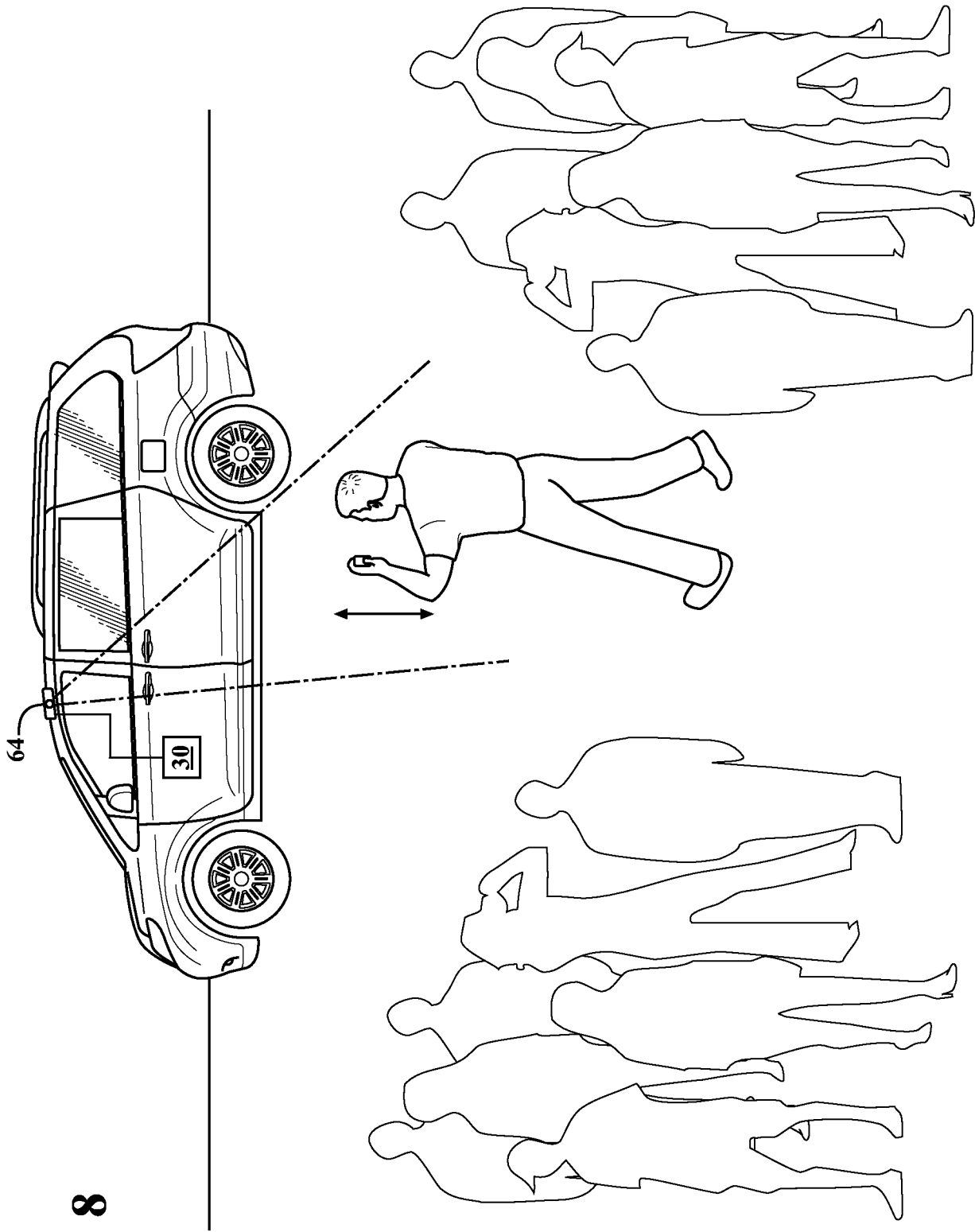


FIG. 8

FIG. 9

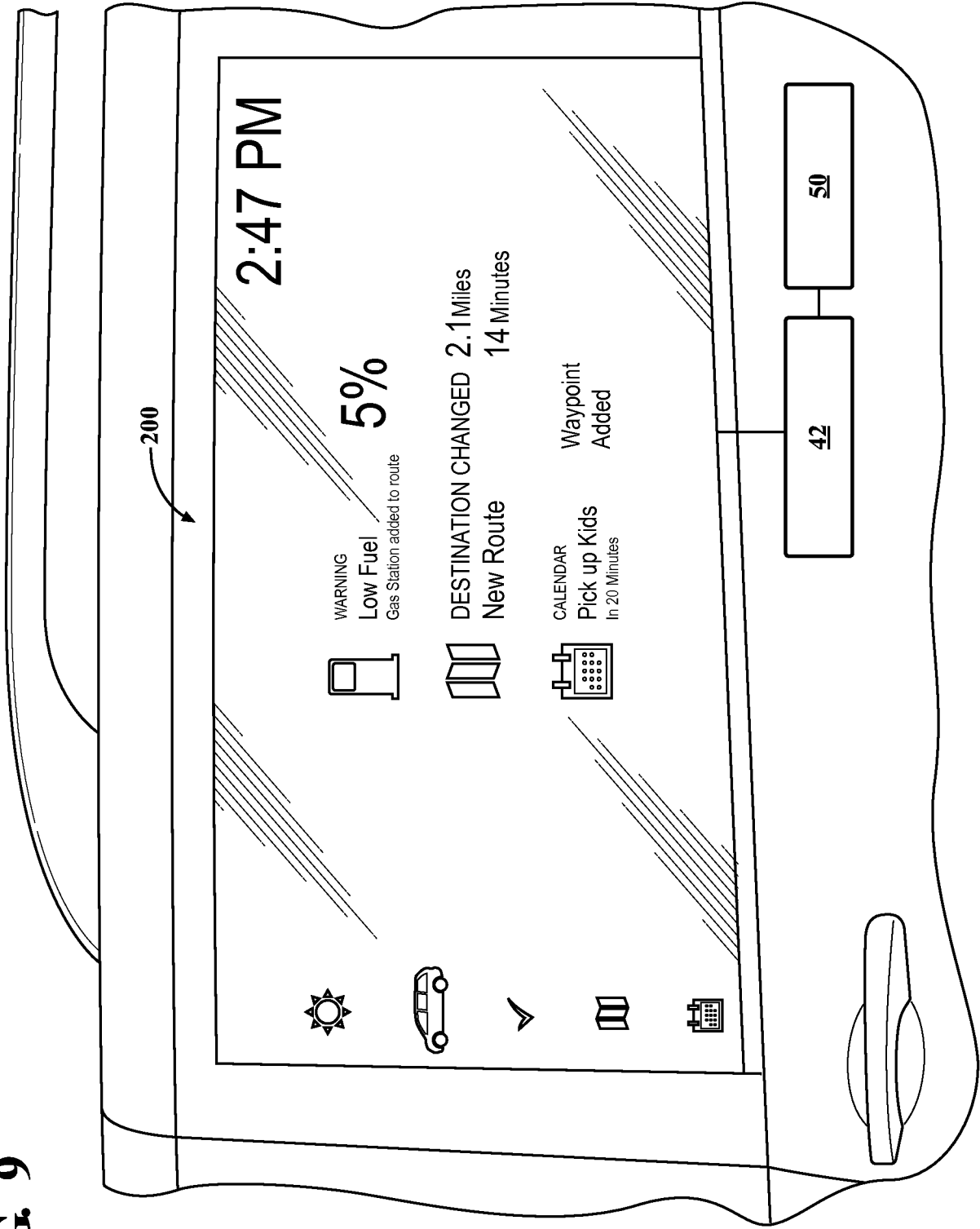


FIG. 10

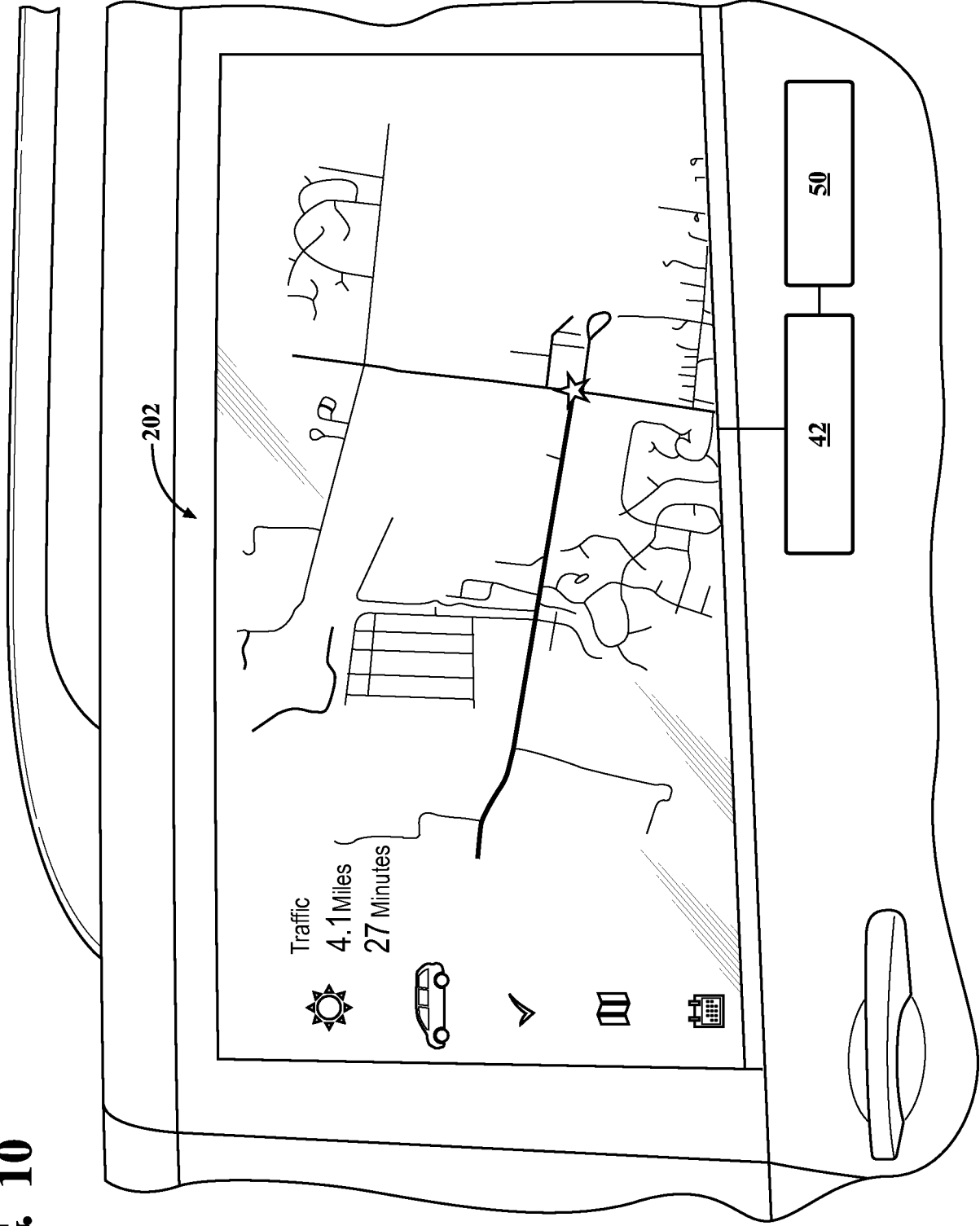


FIG. 11

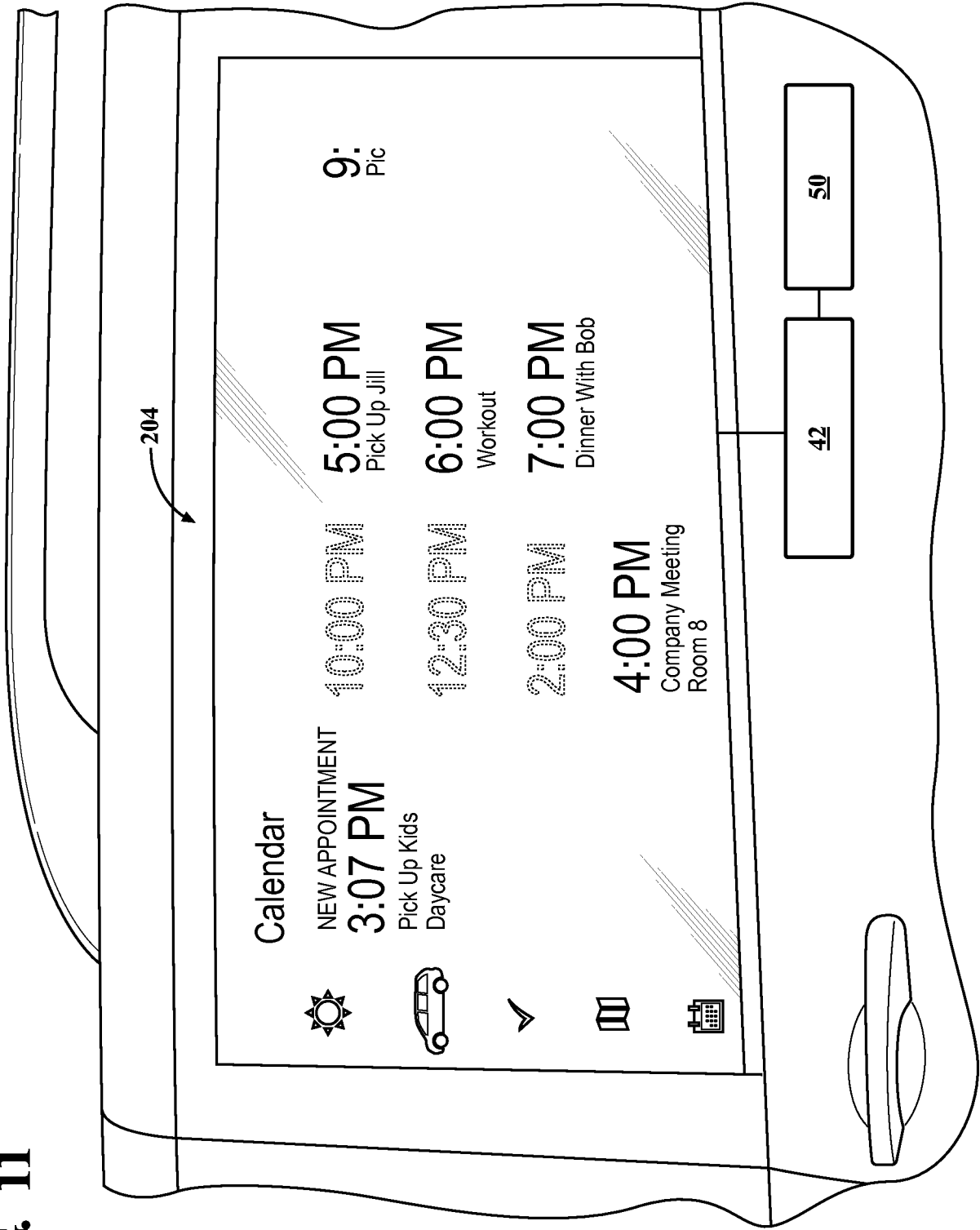


FIG. 12

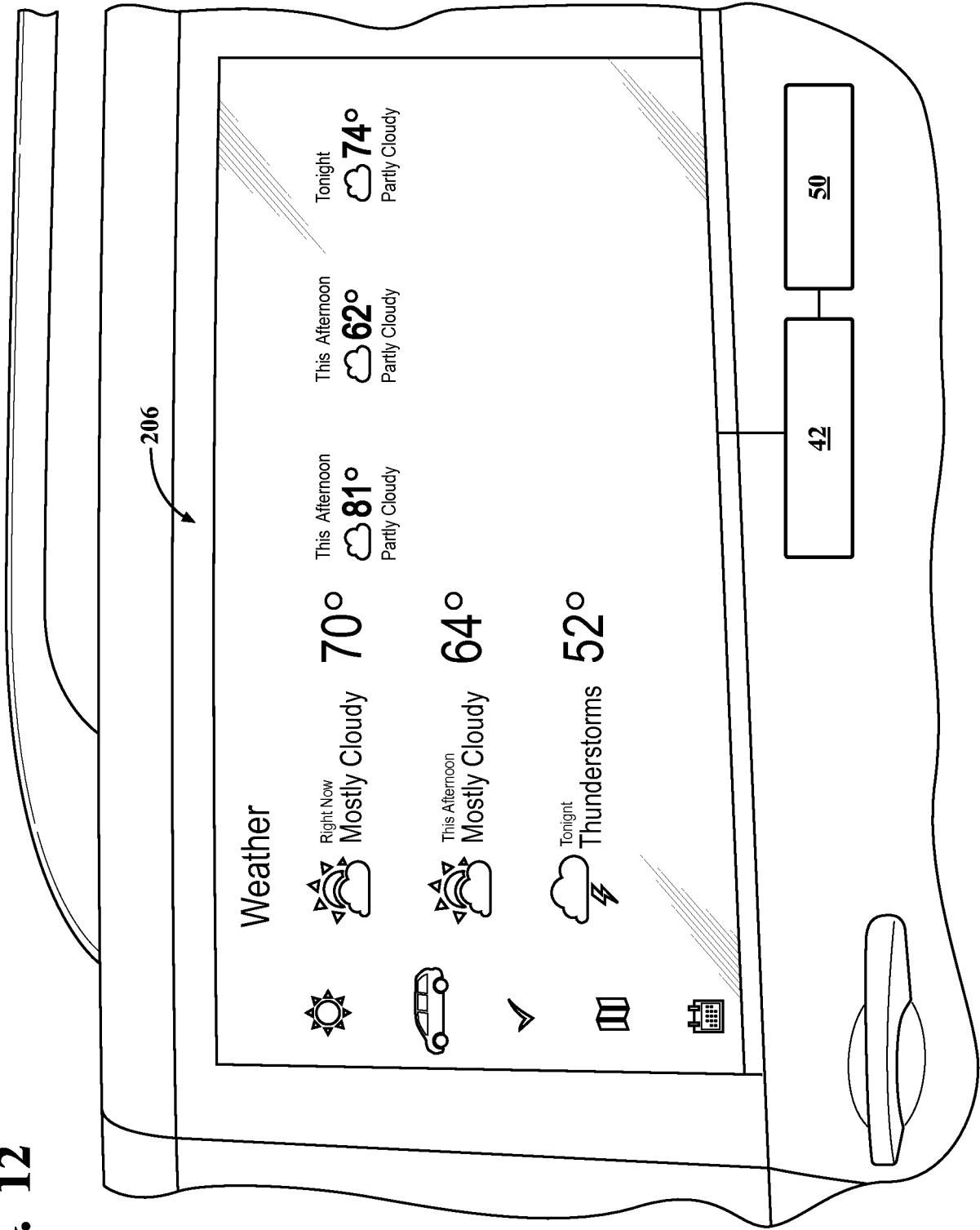


FIG. 13

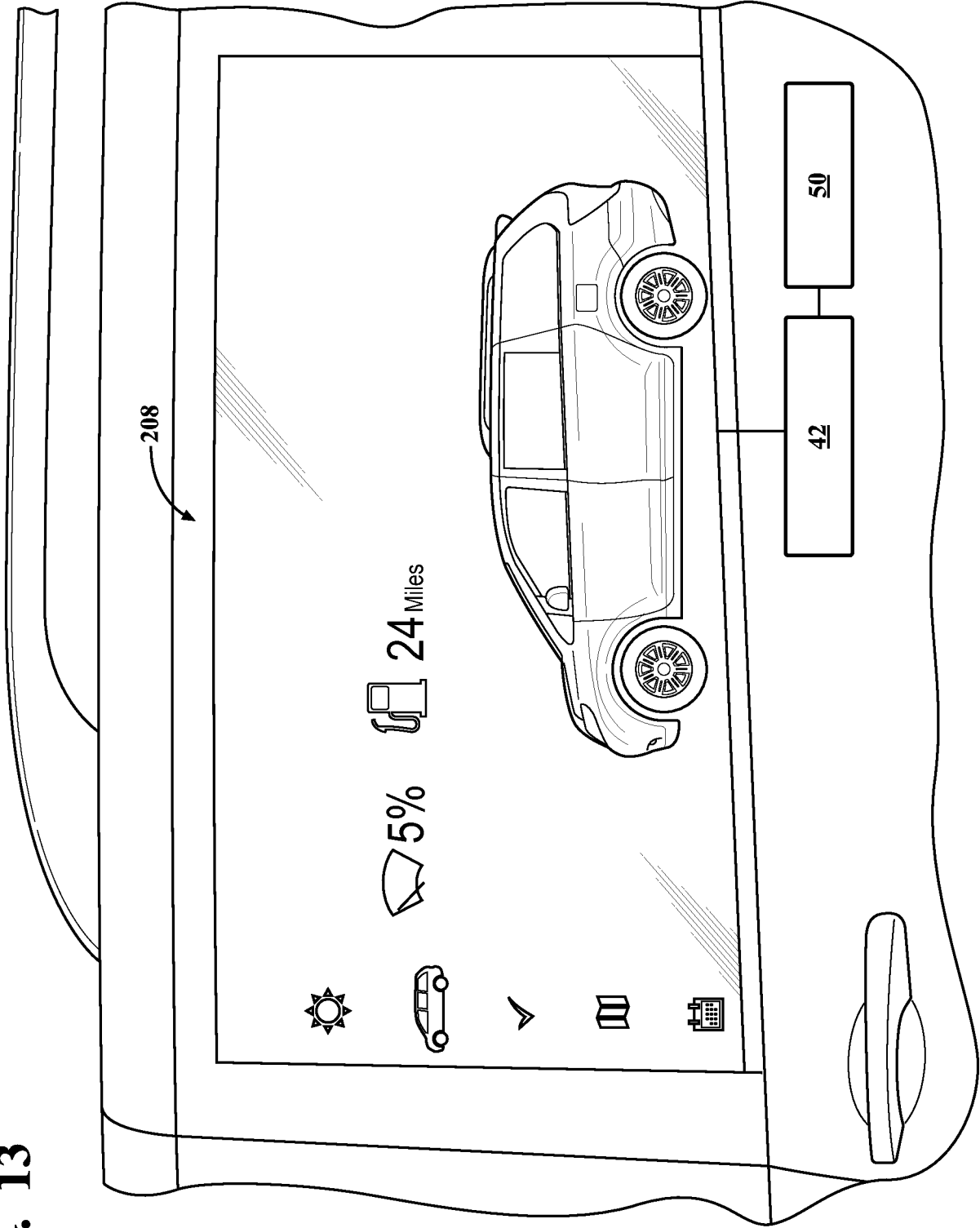
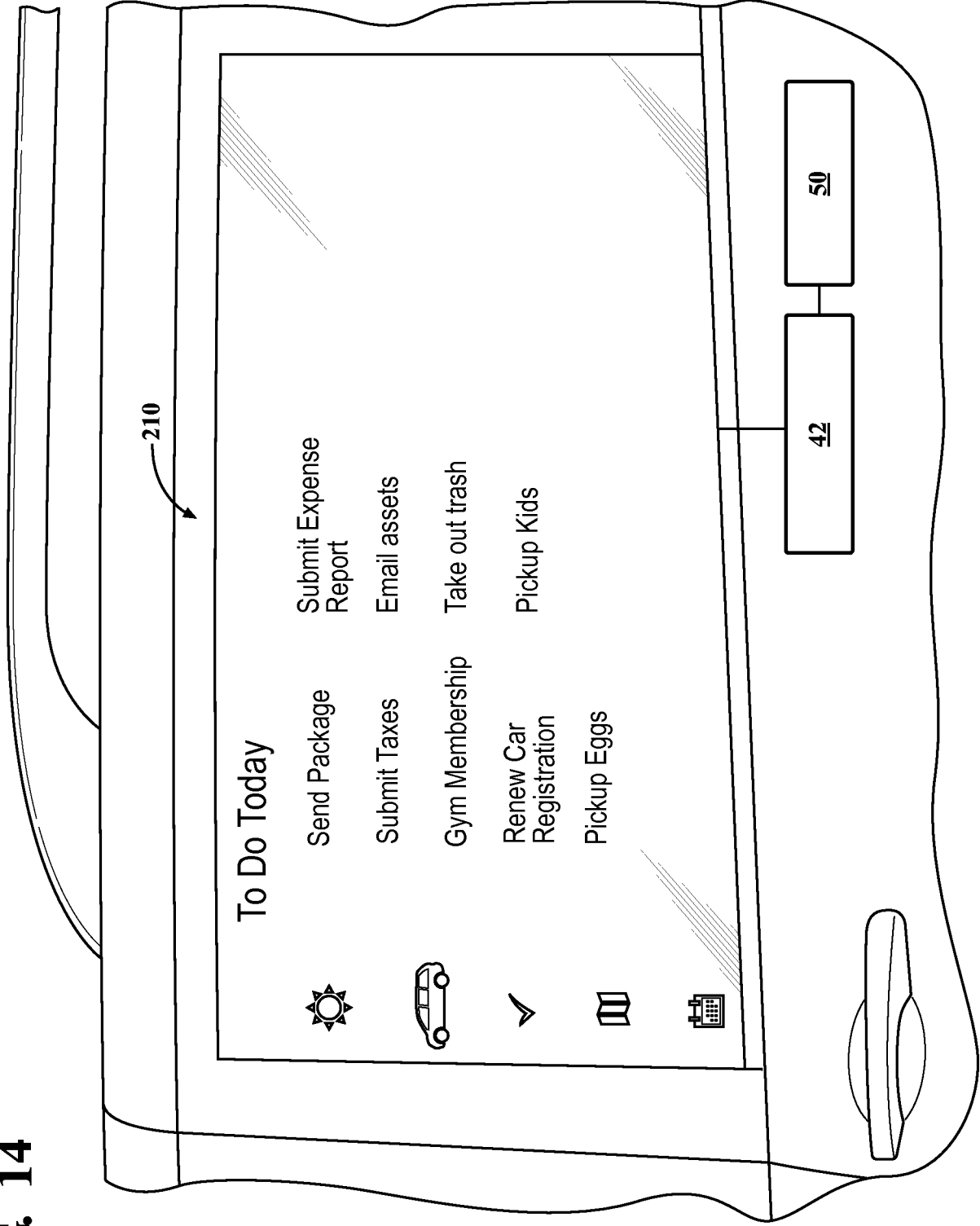


FIG. 14



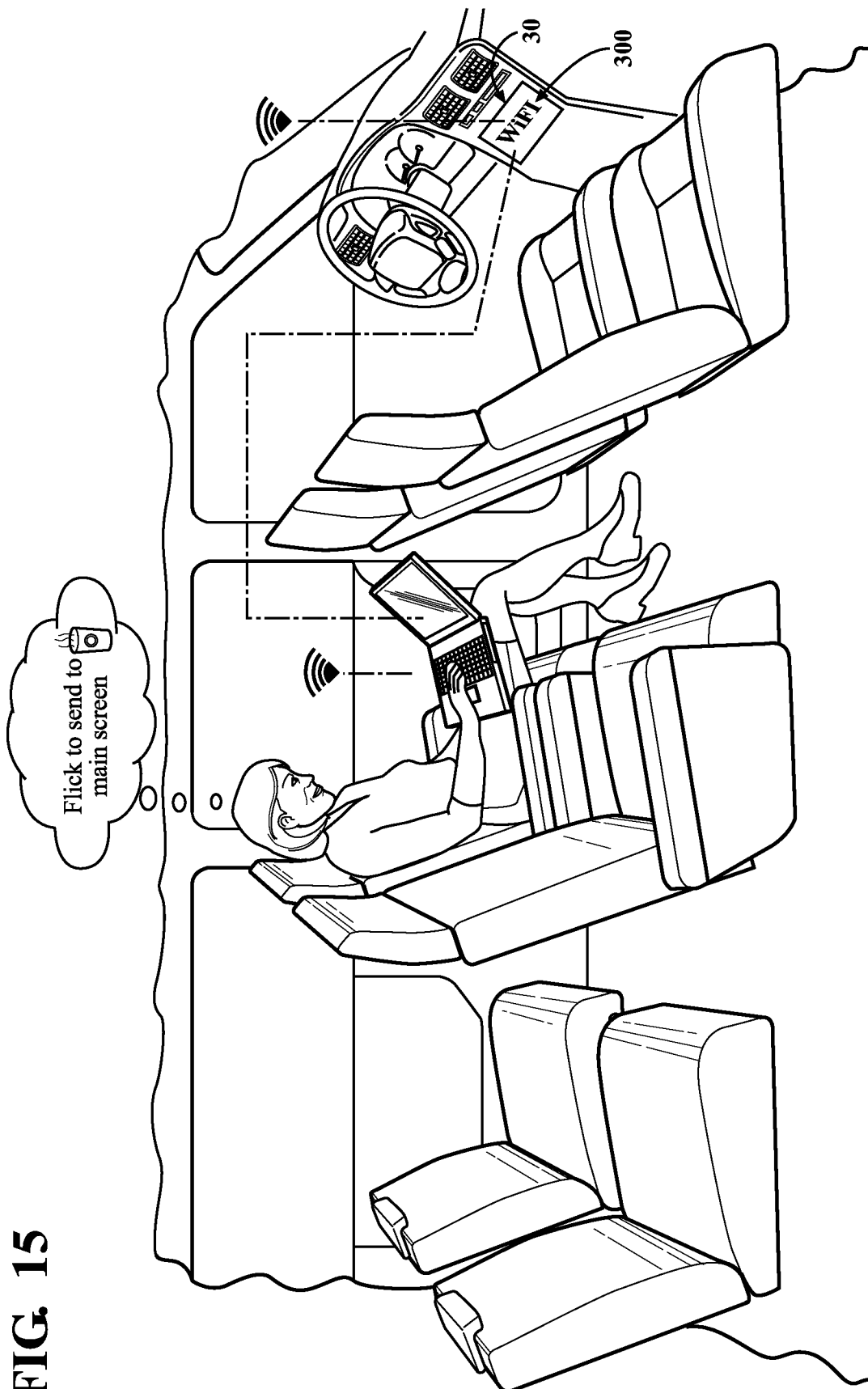
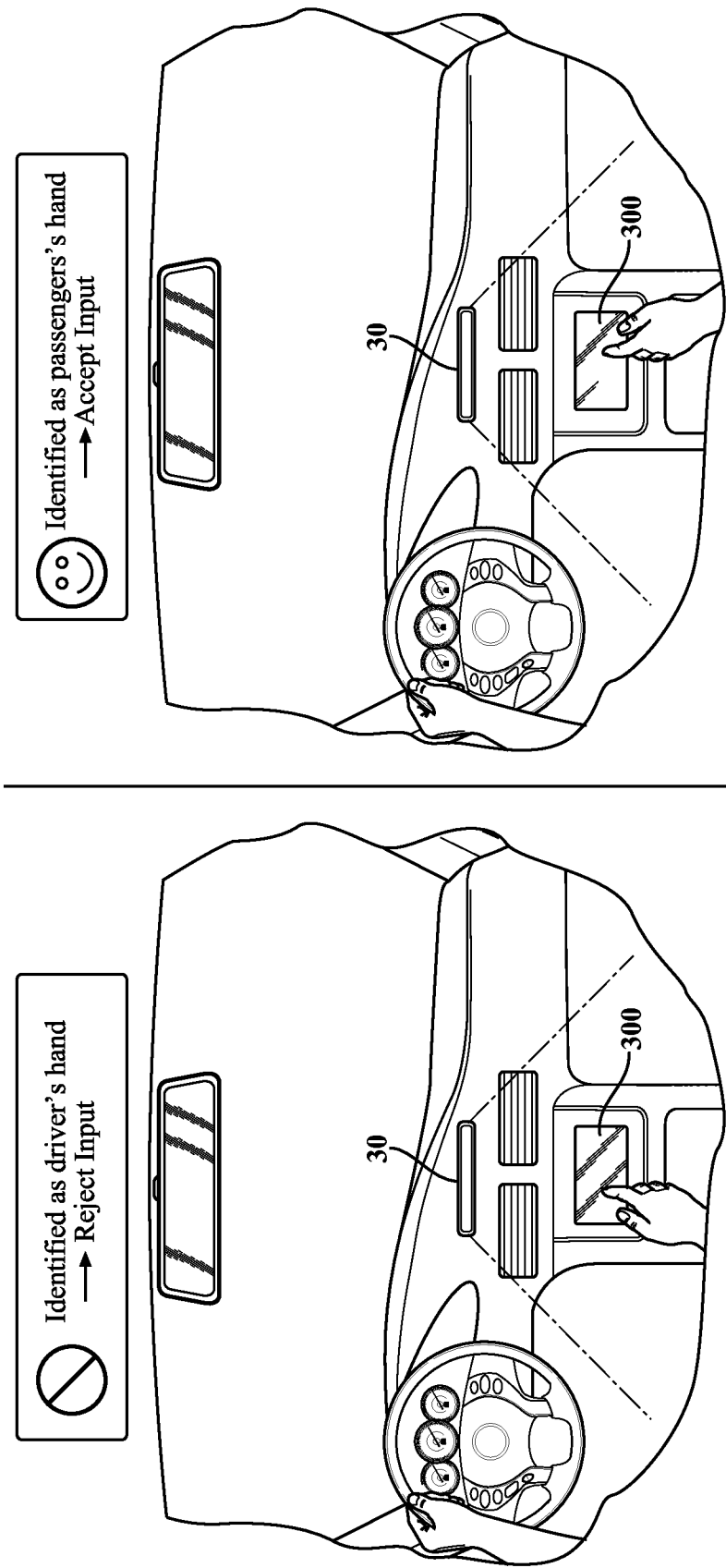


FIG. 16



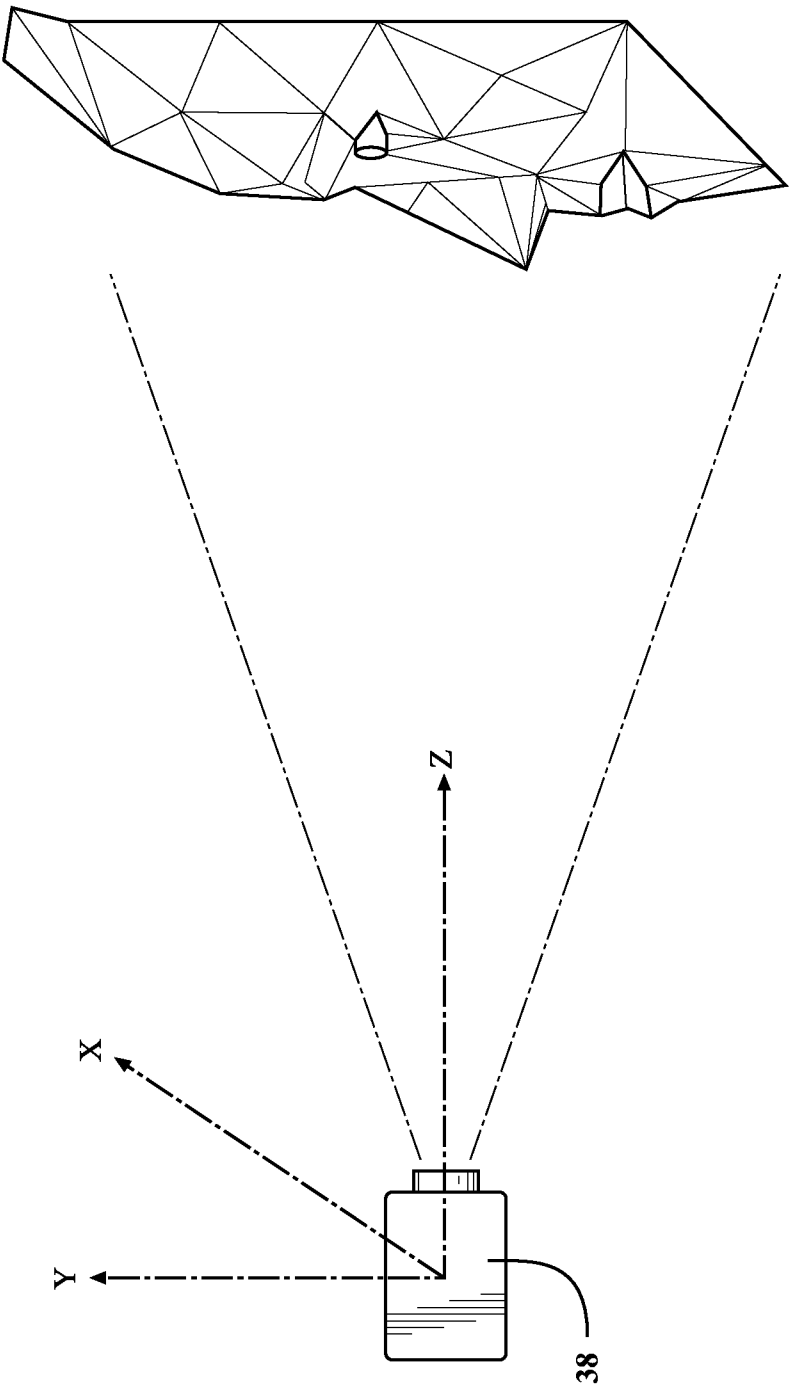
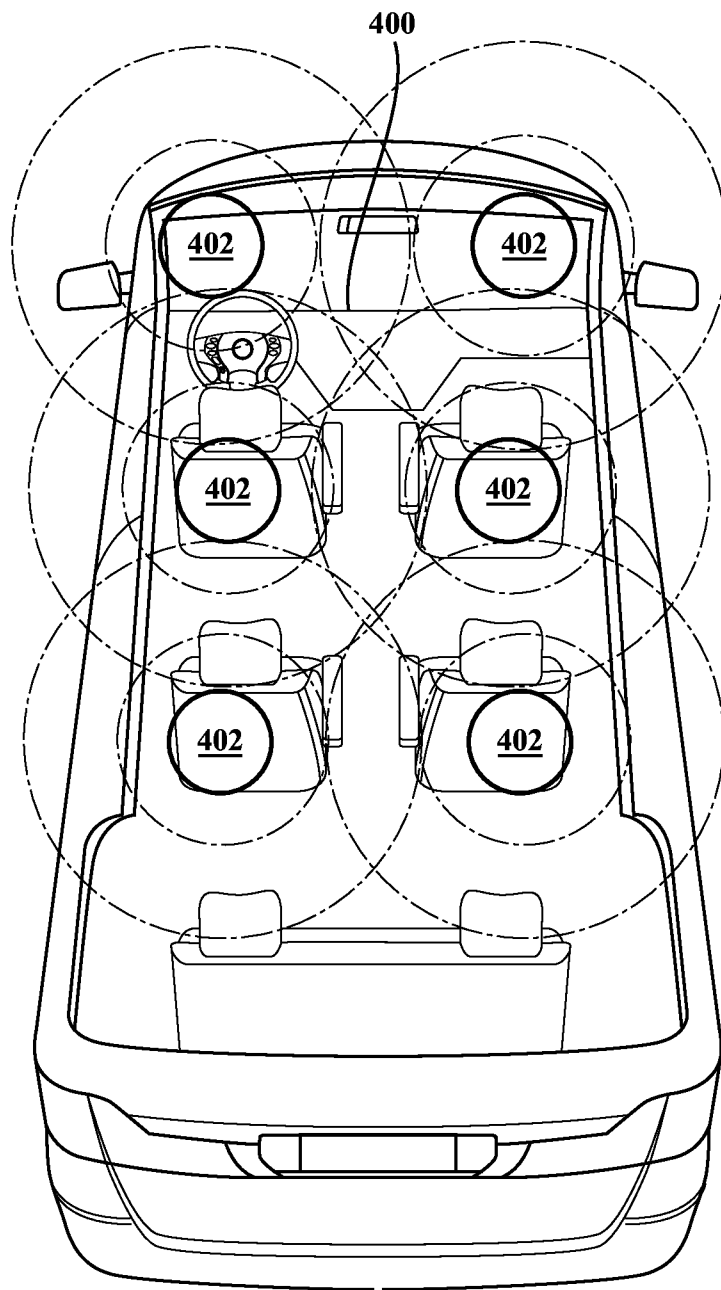


FIG. 17

**FIG. 18**

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/055752

A. CLASSIFICATION OF SUBJECT MATTER

INV. G01C21/36 B60K35/00 B60K37/00 G02B27/01 G06F3/01
G06K9/00 B60R1/00 B60Q1/26 B60Q1/50

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G01C B60K G02B G06F G06K B60R B60Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/231800 A1 (RICCI CHRISTOPHER P [US]) 5 September 2013 (2013-09-05)	1-16,
Y	paragraphs [0067], [0076], [0078], [0086], [0108], [0119], [0120], [0123] - [0125], [0141]; figure 5	18-50
Y	US 2012/089273 A1 (SEDER THOMAS A [US] ET AL) 12 April 2012 (2012-04-12)	17
A	paragraphs [0011], [0013], [0026] - [0028]	
	US 2011/001932 A1 (ZUEHLSDORFF SVEN [DE]) 6 January 2011 (2011-01-06)	1-50
	paragraph [0021]; figure 3	

☐

Further documents are listed in the continuation of Box C.

☒

See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

12 November 2014

Date of mailing of the international search report

19/11/2014

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
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Authorized officer

Rocca, Simone

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/055752

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of Item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/055752

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/055752

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		WO 2009059829 A1	14-05-2009

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-50

Interactive vehicle display with user identification

1.1. claims: 27-50

Interactive vehicle display with vehicle function control
