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REDUCING DISTRACTED DRIVING

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ABSTRACT

An operating system of a computing device (e.g., a smartphone, mobile phone, a tablet computer, a laptop computer, a wearable device, etc.) may limit various features of the computing device based on the location of the computing device within 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, train, a plane, a boat, a helicopter, a personal transport vehicle, etc.). In some examples, the computing device may use ultra-wideband technology to perform device localization and in turn distinguish between being located in the driver's area (e.g., the driver's seat, the dashboard, etc.) of the vehicle and other areas (e.g., a passenger's area, which may include a passenger's seat) of the vehicle. If the computing device is located within the driver's area of the vehicle (which may indicate that if a user is using the computing device, the user is the driver), the computing device may limit the ability of the user to use certain functionality of the computing device by operating in a limited functionality mode. For instance, the computing device may permit access to some applications (e.g., navigation applications, ridesharing applications, music streaming applications, etc.) but limit or prevent access to and/or usage of others (e.g., text messaging applications, video streaming services, social media applications, etc.).

DESCRIPTION

FIG. 1 below is a conceptual diagram illustrating a computing device 100 with an operating system 102 ("OS 102") configured to limit various features of computing device 100 while a user 104 of computing device 100 is operating a vehicle 106 (e.g., an automobile, a motorcycle, a bus, a recreational vehicle (RV), a semi-trailer truck, a tractor or other type of farm equipment, train, a plane, a boat, a helicopter, a personal transport vehicle, etc.). As shown in FIG. 1, computing device 100 may include a presence-sensitive display 108, one or more processors 110, one or more communication components 112 ("COMM components 112"), and one or more storage devices 114. Storage devices 114 may include OS 102 and one or more applications 116.

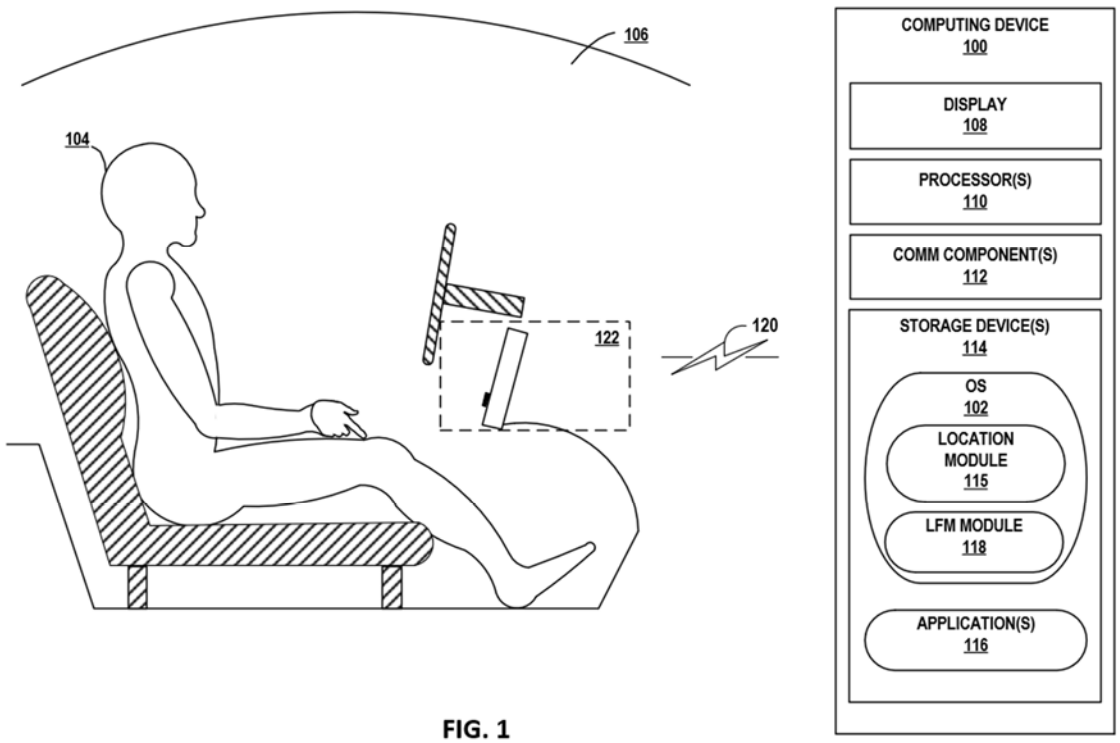

FIG. 1

In the example of FIG. 1, computing device 100 is a mobile computing device configured in accordance with techniques of this disclosure. Examples of computing device 100 may include a mobile phone, a tablet computer, a laptop computer, a wearable device (e.g., a computerized watch, computerized eyewear, etc.), a personal digital assistant (PDA), a gaming system, a media player, an e-book reader, a mobile television platform, etc.

Presence-sensitive display 108 of computing device 100 may be a presence-sensitive display that functions as an input device and as an output device. For example, presence-sensitive display 108 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 capacitive touchscreen, etc. Additionally, presence-sensitive display 108 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 computing device 100.

Processors 110 may implement functionality and/or execute instructions associated with computing device 100. Examples of processors 110 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.

Computing device 100 may include COMM components 112. COMM components 112 may receive and transmit various types of information over a network, such as a cellular radio, a third-generation (3G) radio, a fourth-generation (4G) radio, a fifth-generation (5G) radio, a Bluetooth® radio (or any other personal area network (PAN) radio), a near-field communication (NFC) radio, a WiFi® radio (or any other wireless local area network (WLAN) radio), and/or the like. Computing device 100 may be configured to use COMM components 112 to support ultra-wideband (UWB) technology. For example, computing device 100 may employ UWB via COMM components 112 for wireless car entry.

Storage devices 114 may include one or more computer-readable storage media. For example, storage devices 114 may be configured for long-term, as well as short-term storage of information, such as instructions, data, or other information used by computing device 100. In some examples, storage devices 114 may include non-volatile storage elements. Examples of such non-volatile storage elements include magnetic hard disks, 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 114 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.

Even though using computing device 100 while operating vehicle 106 is clearly dangerous and generally illegal, user 104 of computing device 100 may nonetheless be tempted to do so. For example, user 104 may use computing device 100 to text a friend or watch a video while driving vehicle 106. Being distracted while driving in this way poses a high risk of injury not only for user 104 but also other drivers. In fact, according to the National Highway Traffic Safety Administration, distracted driving claimed 3,142 lives in 2019, a statistic that is especially concerning because of the preventable nature of the incidents.

In accordance with techniques of this disclosure, OS 102 of computing device 100 may limit various features of computing device 100 while user 104 of computing device 100 is operating vehicle 106. For example, because the location of computing device 100 within vehicle 106 may indicate whether user 104 is using computing device 100 while operating vehicle 106, a location module 115 may determine the location of computing device 100 within vehicle 106. Responsive to location module 115 determining that computing device 100 is located within the driver's area (e.g., the driver's seat, the dashboard, etc.) of vehicle 106, a limited functionality mode module 118 ("LFM module 118") may cause computing device 100 to enter a limited functionality mode. While computing device 100 is operating in the limited functionality mode, OS 102 may limit or prevent usage of one or more of applications 116 executing at computing device 100, in this way reducing the rate of distracted driving and improving road safety.

As noted above, location module 115 may determine the location of computing device 100. For example, location module 115 may determine the location of computing device 100 within vehicle 106 based on one or more UWB wireless signals 120 ("UWB signals 120") received by COMM components 112 of computing device 100 from one or more UWB transmitters 122. In some examples, one or more UWB transmitters 122 may be installed at various locations in vehicle 106 (e.g., in the middle of the dashboard, in the driver's side door handle, in the steering wheel, etc.).

Based on UWB signals 120, location module 115 may determine whether computing device 100 is outside vehicle 106, inside the passenger compartment of vehicle 106, in a passenger's area of vehicle 106, in a driver's area of vehicle 106, etc. That is, location module 115 may use UWB signals 120 from UWB transmitters 122 to perform device localization. For example, location module 115 may use a time-of-flight parameter to determine the distance of computing device 100 from UWB transmitters 122. As used here, time-of-flight may refer to the amount of time required for UWB transmitters 122 to send UWB signals 120 and COMM components 112 of computing device 100 to receive UWB signals 120. Because time-of-flight is correlated to distance, location module 115 may process the time-of-flight parameter to determine the distance between computing device 100 and UWB transmitters 122. In examples where two or more UWB transmitters 122 are installed, location module 115 may perform triangulation to determine distance and direction of computing device 100 from UWB transmitters 122.

Location module 115 may use the location of UWB transmitters 122 within vehicle 106 and the determination of distance (and in some cases direction) of computing device 100 from UWB transmitters 122 to determine the area of vehicle 106 in which computing device 100 is located. For example, if UWB transmitters 122 are installed by the driver's door and, based on the time-of-flight parameter, computing device 100 is 20 centimeters (cm) from UWB transmitters 122, location module 115 may determine that computing device 100 is in the driver's area, indicating a high probability that user 104 is sitting in the driver's seat and operating vehicle 106. However, if, based on the time-of-flight parameter, computing device 100 is instead 1.5 meters (m) from UWB transmitters 122, location module 115 may determine that computing device 100 is located in the passenger's area of vehicle 106, indicating a high probability that user 104 is not sitting in the driver's seat or at least not using computing device 100 while operating vehicle 106.

As demonstrated by the above example, location module 115 may determine whether computing device 100 is in the driver's area based on only distance. However, location module 115 may more accurately determine the location of computing device 100 within vehicle 106 when both the distance and direction of computing device 100 from at least one of UWB transmitters 122 are known (e.g., by performing triangulation).

In any case, responsive to location module 115 determining that computing device 100 is located in the driver's area, LFM module 118 may activate a limited functionality mode of computing device 100. When computing device 100 is in the limited functionality mode, OS 102 may limit or prevent access to and/or usage of one or more of applications 116 and features of computing device 100. For example, OS 102 may limit or prevent access to and/or usage of applications that are particularly distracting (e.g., text messaging applications, video streaming services, social media applications, etc.) while allowing access to and/or usage of applications that are less distracting or are useful when operating vehicle 106 (e.g., navigation applications, ridesharing applications, music streaming applications). In some examples, when computing device 100 is in the limited functionality mode, OS 102 may limit various features (e.g., the more interactive and/or distracting features) of applications 116 without completely preventing access to applications 116 by user 104.

In some examples, LFM module 118 may activate a limited functionality mode of computing device 100 based on one or more factors in addition to the location of computing device 100 within vehicle 106. The additional factors may include a state of vehicle 106 (e.g., whether vehicle 106 is in park, in gear, etc.), whether the location of computing device 100 within vehicle 106 is static, an orientation (e.g., landscape, portrait, etc.) of computing device 100, etc. In some examples, computing device 100 may receive data regarding the state of vehicle 106 and other on-board diagnostics from a vehicle head unit (e.g., infotainment system) of vehicle 106. Additionally or alternatively, computing device 100 may use built-in sensors (e.g., accelerometers, geomagnetic field sensors, and gyroscopes) to determine whether vehicle 106 is stationary or moving, whether the location of computing device 100 relative to vehicle 106 is static (indicating, e.g., that computing device 100 is mounted in a fixed position), whether the orientation of computing device 100 is landscape (an orientation more frequently used with entertainment applications) or portrait (an orientation more frequently used with utility applications), etc.

LFM module 118 may activate or deactivate the limited functionality mode based on the location of computing device 100 and one or more of the factors described above. For example, if location module 115 determines that computing device 100 is located within the driver's area and sensors of computing device 100 indicate that vehicle 106 is moving, LFM module 118 may activate the limited functionality mode. Conversely, if location module 115 determines that computing device 100 is located within the driver's area and sensors of computing device 100 indicate that vehicle 106 has been stationary for a predetermined duration (indicating that vehicle 106 is in park), LFM module 118 may not activate the limited functionality mode or, if the limited functionality mode was active (e.g., because user 104 was driving and just parked vehicle 106), LFM module 118 may deactivate the limited functionality mode.

In another example, if location module 115 determines that the location of computing device 100 is within the driver's area and static relative to vehicle 106 (e.g., mounted on a dashboard of vehicle 106), and if sensors of computing device 100 indicate that vehicle 106 is moving and that computing device 100 is in portrait mode, LFM module 118 may activate the limited functionality mode, and OS 102 may permit full access to applications that are useful when operating vehicle 106 (e.g., navigation applications, ridesharing applications, music streaming applications, etc.) and limit usage of particularly distracting applications (e.g., text messaging applications, video streaming services, social media applications, etc.).

In yet another example, if location module 115 determines that the location of computing device 100 is within the driver's area, and if sensors of computing device 100 indicate that vehicle 106 is moving and that computing device 100 is in landscape mode, LFM module 118 may activate the limited functionality mode, and OS 102 may permit full access to applications that are useful when operating vehicle 106 (e.g., navigation applications, ridesharing applications, music streaming applications, etc.) and prevent access to particularly distracting applications (e.g., text messaging applications, video streaming services, social media applications, etc.). In yet another example, if location module 115 determines that the location of computing device 100 is within the passenger's area, and if sensors of computing device 100 indicate that vehicle 106 is moving and that computing device 100 is in landscape mode, LFM module 118 may not activate the limited functionality mode. Thus, LFM module 118 may weigh a variety of factors when determining whether to activate the limited functionality mode and the extent to which OS 102 should prevent or otherwise limit various features of computing device 100.

The techniques of this disclosure include one or more advantages. For example, by preventing or otherwise limiting functionality of computing device 100, the techniques may reduce the rate of distracted driving and thereby improve road safety. Furthermore, by leveraging a variety of features in addition to the location of computing device 100 within vehicle 106, the techniques ensure that functionality that is useful and not distracting to user 104 is still permitted, which may mitigate user frustration and in turn promote compliance with safe driving practices.

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 No. 2019/0308503A1. In another example, the techniques of this disclosure may be combined with the techniques described in U.S. Patent Application No. 2017/0310816A1. In yet another example, the techniques of this disclosure may be combined with the techniques disclosed in U.S. Patent Application No. 2020/0252749A1. In yet another example, the techniques of this disclosure may be combined with the techniques disclosed in Saidi Siuhi, Judith Mwakalonge, "Opportunities and challenges of smart mobile applications in transportation," Journal of Traffic and Transportation Engineering, December 2016. In yet another example, the techniques of this disclosure may be combined with the techniques disclosed in U.S. Patent Application No. 2017/0201619A1. In yet another example, the techniques of this disclosure may be combined with the techniques disclosed in U.S. Patent Application No. 2019/0116257A1.