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AUTOMATIC SWITCHING BETWEEN INTERNET RADIO AND TRADITIONAL RADIO

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ABSTRACT

An infotainment system of a vehicle (e.g., an automobile, a motorcycle, a bus, a recreational vehicle (RV), a semi-trailer truck, etc.) is configured to automatically switch from an Internet radio application (e.g., a music streaming application) to a radio station of a traditional radio (e.g., an AM/FM radio built into the vehicle) in certain situations, such as when the Internet is unavailable. In examples, the infotainment system uses machine learning to generate a personalized model of the music preferences of a user (e.g., a driver). Responsive to determining that a connection to the Internet (e.g., via communication components of the vehicle) is unreliable, poor, nonexistent, and/or the like, the infotainment system scans radio channels of the traditional radio for a radio station that is broadcasting relevant media content (e.g., media content predicted or otherwise determined to be desirable to the user based on the personalized model). Responsive to identifying a radio station broadcasting relevant media content, the infotainment system automatically stops playing the media content from the Internet radio application and starts playing relevant media content that is broadcast by the radio station. Thus, rather than the driver manually switching from the Internet radio to the traditional radio and then trying to find a radio station that is broadcasting relevant media content, which may be distracting to the driver, the techniques described herein automate such tasks. In this way, the techniques described may improve the user experience by reducing distractions to the driver while the driver is operating the vehicle, thereby potentially promoting driving safety and improving the driving experience.

DESCRIPTION

As outlined above, the present disclosure describes 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 boat, a helicopter, a personal transport vehicle, etc.) configured to automatically switch from an Internet radio application (e.g., a music streaming application) to a radio station of a traditional radio (e.g., an AM/FM radio built into the vehicle), such as when the Internet is unavailable (e.g., when connection to the internet is unreliable, poor, nonexistent, etc.). In this way, the techniques described may improve the user experience by reducing distractions to the driver while the driver is operating the vehicle, thereby potentially promoting driving safety and improving the driving experience.

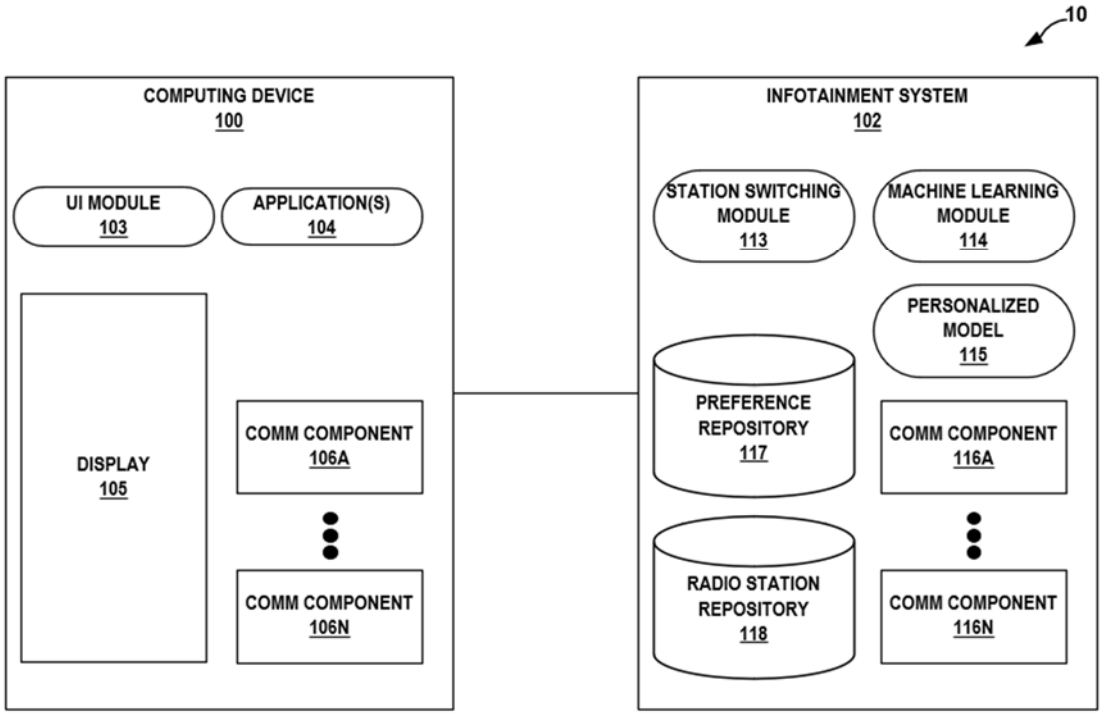

FIG. 1

FIG. 1 is a conceptual diagram illustrating an example system that is configured to perform various aspects of the automatic radio switching techniques described herein. As shown

in the example of FIG. 1, a system 10 may include a computing device 100 and an infotainment system 102. Computing device 100 may include a user interface (UI) module 103, one or more applications 104, a presence-sensitive display 105 ("display 105"), and communication components 106A-106N (collectively, "COMM components 106"). Infotainment system 102 may include a station switching module 113, a machine learning module 114, a personalized model 115, communication components 116A-116N (collectively, "COMM components 116"), a preference repository 117, and a radio station repository 118.

In the example of FIG. 1, computing device 100 is a smartphone. However, other examples of computing device 100 may be a cellular phone, a smartphone, a personal digital assistant (PDA), 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), an add-on device (such as a casting device), smart glasses, a gaming controller, or another type of portable or mobile device.

Infotainment system 102 may represent an integrated head unit that presents an interface (e.g., a graphical user interface – GUI) by which to control the vehicle systems, such as an audio system, 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), and/or the like. The interface may be presented via a console (e.g., an in-vehicle display). Infotainment system 102 may be included in 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 drone, a helicopter, a personal transport vehicle, or any other type of vehicle capable of automatically switching between an Internet radio application and a traditional radio in accordance with techniques described.

Examples of the underlying hardware of computing device 100 includes one or more processors (which are not shown for ease of illustration) that support execution of UI module 103, applications 104, display 105, and COMM components 106. Examples of the processors include application processors, display controllers, auxiliary processors, one or more sensor hubs, and any other hardware configured to function as a processor, a processing unit, or a processing device. Modules (e.g., UI module 103) may be operable (or, in other words, executed) by the processors to perform various actions, operations, or functions of computing device 100. That is, UI module 103 and applications 104 may form executable code that, when executed, causes the processors to perform specific operations in accordance with (e.g., causing computing device 100 to become a specific-purpose computer by which to perform) various aspects of the techniques described.

Display 105 of primary device 100 may represent a presence-sensitive display that functions as an input device and as an output device. Display 105 may be implemented using various display hardware. For example, display 105 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, a pressure-sensitive screen, an acoustic pulse recognition touchscreen, or another presence-sensitive display technology. Display 105 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, such as a user interface for controlling settings of station switching module 113 in accordance with techniques described herein.

COMM components 106, 116 may include wireless communication devices capable of transmitting and/or receiving communication signals such as a cellular radio, a third-generation (3G) radio, a fourth-generation (4G) radio, a fifth-generation (5G) radio, a ultra-wide bandwidth (UWB) radio, a Bluetooth® radio (or any other personal area network (PAN) radio), a near-field communication (NFC) radio, or a Wi-Fi® radio (or any other wireless local area network (WLAN) radio). Additionally or alternatively, COMM components 106, 116 may include wired communication devices capable of transmitting and/or receiving communication signals via a direct link over a wired communication medium (e.g., a universal serial bus – USB – cable).

Computing system 102 includes one or more processors (which are not shown for ease of illustration, and which may be similar, if not substantially similar, to the processors of computing devices 100) and one or more storage devices (which are not shown for ease of illustration). The storage devices may, in some examples, be described as one or more computer-readable storage media. For example, the storage devices may be configured for long-term, as well as short-term storage of information, such as instructions, data, or other information used by computing system 102. Thus, the storage devices may store station switching module 113, machine learning module 114, personalized model 115, preference repository 117, and radio station repository 118.

In accordance with techniques described in this disclosure, infotainment system 102 of a vehicle may be configured to automatically switch from an Internet radio application (e.g., application 104), such as a music streaming application, to a radio station of a traditional radio (e.g., an AM/FM radio built into the vehicle), such as when the Internet is unavailable. That is, responsive to computing device 100 determining that the connection between COMM components 106 and network (e.g., the Internet) is unavailable, computing device 100 may stop playing an Internet radio application (e.g., application 104) and start playing a traditional radio.

In particular, computing device 100 may scan radio stations of the traditional radio and, in response to identifying a radio station broadcasting relevant media content (e.g., media content predicted to be desirable to the user based on personalized model 115), computing device 100 may play that radio station.

To generate personalized model 115, infotainment system 102 may execute machine learning module 114. Machine learning module 114 may represent a deep neural network configured to receive, as input, information about the user's music preferences (hereinafter referred to as "music preference information"). The music preference information may include liked songs (e.g., as indicated by user input), most frequently played songs, most frequently played genres, most frequently played playlists, and/or the like.

Infotainment system 102 may receive the music preference information from one or more of user's apps (e.g., one or more of applications 104), such as a music streaming app that tracks a number of factors relating to music preference, such as when a user searches a song, plays a song, likes a song, plays a song similar to a liked song, searches an artist, plays an artist, searches a genre, plays a genre, creates a playlist, and/or the like. Infotainment system 102 may store the music preference information in preference repository 117. Machine learning module 114 may then use the music preference information as input data to generate output data in the form of personalized model 115 for predicting media content relevant to the user.

Infotainment system 102 may store, in radio station repository 118, information identifying radio stations (hereinafter referred to as "radio station information") of the traditional radio to enable station switching module 113 to identify radio stations broadcasting relevant media content. Radio station information may include the frequency of each radio station, the name of each radio station, the language of each radio station, the geographic location of each

radio station, the primary media content (e.g., sports, news, entertainment, culture, religion, music, etc.) of each radio station, the most frequently played songs of each radio station, the most frequently played artists of each radio station, the most frequently played genres of each radio station, the current song rotation of each radio station, and/or the like.

Based on personalized model 115 and the radio station information, infotainment system 102 may identify radio stations broadcasting relevant media content. For example, station switching module 113 may assign a score to each parameter included in the radio station information (e.g., geographic location, primary media content, most frequently played songs, most frequently played artists, etc.) and rank the radio stations in an order indicative of the radio stations most likely to broadcast media content desirable to the user based on personalized model 115. Thus, if personalized model 115 of a user indicates that the user prefers high quality sound, a music radio station, and country music, then a radio station in close proximity (e.g., based on a location provided by a global positioning system (GPS)) to the vehicle of the user that primarily plays music (e.g., as opposed to hosting talk shows) and exclusively plays country music may be a radio station that is first in the ranking (hereinafter referred to as a “first radio station”). Station switching module 113 may compute a ranking of the radio stations before automatically switching from an Internet radio application to a traditional radio of the vehicle.

Responsive to connection to the network being unavailable, station switching module 113 may select the radio stations of the traditional radio for a radio station broadcasting relevant media content. For example, station switching module 113 may cause a radio built into the vehicle to receive (e.g., via COMM components 116) the frequency (e.g., 97.3 FM) of the carrier wave associated with the first radio station, extract the original program sound from the

frequency of the carrier wave, and reproduce the sound (e.g., via one or more speakers built into the vehicle) for the user to hear.

In some examples, the radio station information may be regularly updated (e.g., via COMM components 116) such that radio station repository 118 includes the song currently being played by each radio station. In such examples, station switching module 113 may rank, at least in part, the radio stations of the traditional radio based on the songs currently being played by the radio stations. Thus, if music preference information indicates that the user's most frequently played song is "Patent Pending Cowboy," then personalized model 115 may in turn indicate that the user prefers listening to "Patent Pending Cowboy" to every other song. As a result, station switching module 113 may determine that the first radio station is a radio station currently playing "Patent Pending Cowboy," even if that radio station would otherwise not be the first radio station. As such, the ranking of the radio station may dynamically change based on the songs currently being played by the radio stations.

Similarly, station switching module 113 may rank, at least in part, the radio stations of the traditional radio based on the songs that will be played by the radio stations. Station switching module 113 may predict the songs that will be played by the radio stations by detecting patterns in the song rotations of the radio stations. For example, if a radio station plays "Patent Pending Cowboy" every hour on the hour, then station switching module 113 may rank the radio stations in view of this prediction. As such, at 4:59 PM, station switching module 113 may determine that the radio station that plays "Patent Pending Cowboy" every hour on the hour is the first radio station in the ranking.

As another example, station switching module 113 may predict the songs that will be played by each of the radio stations based on a corresponding radio station playlist. Infotainment

system 102 may access (e.g., via COMM components 116) the radio station playlists via the Internet (e.g., websites associated with the radio stations), or may otherwise obtain or access such playlists from the radio stations. The radio station playlists may indicate the order of songs, artists, and/or the like to be played during a time period (e.g., 5:00 PM to 6:00 PM). Infotainment system 102 may store the radio station playlists in radio station repository 118. In any case, the rankings of the radio stations may dynamically change based on the songs that will be played by the radio stations.

In some examples, the user may change the operation of station switching module 113. For example, the user may interact with a graphical user interface (GUI) generated by UI module 103 of computing device 100. The GUI may include graphical elements associated with functionality for performing techniques in accordance with this disclosure. For example, the GUI may include an icon for changing settings of station switching module 113. By selecting the icon (e.g., by providing an input via display 105), the user may, for instance, modify station switching module 113 so that station switching module 113 does not automatically switch to the first radio station of the traditional radio but instead recommends to the user to switch to the first radio station. In such an example, responsive to the user assenting to the recommendation, station switching module 113 may then switch to the first radio station (e.g., by receiving the frequency of the carrier wave, extracting the original sound from the frequency of the carrier wave, and reproducing the sound for the user to hear).

In some examples, the user may change the settings of station switching module 113 to control when station switching module 113 switches from the traditional radio to the Internet radio application (e.g., application 104). For example, the default setting may be that station switching module 113 automatically stops playing the traditional radio and starts playing the

Internet radio application in response to connection to the network being available again. However, the user may change the settings of station switching module 113 so that station switching module 113 continues to play the traditional radio even if connection to the network is available again.

One or more advantages of the techniques described in this disclosure include automating tasks that may otherwise distract a user, such as a driver. Rather than the driver manually switching from the Internet radio to the traditional radio and then trying to find a radio station broadcasting relevant media content, which may be distracting to the driver, the techniques described automate such tasks. In this way, the techniques described may improve the user experience by reducing distractions to the driver while the driver is operating the vehicle, thereby potentially promoting driving safety.

Although one or more of the techniques of this disclosure have been described with respect to infotainment system 102, one or more of these techniques may also be performed by computing device 100. It is noted that the techniques of this disclosure may be combined with any other suitable technology or combination of technologies, including, for example, those listed as references below.

References

1. US Patent Application No. US20120129476A1
2. US Patent Application No. US20180165359A1
3. US Patent Application No. US20110040707A1
4. US Patent Application No. US20170124074A1