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DRIVER DISTRACTION FRAMEWORK

Billy Lam

Jorge Pereira

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ABSTRACT

An application library may define an infrastructure (e.g., a framework for managing, monitoring, and provisioning resources) that provides mechanisms for validating graphical user interfaces (GUIs) of an application to ensure the application complies with various standards, such as distraction and safety guidelines as specified by various traffic agencies across the globe (e.g., the Japan Automobile Manufacturers Association (JAMA), the National Highway Traffic Safety Administration (NHTSA), etc.). For example, the application library may limit a complexity of the application by constraining the number of pages in an application flow (e.g., a series of steps required to complete a task), the number of items per page, etc. Responsive to validating the GUIs, the application library may permit display of the GUIs via a head unit (e.g., an infotainment system) of a vehicle (e.g., automobile, motorcycle, a bus, a recreational vehicle (RV), a semi-trailer truck, a tractor or other type of farm equipment, a train, a plane, a helicopter, etc.).

DESCRIPTION

FIG. 1 below is a conceptual diagram illustrating a head unit 100 (e.g., an infotainment system) of a vehicle (e.g., an automobile, a motorcycle, a bus, a recreational vehicle (RV), a semi-trailer truck, a tractor or other type of farm equipment, a train, a plane, a helicopter, etc.) that includes applications 102A-102N (collectively, “applications 102”) that invoke functions of an application library 104 to display, at a presence-sensitive display 106 of head unit 100 or some other display in communication with head unit 100, graphical user interfaces (GUIs) in compliance with various standards, such as distraction and safety guidelines as specified by

various traffic agencies across the globe (e.g., the Japan Automobile Manufacturers Association (JAMA), the National Highway Traffic Safety Administration (NHTSA), etc.). As shown in FIG. 1, head unit 100 may include one presence-sensitive display 106, one or more processors 108, and one or more storage devices 110. As shown in FIG. 1, storage devices 110 includes applications 102 and application library 104.

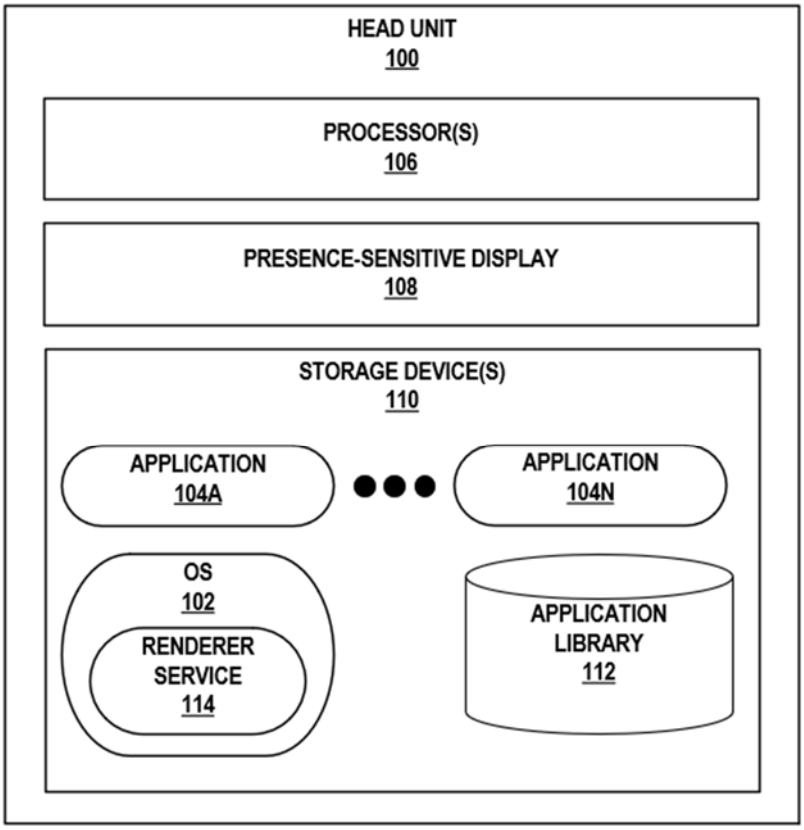

FIG. 1

Head unit 100 may operate to assist, inform, entertain, and/or provide for interactions with one or more occupants of a vehicle. Head unit 100 may represent an integrated head unit that provides a user interface (UI), such as a voice user interface (VUI), a graphical user interface (GUI), etc. In general, head unit 100 may control one or more vehicle systems, such as a heating, ventilation, and air conditioning (HVAC) system, a lighting system (for controlling interior

and/or exterior lights), an infotainment system, a seating system (for controlling a position of a driver and/or passenger seat), etc.

Presence-sensitive display 106 of head unit 100 may be a presence-sensitive display that functions as an input device and as an output device. For example, presence-sensitive display 106 may function as an input device using a presence-sensitive input component, such as a resistive touchscreen, a surface acoustic wave touchscreen, a capacitive touchscreen, a projective capacitance touchscreen, a pressure sensitive screen, an acoustic pulse recognition touchscreen, or another presence-sensitive display technology. Additionally, presence-sensitive display 106 may function as an output (e.g., display) device using any of one or more display components, such as a liquid crystal display (LCD), dot matrix display, light emitting diode (LED) display, microLED display, organic light-emitting diode (OLED) display, e-ink, active-matrix organic light-emitting diode (AMOLED) display, or similar monochrome or color display capable of outputting visible information to a user of head unit 100.

Processors 108 may implement functionality and/or execute instructions associated with head unit 100. Examples of processors 108 may include one or more of an application specific integrated circuit (ASIC), a field programmable gate array (FPGA), an application processor, a display controller, an auxiliary processor, a central processing unit (CPU), a graphics processing unit (GPU), one or more sensor hubs, and any other hardware configure to function as a processor, a processing unit, or a processing device.

Storage devices 110 may include one or more computer-readable storage media. For example, storage devices 110 may be configured for long-term, as well as short-term storage of information, such as instructions, data, or other information used by head unit 100. In some examples, storage devices 110 may include non-volatile storage elements. Examples of such

non-volatile storage elements include magnetic hard discs, optical discs, solid state discs, and/or the like. In other examples, in place of, or in addition to the non-volatile storage elements, storage devices 110 may include one or more so-called “temporary” memory devices, meaning that a primary purpose of these devices may not be long-term data storage. For example, the devices may comprise volatile memory devices, meaning that the devices may not maintain stored contents when the devices are not receiving power. Examples of volatile memory devices include random-access memories (RAM), dynamic random-access memories (DRAM), static random-access memories (SRAM), etc.

Applications 102 may represent third-party applications that a user of head unit 100 obtains via application store services. Applications 102 may extend the software functionality of head unit 100, where applications 102 may execute within an execution environment provided by an operating system of head unit 100 or a computing device (e.g., a cellular phone, a smartphone, a desktop computer, a laptop computer, a tablet computer, a portable gaming device, a portable media player, an e-book reader, a watch (including a so-called smartwatch), a gaming controller, etc.) in communication with head unit 100.

Applications 102 may, as a few examples, provide gaming services (e.g., video games), email services, web browsing services, texting and/or chat services, web conferencing services, video conferencing services, music services (including streaming music services), video services (including video streaming services), navigation services, word processing services, spreadsheet services, slide and/or presentation services, assistant services, text entry services, or any other service commonly provided by applications.

As further shown in FIG. 1, storage device 110 includes application library 104. Application library 104 may represent a collection of implementations of behavior that has a

well-defined interface by which the behavior is invoked. For instance, application library 104 may store a set of implementation behaviors, such as configuration data, pre-written code, subroutines, values, classes, etc. In some examples, application library 104 represents a collection of non-volatile resources (e.g., configuration data, documentation, help data, message templates, pre-written code and subroutines, classes, values, type specifications, etc.).

In general, third-party developers ("developers") may develop applications 102 for head unit 100 of a vehicle. Applications 102 may need to satisfy various guidelines (relating to, e.g., consistency, predictability, customizability, etc.) to ensure driver safety and a positive user experience. For example, as shown below in FIG. 2, various traffic agencies across the globe (e.g., JAMA, NHTSA, etc.) may specify distraction and safety guidelines with which applications 102 must comply. For example, a non-JAMA traffic agency may have a list limit of 21 for single action lists, 6 for settings lists, 6 for radio lists, 6 to 9 for map lists, 3 for route lists, and 3 rows for a detailed view. JAMA may have a list limit of 12 for single action lists. Due to the various distraction and safety guidelines, developing applications 102 for head unit 100 to be in compliance with such standards may be inconvenient, time-consuming, and even difficult.

	Lists (single action)	Lists (multi action)	Settings lists	Radio lists	Map lists	Route lists	Detail view
List limit (non-JAMA)	21	?	6	6	6-9	3	3 rows
List limit (JAMA)	12	?	?	?	?	?	?

FIG. 2

In accordance with techniques of this disclosure, application library 104 may define an infrastructure (e.g., a framework for managing, monitoring, and provisioning resources) that provides mechanisms for validating GUIs of applications 102 to ensure applications 102 comply

with various standards. For example, application library 104 may limit a complexity of applications 102 by constraining the number of pages in an application flow (e.g., a series of steps required to complete a task), the number of items per page, etc. Responsive to validating the GUIs, application library 104 may permit display of the GUIs via presence-sensitive display 106 of head unit 100.

Applications 102 may invoke functions from application library 104 that allow applications 102 to generate a GUI based on a GUI template. The GUI template may be a pre-determined layout (in this way ensuring a consistent look and feel) and include standard GUI elements, such as grids, lists, tab bars, etc. In some examples, the GUI template may be customizable (e.g., the elements of the GUI template may be rearranged). Applications 102 may populate the GUI template with content, such as images, text, etc.

As noted above, application library 104 may define an infrastructure that provides mechanisms for validating GUIs of applications 102 to ensure applications 102 comply with various standards. For example, application library 104 may limit a complexity of applications 102 by constraining the number of pages in an application flow (e.g., a series of steps required to complete a task), the number of items per page, etc. For example, as shown in FIG. 3 below, application library 104 may constrain the number of different pages in an application flow to a

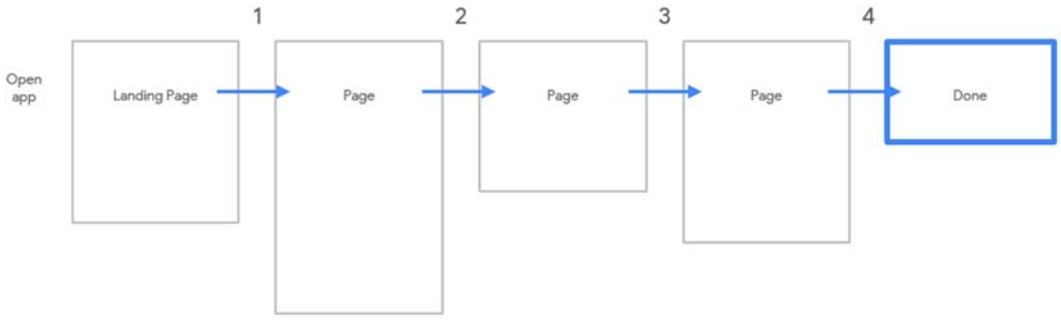

FIG. 3

maximum of 4 different pages (not including a landing page of applications 102) to comply with various distraction and safety guidelines, including those of JAMA. In other words, application library 104 may constrain the number of transitions between different pages in an application flow to a maximum of 4 transition (such that transitioning forward and backward between already visited pages does not count toward the number of transitions).

Similarly, application library 104 may constrain the number of items per page to a maximum of 6, However, it should be understood that application library 104 may constrain the number of pages in the application flow to a maximum of 3 pages, 5 pages, or any other number of pages, and may constrain the number of items per page to a maximum of 4 items, 5 items, 7 items, or any other number of items. In some examples, the maximum number of pages in the application workflow and maximum number of items per page may be based on a type of applications 104 (e.g., a communication application, a navigation application, a media playback application, etc.).

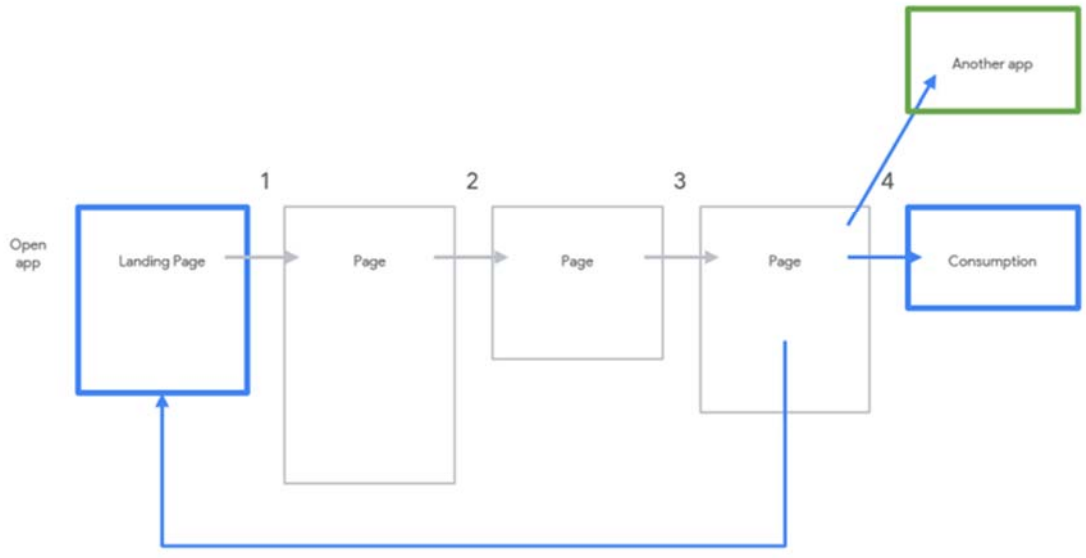

FIG. 4

As shown in FIG. 4, an application flow may be ‘done’ (FIG. 3) when the application flow reaches a consumption page (e.g., a page that provides a “sit-and-stay” experience, such as navigation, media playback, in-call information, etc.), returns to a landing page (FIG. 3), or another application is opened. As such, for application library 104 to validate an application flow and permit display of the GUIs of application library 104, the application flow may need to progress from the landing page to the consumption page in a maximum of, for example, 4 steps. In some examples, transitioning forwards and backwards between already visited pages in the application flow, scrolling a page, performing toggles, and the like may not count as a step.

In some cases, applications 102 may provide an optional application subflow (e.g., to allow a user to change settings, filter a list, edit a field, etc.) that deviates from a primary application flow of a given task. Each step in the application subflow may count to the overall number of steps (e.g., 4 steps) allowed by application library 104 such that any application flow (irrespective of whether the application flow includes one or more pages of an optional application subflow) can only include a maximum of 4 pages (not including the landing page).

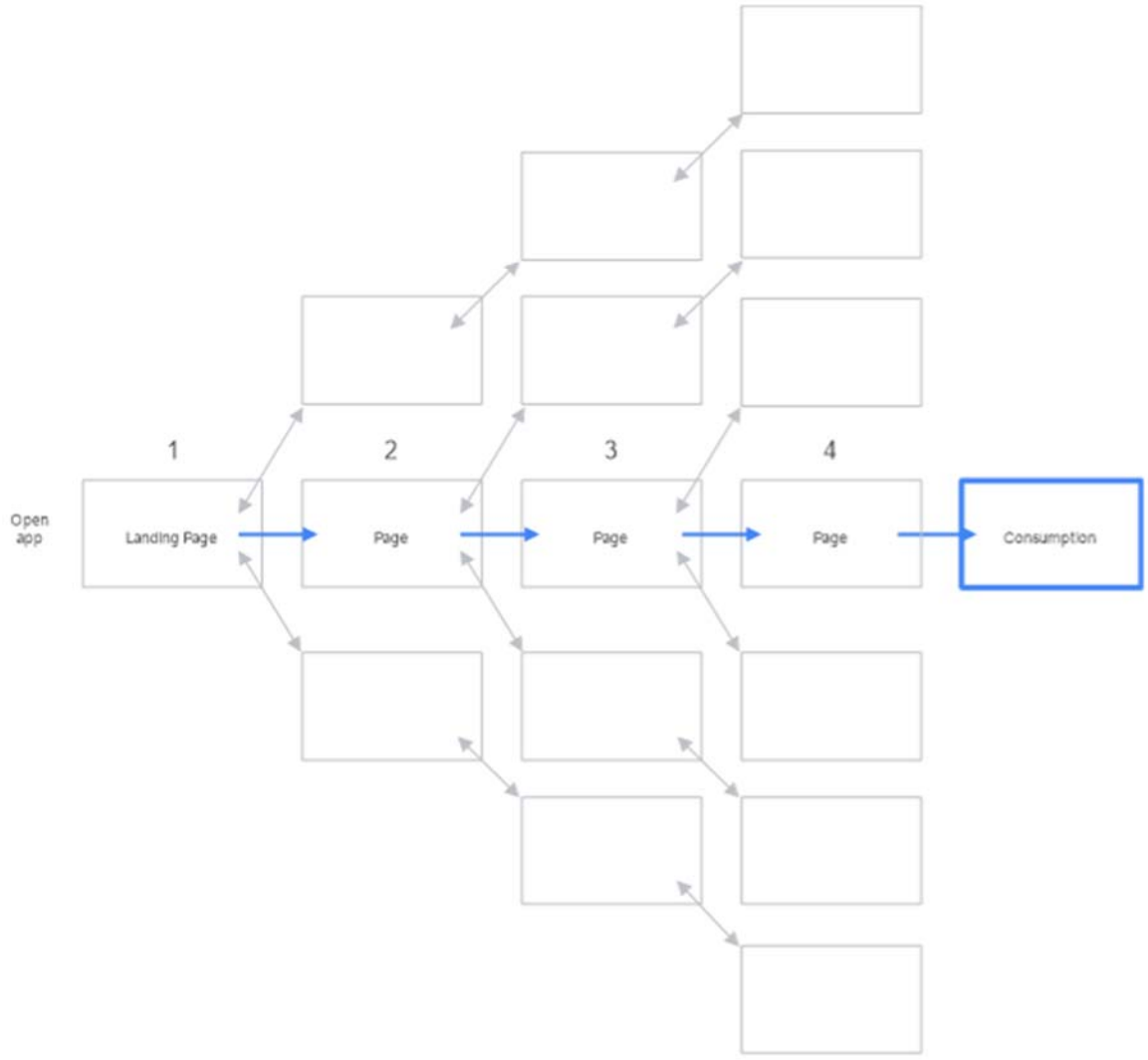

FIG. 5

Various examples of application flows for a navigation application are shown in FIGS. 6A-6D below. In FIG. 6A, the application flow includes a single step of transitioning from a landing page to a navigation page in response to a user selecting a home tab.

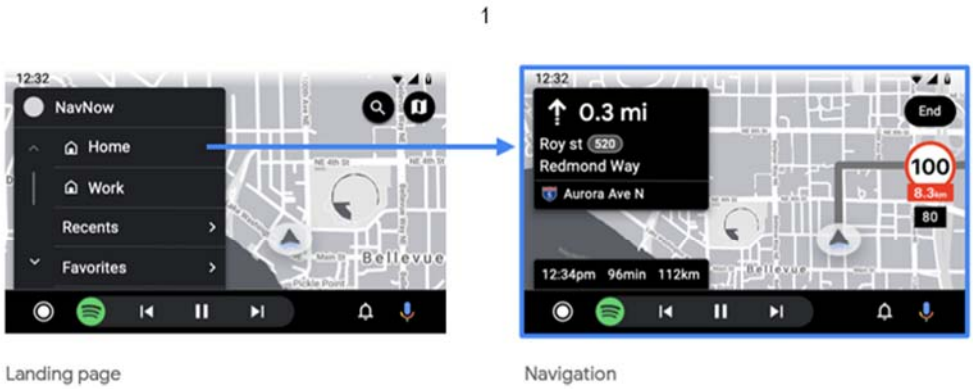

FIG. 6A

In FIG. 6B, the application flow includes a first step of transitioning from a landing page to a list page in response to a user selecting a recents tab, and a second step of transitioning from the list page to a navigation page in response to the user selecting a place.

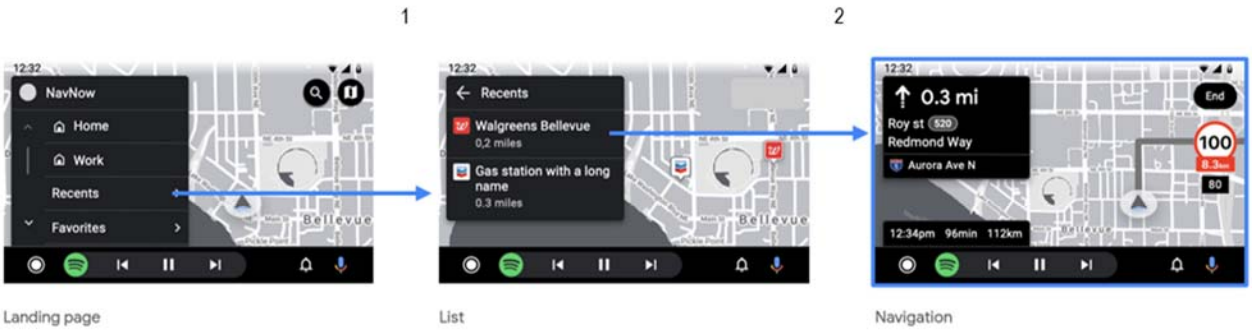

FIG. 6B

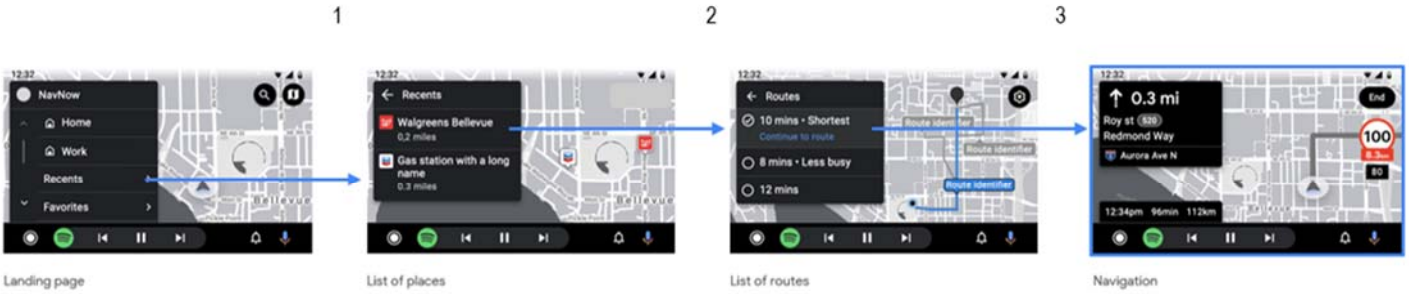

FIG. 6C

In FIG. 6C, the application flow includes a first step of transitioning from a landing page to a list of places page in response to a user selecting a recents tab, a second step of transitioning from the list of places page to a list of routes page in response to the user selecting a place, and a third step of transitioning from the list of routes page to a navigation page in response to the user selecting a route.

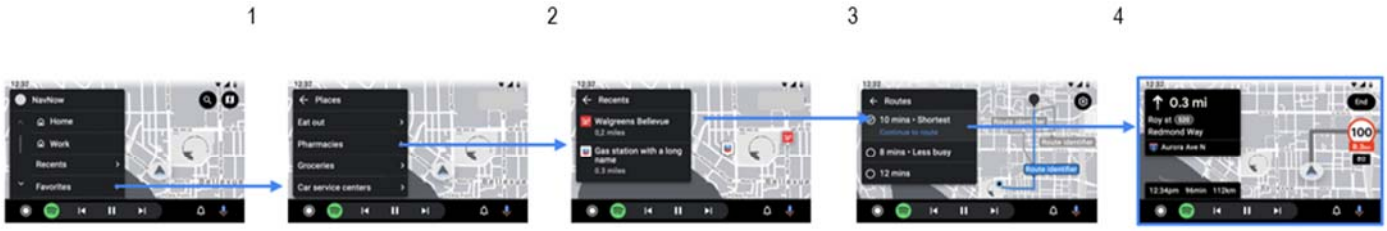

FIG. 6D

In FIG. 6D, the application flow includes a first step of transitioning from a landing page to a list of general places page in response to a user selecting a favorites tab, a second step of transitioning from the list of general places page to a list of specific places page in response to

the user selecting a general place, a third step of transitioning from the list of specific places page a list of routes page in response to the user selecting a specific place, and a fourth step of transitioning from the list of routes page to a navigation page in response to the user selecting a route.

Accordingly, developers may use application library 104 to develop applications 102 to make applications 102 compliant with various distraction and safety guidelines. Furthermore, design guidelines may be published that provide user experience (UX) principles (e.g., show actionable content early in the application flow, combine steps where possible, provide pre-filled choices, etc.), do's and don'ts, sample user interface (UI) flows for different kinds of use cases (e.g., browse flows, settings flows, detail page layouts, etc.), and so on. For instance, the guidelines may explicitly prohibit application flows intended to circumvent the constraints of application library 104.

In some examples, applications 102 may, via application library 104, limit the amount of user interactions with applications 102. For example, applications 102 may incorporate an attention buffer to monitor an amount or rate of interaction with content presented by GUIs of applications 102 and suspend user interaction when a level of the attention buffer indicates the amount or rate of interaction exceeds pre-determined thresholds for situationally-aware driving. In this way, the attention buffer may serve to encourage a responsible interaction level and suspend an irresponsible interaction level. A level of the attention buffer may decrease or increase based on user inputs (e.g., tapping, scrolling, swiping, etc.). For example, applications 102 may decrease the level of the attention buffer in response to presence-sensitive display 106 receiving user inputs. Similarly, applications 102 may decrease the level of the attention buffer in response to determining that no user inputs have been received in a given time period.

One or more advantages of the techniques described in this disclosure include ensuring that user experiences with applications 102 are safe and suitable for use while driving. For examples, the techniques may limit the amount of information that applications 102 present to a user driving a vehicle, and the amount of interactions that users can perform within applications 102. In this way, the techniques help developers develop applications 104 that adhere to distraction and safety guidelines as specified by various traffic agencies across the globe.

It is noted that the techniques of this disclosure may be combined with any other suitable technique or combination of techniques. As one example, the techniques of this disclosure may be combined with the techniques described in U.S. Patent Application Publication No. 2014/0106726A1. In another example, the techniques of this disclosure may be combined with the techniques described in U.S. Patent Application Publication No. 2018/0054570A1. In yet another example, the techniques of this disclosure may be combined with the techniques described in "SDL Overview Guides," CloudFront, August 12, 2019. In yet another example, the techniques of this disclosure may be combined with the techniques described in "CarPlay App Programming Guide," Apple, March 31, 2021. In yet another example, the techniques of this disclosure may be combined with the techniques described in "Media Constants," Android Developers, September 1, 2021.