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(54) **METHOD(S) AND SYSTEM(S) TO ENABLE AN IMPROVED AUTOMATED ASSISTANT SUGGESTION SERVICE FOR VEHICLE(S)**

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G07C 5/00 (2006.01)

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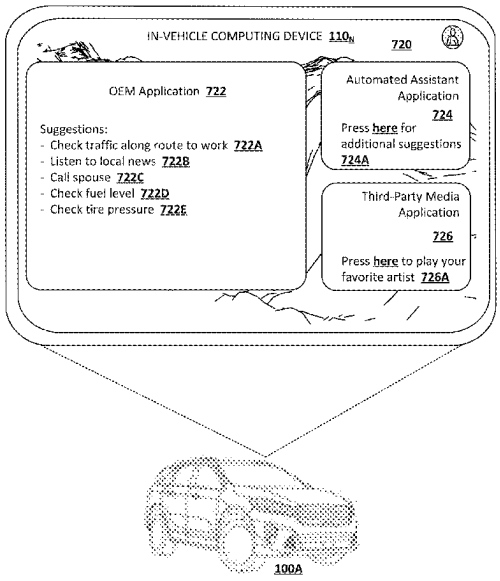
(74) *Attorney, Agent, or Firm* — Gray Ice Higdon

(57) **ABSTRACT**

Implementations described herein relate to various techniques that enable an improved automated assistant suggestion service for vehicle(s). For example, implementations can initialize and perform a recurring system health check service to ensure a connection is maintained between at least an OEM application of an in-vehicle computing device of a given vehicle and the suggestion service accessible by the in-vehicle computing device of the given vehicle. By ensuring this connection is maintained, the suggestion service is less prone to failure and suggestion(s) may still be provided in situations when the suggestion service does fail. Additionally, or alternatively, implementations can utilize a versioning API to ensure compatibility between at least the OEM application and the suggestion service. By ensuring this compatibility, the suggestion service for the vehicle(s) is more robust to version updates and the applications need not be fully compatible.

20 Claims, 8 Drawing Sheets



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CPC ***G07C 5/0816*** (2013.01); ***G07C 5/085*** (2013.01); *G06F 2201/835* (2013.01)

(58) **Field of Classification Search**
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See application file for complete search history.

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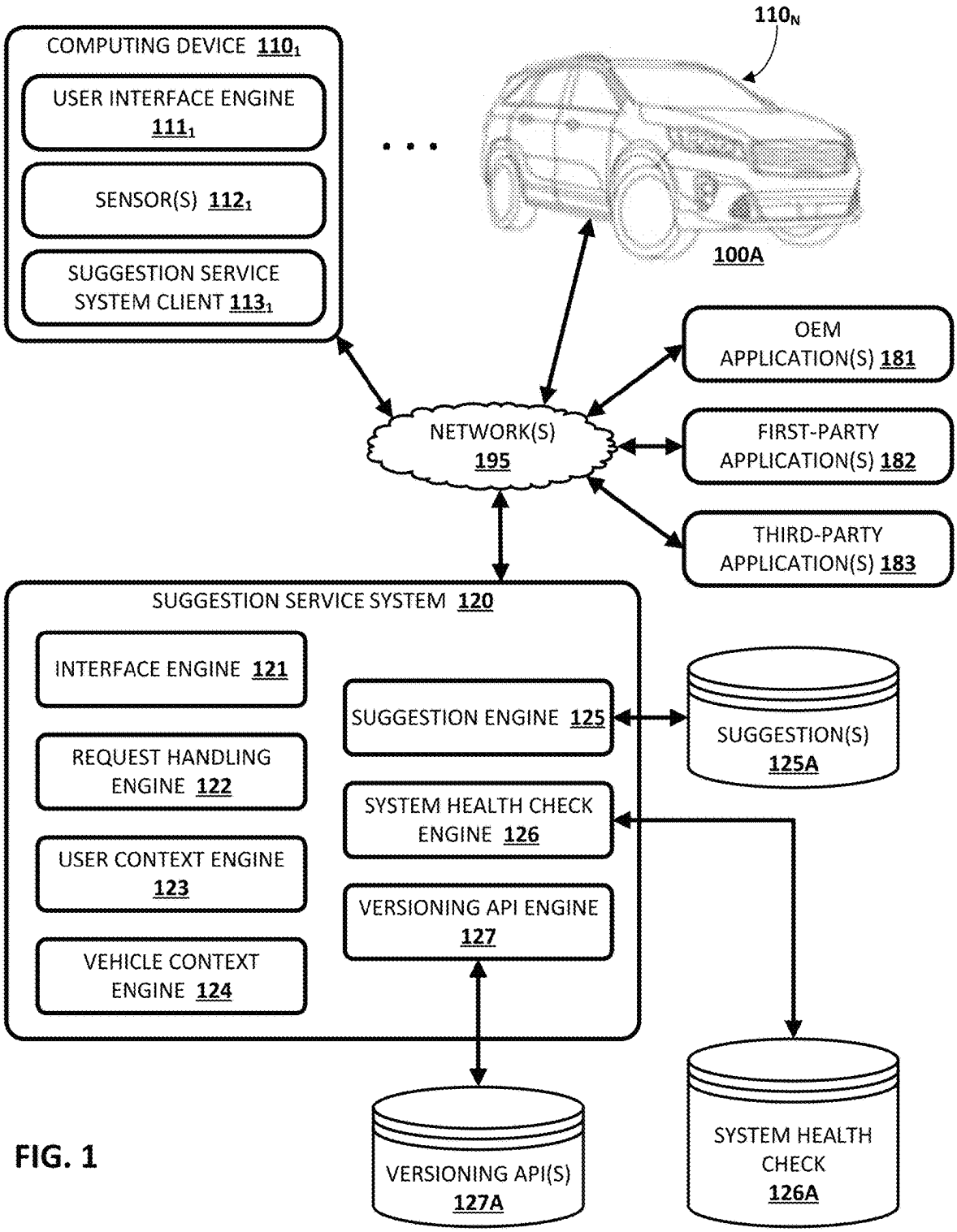
COMPUTING DEVICE 110$_1$
USER INTERFACE ENGINE 111$_1$
SENSOR(S) 112$_1$
SUGGESTION SERVICE SYSTEM CLIENT 113$_1$
110$_N$
100A
OEM APPLICATION(S) 181
FIRST-PARTY APPLICATION(S) 182
THIRD-PARTY APPLICATION(S) 183
NETWORK(S) 195
SUGGESTION SERVICE SYSTEM 120
INTERFACE ENGINE 121
REQUEST HANDLING ENGINE 122
USER CONTEXT ENGINE 123
VEHICLE CONTEXT ENGINE 124
SUGGESTION ENGINE 125
SYSTEM HEALTH CHECK ENGINE 126
VERSIONING API ENGINE 127
SUGGESTION(S) 125A
VERSIONING API(S) 127A
SYSTEM HEALTH CHECK 126A

FIG. 1

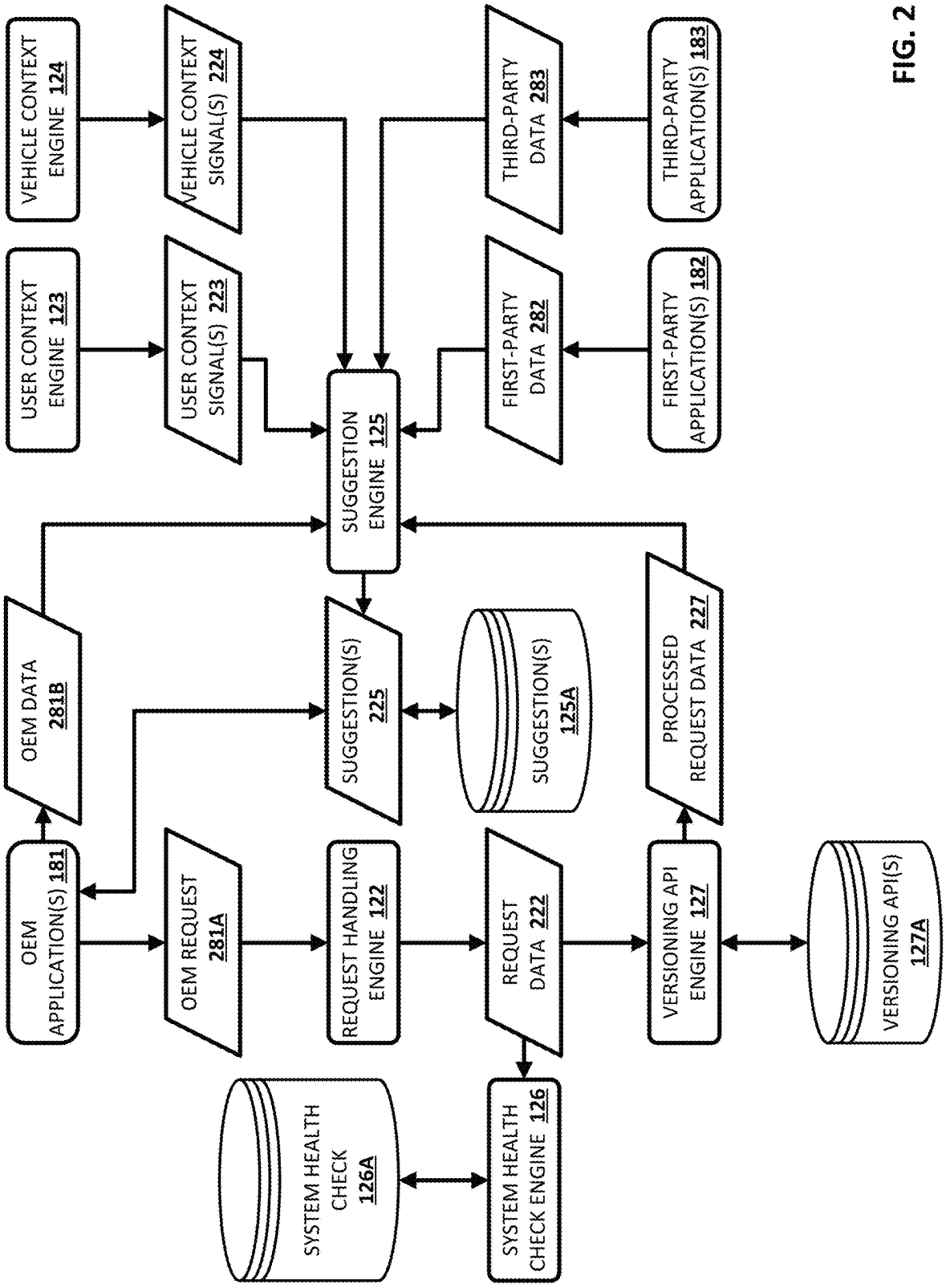
VEHICLE CONTEXT ENGINE 124
VEHICLE CONTEXT SIGNAL(S) 224
THIRD-PARTY DATA 283
THIRD-PARTY APPLICATION(S) 183
USER CONTEXT ENGINE 123
USER CONTEXT SIGNAL(S) 223
FIRST-PARTY DATA 282
FIRST-PARTY APPLICATION(S) 182
SUGGESTION ENGINE 125
OEM DATA 281B
SUGGESTION(S) 225
SUGGESTION(S) 125A
PROCESSED REQUEST DATA 227
OEM APPLICATION(S) 181
OEM REQUEST 281A
REQUEST HANDLING ENGINE 122
REQUEST DATA 222
VERSIONING API ENGINE 127
VERSIONING API(S) 127A
SYSTEM HEALTH CHECK 126A
SYSTEM HEALTH CHECK ENGINE 126

FIG. 2

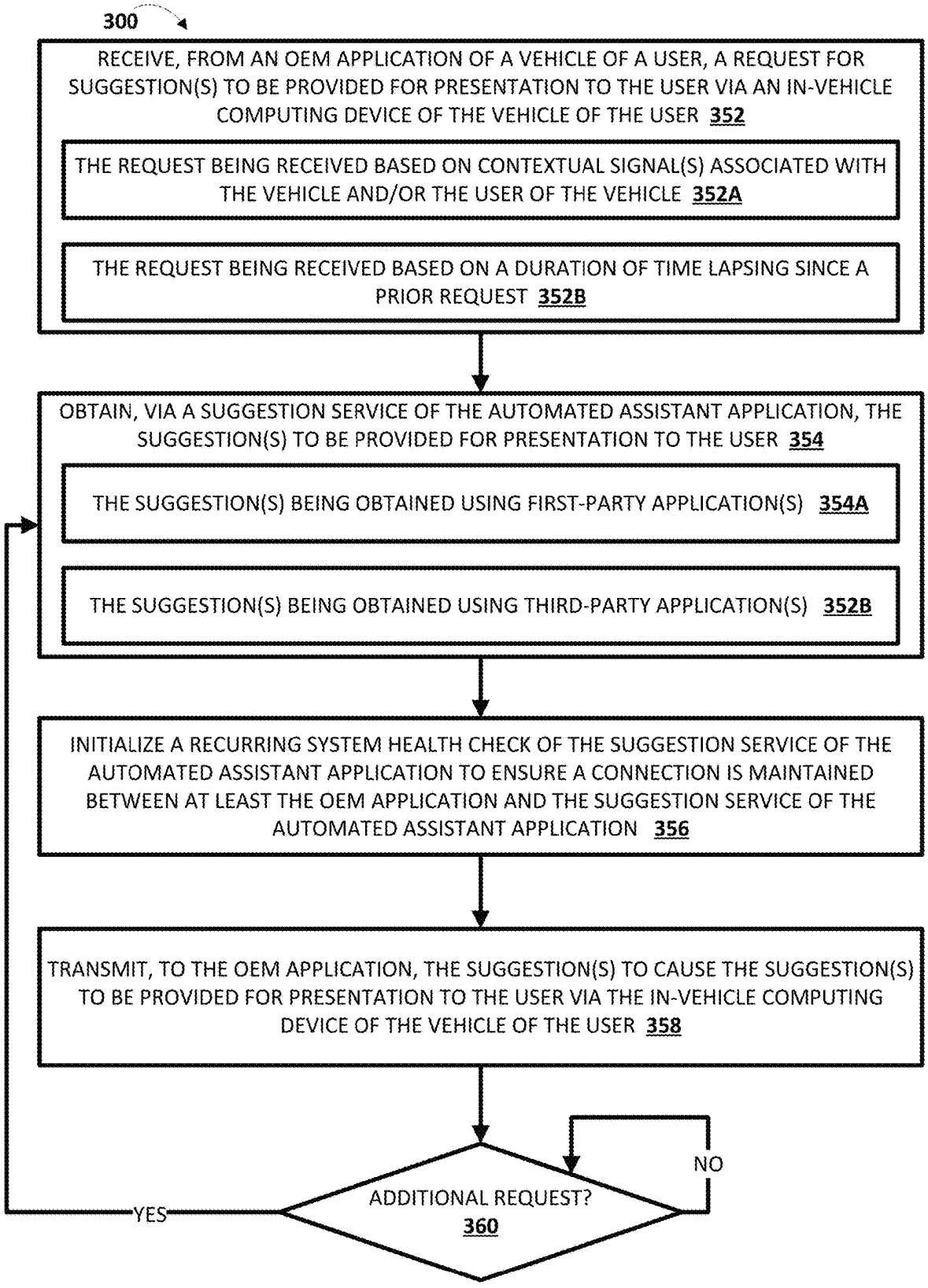
300
RECEIVE, FROM AN OEM APPLICATION OF A VEHICLE OF A USER, A REQUEST FOR SUGGESTION(S) TO BE PROVIDED FOR PRESENTATION TO THE USER VIA AN IN-VEHICLE COMPUTING DEVICE OF THE VEHICLE OF THE USER 352
THE REQUEST BEING RECEIVED BASED ON CONTEXTUAL SIGNAL(S) ASSOCIATED WITH THE VEHICLE AND/OR THE USER OF THE VEHICLE 352A
THE REQUEST BEING RECEIVED BASED ON A DURATION OF TIME LAPSING SINCE A PRIOR REQUEST 352B
OBTAIN, VIA A SUGGESTION SERVICE OF THE AUTOMATED ASSISTANT APPLICATION, THE SUGGESTION(S) TO BE PROVIDED FOR PRESENTATION TO THE USER 354
THE SUGGESTION(S) BEING OBTAINED USING FIRST-PARTY APPLICATION(S) 354A
THE SUGGESTION(S) BEING OBTAINED USING THIRD-PARTY APPLICATION(S) 352B
INITIALIZE A RECURRING SYSTEM HEALTH CHECK OF THE SUGGESTION SERVICE OF THE AUTOMATED ASSISTANT APPLICATION TO ENSURE A CONNECTION IS MAINTAINED BETWEEN AT LEAST THE OEM APPLICATION AND THE SUGGESTION SERVICE OF THE AUTOMATED ASSISTANT APPLICATION 356
TRANSMIT, TO THE OEM APPLICATION, THE SUGGESTION(S) TO CAUSE THE SUGGESTION(S) TO BE PROVIDED FOR PRESENTATION TO THE USER VIA THE IN-VEHICLE COMPUTING DEVICE OF THE VEHICLE OF THE USER 358
ADDITIONAL REQUEST? 360
NO
YES

FIG. 3

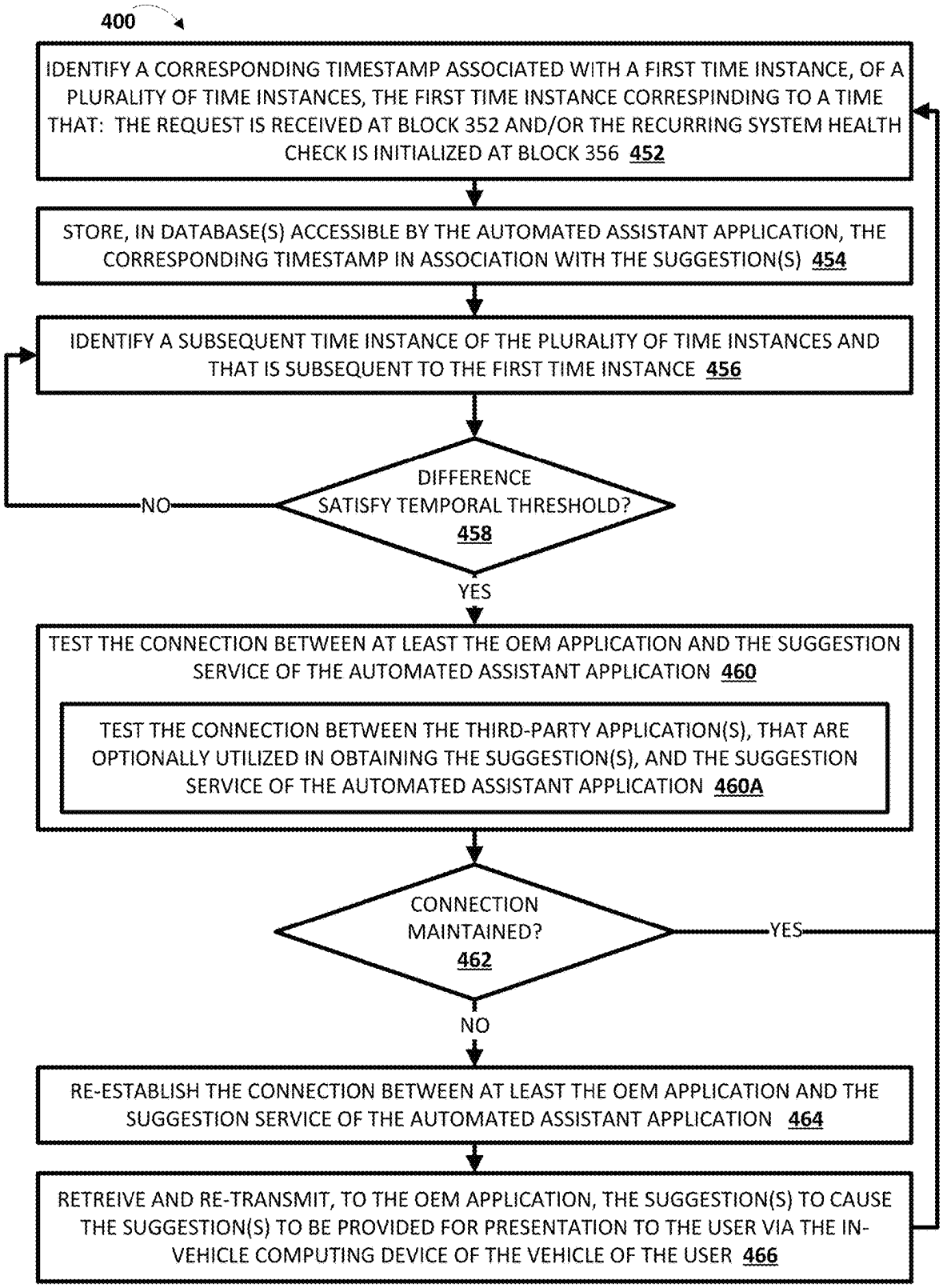
400
IDENTIFY A CORRESPONDING TIMESTAMP ASSOCIATED WITH A FIRST TIME INSTANCE, OF A PLURALITY OF TIME INSTANCES, THE FIRST TIME INSTANCE CORRESPINDING TO A TIME THAT: THE REQUEST IS RECEIVED AT BLOCK 352 AND/OR THE RECURRING SYSTEM HEALTH CHECK IS INITIALIZED AT BLOCK 356 452
STORE, IN DATABASE(S) ACCESSIBLE BY THE AUTOMATED ASSISTANT APPLICATION, THE CORRESPONDING TIMESTAMP IN ASSOCIATION WITH THE SUGGESTION(S) 454
IDENTIFY A SUBSEQUENT TIME INSTANCE OF THE PLURALITY OF TIME INSTANCES AND THAT IS SUBSEQUENT TO THE FIRST TIME INSTANCE 456
DIFFERENCE SATISFY TEMPORAL THRESHOLD? 458
NO
YES
TEST THE CONNECTION BETWEEN AT LEAST THE OEM APPLICATION AND THE SUGGESTION SERVICE OF THE AUTOMATED ASSISTANT APPLICATION 460
TEST THE CONNECTION BETWEEN THE THIRD-PARTY APPLICATION(S), THAT ARE OPTIONALLY UTILIZED IN OBTAINING THE SUGGESTION(S), AND THE SUGGESTION SERVICE OF THE AUTOMATED ASSISTANT APPLICATION 460A
CONNECTION MAINTAINED? 462
YES
NO
RE-ESTABLISH THE CONNECTION BETWEEN AT LEAST THE OEM APPLICATION AND THE SUGGESTION SERVICE OF THE AUTOMATED ASSISTANT APPLICATION 464
RETREIVE AND RE-TRANSMIT, TO THE OEM APPLICATION, THE SUGGESTION(S) TO CAUSE THE SUGGESTION(S) TO BE PROVIDED FOR PRESENTATION TO THE USER VIA THE IN-VEHICLE COMPUTING DEVICE OF THE VEHICLE OF THE USER 466

FIG. 4

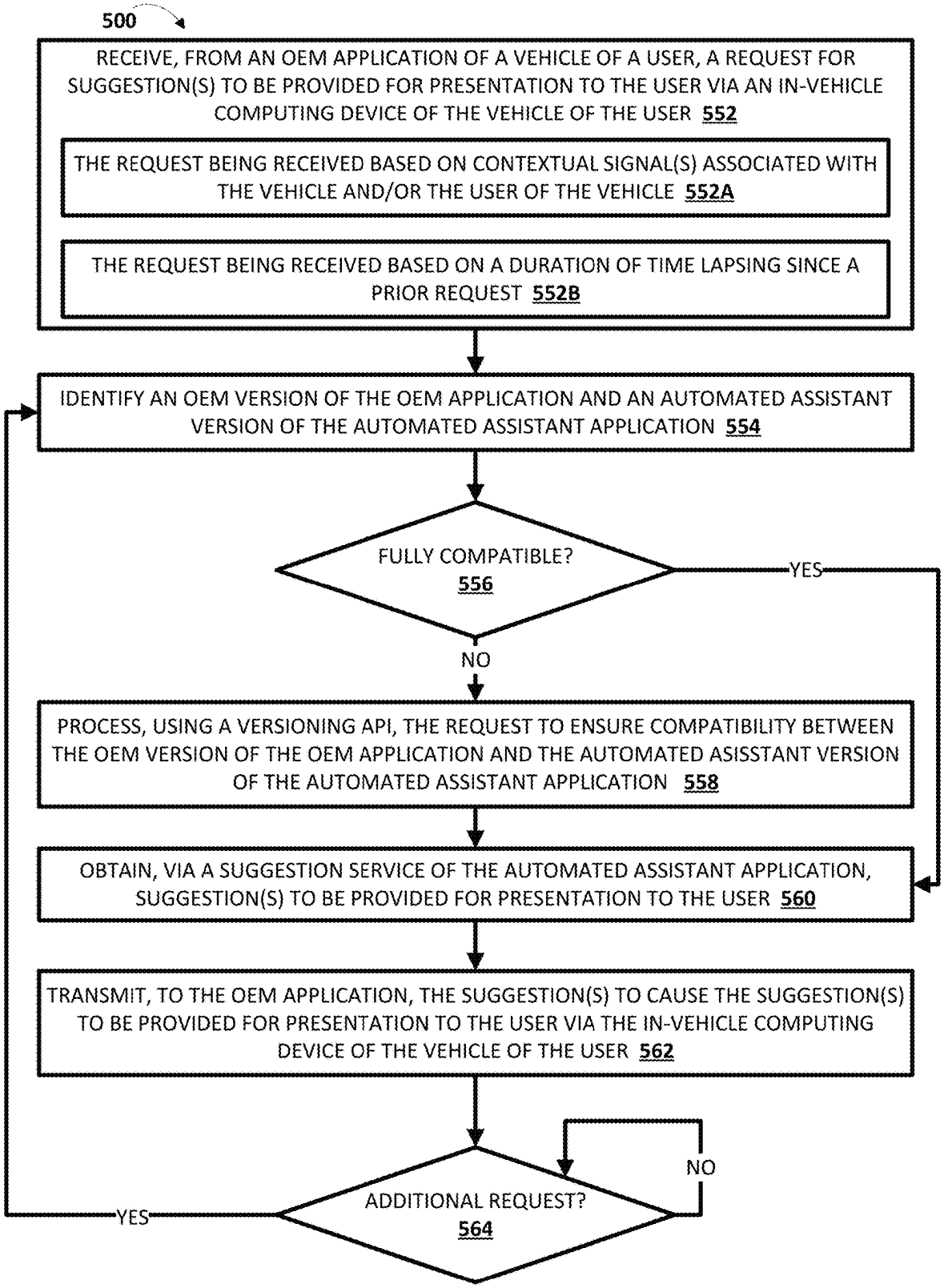
500
RECEIVE, FROM AN OEM APPLICATION OF A VEHICLE OF A USER, A REQUEST FOR SUGGESTION(S) TO BE PROVIDED FOR PRESENTATION TO THE USER VIA AN IN-VEHICLE COMPUTING DEVICE OF THE VEHICLE OF THE USER 552
THE REQUEST BEING RECEIVED BASED ON CONTEXTUAL SIGNAL(S) ASSOCIATED WITH THE VEHICLE AND/OR THE USER OF THE VEHICLE 552A
THE REQUEST BEING RECEIVED BASED ON A DURATION OF TIME LAPSING SINCE A PRIOR REQUEST 552B
IDENTIFY AN OEM VERSION OF THE OEM APPLICATION AND AN AUTOMATED ASSISTANT VERSION OF THE AUTOMATED ASSISTANT APPLICATION 554
FULLY COMPATIBLE? 556
YES
NO
PROCESS, USING A VERSIONING API, THE REQUEST TO ENSURE COMPATIBILITY BETWEEN THE OEM VERSION OF THE OEM APPLICATION AND THE AUTOMATED ASISSTANT VERSION OF THE AUTOMATED ASSISTANT APPLICATION 558
OBTAIN, VIA A SUGGESTION SERVICE OF THE AUTOMATED ASSISTANT APPLICATION, SUGGESTION(S) TO BE PROVIDED FOR PRESENTATION TO THE USER 560
TRANSMIT, TO THE OEM APPLICATION, THE SUGGESTION(S) TO CAUSE THE SUGGESTION(S) TO BE PROVIDED FOR PRESENTATION TO THE USER VIA THE IN-VEHICLE COMPUTING DEVICE OF THE VEHICLE OF THE USER 562
ADDITIONAL REQUEST? 564
NO
YES

FIG. 5

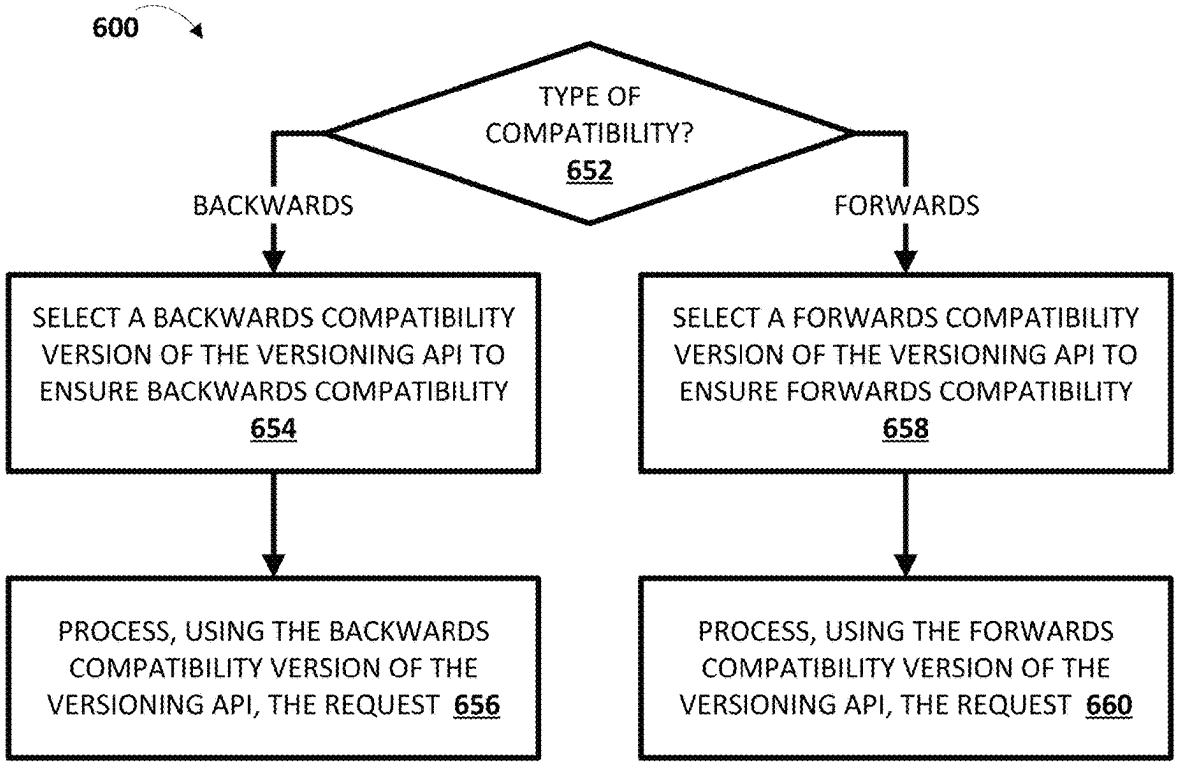
600
TYPE OF COMPATIBILITY? 652
BACKWARDS
FORWARDS
SELECT A BACKWARDS COMPATIBILITY VERSION OF THE VERSIONING API TO ENSURE BACKWARDS COMPATIBILITY 654
SELECT A FORWARDS COMPATIBILITY VERSION OF THE VERSIONING API TO ENSURE FORWARDS COMPATIBILITY 658
PROCESS, USING THE BACKWARDS COMPATIBILITY VERSION OF THE VERSIONING API, THE REQUEST 656
PROCESS, USING THE FORWARDS COMPATIBILITY VERSION OF THE VERSIONING API, THE REQUEST 660

FIG. 6

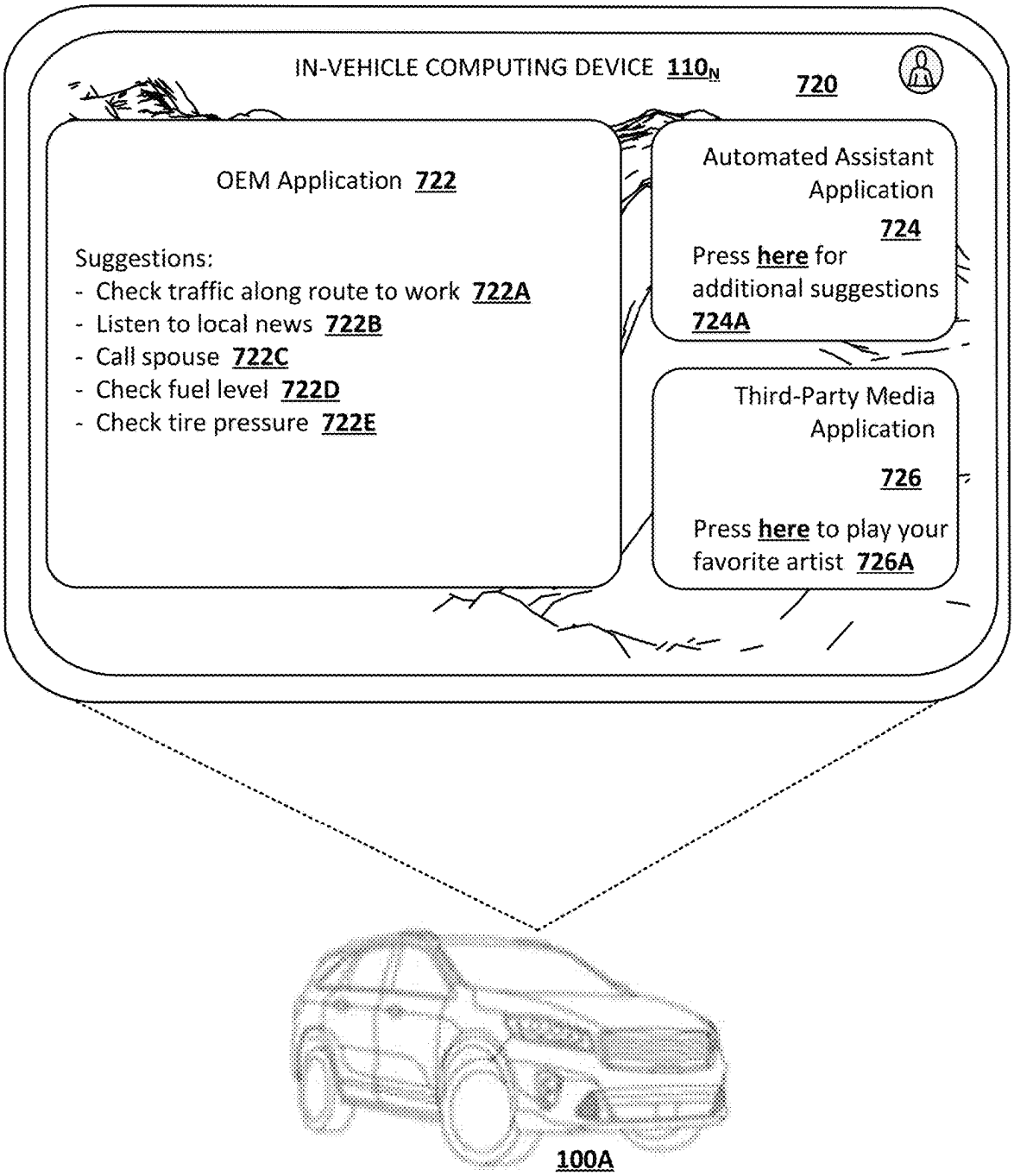
IN-VEHICLE COMPUTING DEVICE 110N
720
OEM Application 722
Suggestions:
- Check traffic along route to work 722A
- Listen to local news 722B
- Call spouse 722C
- Check fuel level 722D
- Check tire pressure 722E
Automated Assistant Application
724
Press here for additional suggestions
724A
Third-Party Media Application
726
Press here to play your favorite artist 726A
100A

FIG. 7

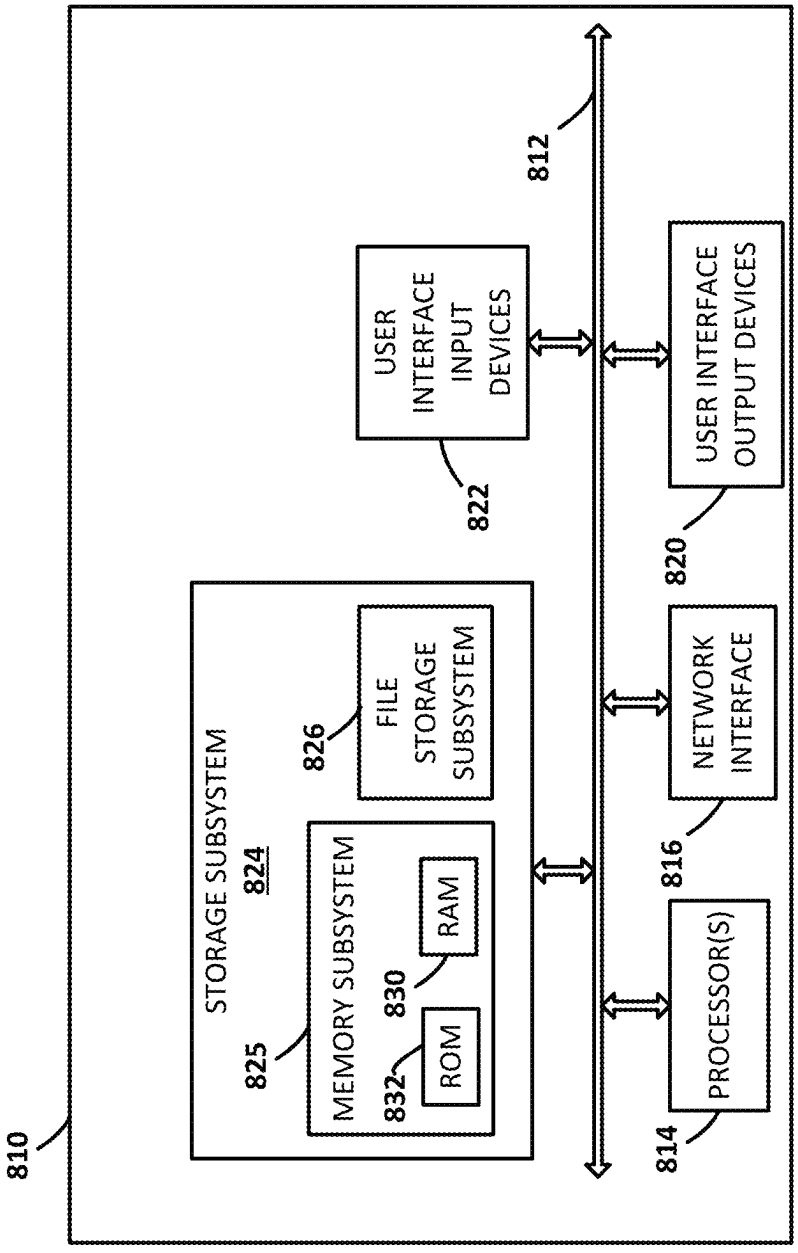
810
STORAGE SUBSYSTEM
824
825
MEMORY SUBSYSTEM
832
ROM
830
RAM
826
FILE STORAGE SUBSYSTEM
822
USER INTERFACE INPUT DEVICES
812
820
USER INTERFACE OUTPUT DEVICES
816
NETWORK INTERFACE
814
PROCESSOR(S)

FIG. 8

METHOD(S) AND SYSTEM(S) TO ENABLE AN IMPROVED AUTOMATED ASSISTANT SUGGESTION SERVICE FOR VEHICLE(S)

BACKGROUND

Computing devices and their respective applications typically provide robust functionality to assist humans (referred to herein as "users") with various tasks. When a particular computing device has access to an automated assistant application, the automated assistant application can control these applications, and on behalf of the users, to perform the various tasks. In some instances, the automated assistant application may proactively provide suggestions to familiarize the users with the various tasks that the automated assistant application can perform on behalf of the users and by controlling these applications.

For example, assume the automated assistant application includes a suggestion service that interacts with at least an original equipment manufacturer (OEM) application of a vehicle via an in-vehicle computing device of the vehicle (e.g., a vehicle infotainment center, etc.). In this example, the automated assistant suggestion service can generate suggestions for respective applications that are accessible at the in-vehicle computing device, such as a first suggestion associated with controlling a media application of the in-vehicle computing device, a second suggestion associated with controlling a phone application of the in-vehicle computing device, and so on. Further, the automated assistant suggestion service can provide the suggestions to the OEM application and can cause the suggestions to be provided for presentation to a user of the vehicle via the OEM application visually and/or audibly.

However, in some instances, a connection between at least the automated assistant application and the OEM application may fail. As a result, suggestions may no longer be provided for presentation to the user until the connection is re-established. Further, in these or other instances, versions of the automated assistant application and versions of the OEM application may be updated at different rates. As a result, the versions of the automated assistant application and the versions of the OEM application may not always be fully compatible. Accordingly, there is a need in the art for an improved automated assistant suggestion service that is robust to these and other issues.

SUMMARY

Implementations described herein relate to various techniques that enable an improved automated assistant suggestion service for vehicle(s). For example, assume an original equipment manufacturer (OEM) application executing at least in part at an in-vehicle computing device of a given vehicle of a user generates a request for suggestions that are to be provided for presentation to the user of the given vehicle via the in-vehicle computing device. In this example, the OEM can transmit the request for suggestions to a suggestion service of an automated assistant application executing at least in part at the in-vehicle computing device. Further, the automated assistant application can cause the suggestion service to obtain the suggestions, which are transmitted back to the OEM application responsive to the request, and the OEM application can provide the suggestions for presentation to the user of the given vehicle via the in-vehicle computing device. Implementations can initialize and perform a recurring system health check service to ensure a connection is maintained between at least the OEM and the suggestion service of the automated assistant application. Additionally, or alternatively, implementations can utilize a versioning application programming interface (API) to ensure compatibility between at least an OEM version of the OEM application and an automated assistant version of the automated assistant application (or the suggestion service of the automated assistant application). As a result, the techniques described herein result enable the suggestion service of the automated assistant application to be more robust to failure caused by different issues.

In various implementations, the recurring system health check can be initialized when an initial request is transmitted from the OEM application to the automated assistant application, such as when the given vehicle is powered to an "on" state when the user enters the given vehicle. Notably, the system health check described herein can be performed in a recurring manner in that it can be performed periodically and/or aperiodically. Further, the recurring system health check described herein can be performed as a background process in that it can be performed while the suggestion service of the automated assistant application is being actively utilized to obtain the suggestions and/or while the suggestion service of the automated assistant application is dormant. In performing the recurring system health check of the suggestion service of the automated application, a corresponding timestamp associated a time instance, of a plurality of time instances, at which the is received and/or the recurring system health check is initialized can be stored in one or more database(s) and optionally in association with the suggestions transmitted to the OEM application responsive to the request. Further, and assuming that a subsequent time instance, of the plurality of time instances and that is subsequent to the time instance, satisfies a temporal threshold, the connection between at least the OEM application and the suggestion service of the automated assistant can be tested to determine whether the connection is maintained. Put another way, the recurring system health check can be performed to proactively determine whether the connection between at least the OEM application and the suggestion service of the automated assistant application has failed at approximately the same time that the OEM application is predicted to transmit an additional request to the suggestion service of the automated assistant application by utilizing the temporal threshold.

In some versions of those implementations, and assuming that the connection between at least the OEM and the suggestion service of the automated assistant application has been maintained, the recurring system health check can continue being performed as a background process. However, in some additional or alternative versions of those implementations, and assuming that the connection between at least the OEM and the suggestion service of the automated assistant application has failed, the connection between at least the OEM and the suggestion service of the automated assistant application can be re-established to enable the suggestions and/or additional suggestions to be provided. In some instances, and in response to the connection being re-established, the suggestion service can retrieve and re-transmit the suggestions that were previously provided to the OEM application. In these and other instances, and in response to the connection being re-established, the suggestion service can obtain additional suggestions (e.g., not based on an explicit request from the OEM application), and transmit the additional suggestions to the OEM application. Moreover, the recurring system health check can continue being performed as a background process. Accordingly, techniques described herein result in an improved sugges-

tion service of the automated assistant application for providing the suggestions for the given vehicle.

In various implementations, an OEM version of the OEM application and an automated assistant version of the automated assistant application can be identified. Further, it can be determined whether the OEM version of the OEM application and the automated assistant version of the automated assistant application are fully compatible, backwards compatible, and/or forwards compatible based on, for instance, corresponding major version indicators, corresponding minor version indicators, and/or other version indicators of corresponding versions of these applications. In some versions of those implementations, the OEM version of the OEM application and/or the automated assistant version of the automated assistant application can be provided by the respective parties. In additional or alternative implementations, the OEM version of the OEM application and/or the automated assistant version of the automated assistant application can include semantic versions of the OEM version of the OEM application and/or the automated assistant version of the automated assistant application. In these implementations, the corresponding major version indicators can be incremented when incompatible changes are made to the OEM version of the OEM application and/or the automated assistant version of the automated assistant application, and the corresponding minor version indicators can be incremented when compatible changes are made to the OEM version of the OEM application and/or the automated assistant version of the automated assistant application.

For example, assume the OEM version of the OEM application corresponds to version 1.6 of the OEM application. In this example, "1" corresponds to the major OEM version indicator and "6" corresponds to the minor OEM version indicator. Also, for example, assume the automated assistant version of the automated assistant application corresponds to version 2.3 of the automated assistant application. In this example, "2" corresponds to the major automated assistant version indicator and "3" corresponds to the minor automated assistant version indicator. In some implementations, the OEM version of the OEM application and/or the automated assistant version of the automated assistant application may include additional or alternative version indicators that indicate patch releases, bug fixes, and/or any other indicators. Further, in the above example, it can be determined that the OEM version of the OEM application is not fully compatible with the automated assistant version, but rather that the OEM version of the OEM application is backwards compatible with the automated assistant version based on comparing the corresponding major version indicators and/or the corresponding minor version indicators. In contrast, assume the OEM version of the OEM application corresponds to version 2.3 of the OEM application and assume the automated assistant version of the automated assistant application corresponds to version 1.6 of the automated assistant application. In this example, it can be determined that the OEM version of the OEM application is not fully compatible with the automated assistant version of the automated assistant application, but rather that the OEM version of the OEM application is forwards compatible with the automated assistant version based on comparing the corresponding major version indicators and/or the corresponding minor version indicators. Lastly, assume the OEM version of the OEM application corresponds to version 2.0 of the OEM application and assume the automated assistant version of the automated assistant application corresponds to version 1.0 of the automated assistant application. In this example, it can be determined that the OEM version of the OEM application are fully compatible based on comparing the corresponding major version indicators and/or the corresponding minor version indicators.

In some versions of those implementations, the request can be processed using different APIs based on whether the OEM version of the OEM application is fully compatible, backwards compatible, or forwards compatible with the automated assistant version of the automated assistant application. For example, in implementations when it is determined that the OEM version of the OEM application is fully compatible with the automated assistant version of the automated assistant application, the request can be processed using an existing API. However, in implementations when it is determined that the OEM version of the OEM application is backwards compatible or forwards compatible with the automated assistant version of the automated assistant application, the request can be processed using a backwards compatibility version of the versioning API or a forwards compatibility version of the versioning API, respectively. The backwards compatibility version of the versioning API and the forwards compatibility version of the versioning API each include one or more unique components that enforce backwards compatibility and forwards compatibility, respectively. In particular, the one or more unique components utilize a mapping to one or more unique components to enforce the backwards compatibility and the forwards compatibility.

In various implementations, the OEM can provide an indication to the automated assistant application on when and/or how to generate and transmit the request for the suggestions to the automated assistant application. Accordingly, the suggestion service of the automated assistant application may be utilized in obtaining suggestions while the given vehicle is navigating along a particular route. In some versions of those implementations, the OEM application can periodically generate and transmit the request for the suggestions to the automated assistant application. For example, the OEM application can initially generate and transmit the request for the suggestions to the automated assistant application when the given vehicle is powered to an "on" state when the user enters the given vehicle, and subsequently generate and transmit additional requests for additional suggestions to the automated assistant application at periodic intervals (e.g., every 30 seconds, every minute, every two minutes, etc.).

In additional or alternative implementations, the OEM application can periodically generate and transmit the request for the suggestions to the automated assistant application based on one or more contextual signals associated with the given vehicle and/or the user of the given vehicle. For example, the OEM application can generate and transmit requests for suggestions based on a state of the given vehicle and/or a state of the user of the given vehicle. In this example, the state of the given vehicle and/or a state of the user of the given vehicle can be determined based on sensor data instances of sensor data generated by various sensors of the given vehicle, the in-vehicle computing device of the given vehicle, and/or other computing devices (e.g., a mobile computing device of the user of the given vehicle). The state of the given vehicle can include, for instance, the given vehicle being powered to an "on" state, whether the given vehicle is moving, whether the given vehicle is stopped, whether the given vehicle is parked, whether the given vehicle is following a particular route, whether the given vehicle includes additional occupants that are in addition to the user of the given vehicle, information asso-

ciated with operation of the given vehicle, such as how much of an energy source (e.g., gas, battery, etc.) is available to the given vehicle, whether any dashboard indicators are illuminated, and/or any other signals that characterize the state of the given vehicle. Further, the state of the user of the given vehicle can include, for instance, whether the user is driving the given vehicle, whether the user is a passenger of the given vehicle, an engagement level of the user while the given vehicle is moving, an origin location of the user, a destination location of the user, a route that the user is predicted to follow from the origin location to the destination location, and/or any other signals that characterizes the state of the user.

In various implementations, when the suggestion service of the automated assistant application transmits the suggestions to the OEM application responsive to the request, the OEM application can present the suggestions for presentation to the user via the in-vehicle computing device of the given vehicle. In some versions of those implementations, the OEM application can present the suggestions for audible presentation to the user via one or more speakers of the in-vehicle computing device of the given vehicle. In additional or alternative versions of those implementations, the OEM application can present the suggestions for visual presentation to the user via a display of the in-vehicle computing device of the given vehicle. In these implementations, and although the suggestions may be obtained by the suggestion service of the automated assistant application, the OEM application can visually present one or more of the suggestions in a portion of the display of the in-vehicle computing device that is dedicated to the OEM application. Put another way, the suggestion service of the automated assistant application can donate one or more of the suggestions to the OEM application such that it appears, from the perspective of the user of the given vehicle, that the OEM application obtained the suggestions, such as suggestions that are related to operation of the given vehicle. Further, the OEM application can visually present one or more other suggestions in a portion of the display of the in-vehicle computing device that is dedicated to the automated assistant application, such as suggestions that are related to controlling automated assistant functionalities.

Although the above techniques are described with respect to the OEM application and the automated assistant application, it should be understood that is for the sake of example and is not meant to be limiting. For example, the recurring system health check and the utilization of the different versioning APIs described herein can also be applied to first-party application(s) and/or third-party application(s) that are utilized by the suggestion service of the automated assistant application in obtaining the suggestions. As used herein, the term "first-party application" may refer to a software application that is developed and/or maintained by the same entity that develops and/or maintains the automated assistant application described herein and that is distinct from the automated assistant application described herein. Further, as used herein, the term "third-party application" may refer to a software application or system that is developed and/or maintained by an entity that is different from the entity that develops and/or maintains the automated assistant described herein.

By using the techniques described herein, various technical advantages can be achieved. As one non-limiting example, techniques described herein enable a system to perform the recurring system health check to ensure that connections are maintained between the automated assistant application, and the OEM application (and optionally one or more first-party applications and/or one or more third-party applications). In the event that one or more of these connections fail, the system can re-establish the failed connections to ensure that the suggestion service of the automated assistant application can continue to provide the suggestion(s). As a result, the suggestion service of the automated assistant application is more robust to issues associated with connection failures. As another non-limiting example, techniques described herein enable a system to utilize the versioning API to enforce compatibility between the automated assistant application, and the OEM application (and optionally one or more first-party applications and/or one or more third-party applications). In the event that one or more of these applications are not fully compatible with the automated assistant application, the system can utilize different versioning APIs to enforce compatibility between these applications. As a result, the suggestion service of the automated assistant application is more robust to issues associated with different versions of different applications that are not fully compatible.

The above description is provided as an overview of only some implementations disclosed herein. Those implementations, and other implementations, are described in additional detail herein.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** depicts a block diagram of an example hardware and software environment that demonstrates various aspects of the present disclosure, and in which implementations disclosed herein can be implemented.

FIG. **2** depicts a process flow of an example automated assistant suggestion service that demonstrates various aspects of FIG. **1**, and in which implementations disclosed herein can be implemented.

FIG. **3** depicts a flowchart illustrating an example method of initializing a health check of an automated assistant suggestion service, in accordance with various implementations.

FIG. **4** depicts a flowchart illustrating an example method of performing the health check of the automated assistant suggestion service from FIG. **3**, in accordance with various implementations.

FIG. **5** depicts a flowchart illustrating an example method of ensuring compatibility between an OEM version of an OEM application and an automated assistant version of an automated assistant application, in accordance with various implementations.

FIG. **6** depicts a flowchart illustrating an example method of ensuring compatibility between the OEM version of the OEM application and the automated assistant version of the automated assistant application from FIG. **5**, in accordance with various implementations.

FIG. **7** depicts a non-limiting example of a display of an in-vehicle computing device that illustrates various suggestions provided for presentation to a user of a vehicle, in accordance with various implementations.

FIG. **8** depicts an example architecture of a computing device, in accordance with various implementations.

DETAILED DESCRIPTION OF THE DRAWINGS

Turning now to FIG. **1**, an environment in which one or more selected aspects of the present disclosure may be implemented is depicted. The example environment includes a plurality of computing devices $\mathbf{110}_{1-N}$, a suggestion service system **120** of an automated assistant applica-

tion, a vehicle **100**A, one or more original equipment manufacturer (OEM) applications **181**, one or more first-party applications **182**, and one or more third-party applications **183**. Each of these components $\mathbf{110}_{1\text{-}N}$, **120**, **181**, **182**, and **183** may communicate, for example, through one or more networks indicated generally by **195**. The one or more networks can include wired or wireless networks, such as local area networks (LANs) including Wi-Fi, Bluetooth, near-field communication, and/or other LANs, wide area networks (WANs) including the internet, and/or any other network to facilitate communication between the components depicted in FIG. **1**.

In various implementations, an individual (which in the current context may also be referred to as a "user") may operate one or more of the computing devices $\mathbf{110}_{1\text{-}N}$ to interact with other components depicted in FIG. **1**. The computing devices $\mathbf{110}_{1\text{-}N}$ may be, for example, a desktop computing device, a laptop computing device, a tablet computing device, a mobile phone computing device, an in-vehicle computing device of the vehicle **100**A (e.g., an in-vehicle communications system, an in-vehicle entertainment system, and/or an in-vehicle navigation system as shown with respect to $\mathbf{110}_N$), or a wearable apparatus that includes a computing device, such as a head-mounted display ("HMD") that provides an augmented reality ("AR") or virtual reality ("VR") immersive computing experience, a "smart" watch, and so forth. Additional and/or alternative computing devices may be provided.

Each of the computing devices $\mathbf{110}_{1\text{-}N}$ and the suggestion service system **120** may include one or more memories for storage of data and software applications (e.g., one or more of the OEM applications **181**, one or more of the first-party applications **182**, and/or one or more of the third-party applications **183**), one or more processors for accessing data and executing the software applications, and other components that facilitate communication over one or more of the networks **195**. The operations performed by one or more of the computing devices $\mathbf{110}_{1\text{-}N}$ and/or the suggestion service system **120** may be distributed across multiple computer systems. For example, the suggestion service system **120** may be implemented as, for example, computer programs running exclusively on or distributed across one or more computers in one or more locations that are communicatively coupled to each other over one or more of the networks **195**.

One or more of the components $\mathbf{110}_{1\text{-}N}$, **120**, **181**, **182**, and **183** may operate a variety of different components that may be used, for instance, to improve a suggestion service of an automated assistant application as described herein. For example, a computing device $\mathbf{110}_1$ may include user interface engine $\mathbf{111}_1$ to detect and process user input (e.g., spoken input, typed input, and/or touch input) directed to the computing device $\mathbf{110}_1$. As another example, the computing device $\mathbf{110}_1$ may include one or more sensors $\mathbf{112}_1$ to generate corresponding sensor data. The one or more sensors can include, for example, global positioning system ("GPS") sensors to generate GPS data, vision components to generate vision data in a field of view of the vision components, microphones to generate audio data based on spoken input captured in an environment of the computing device $\mathbf{110}_1$, and/or other sensors to generate corresponding sensor data. As yet another example, the computing device $\mathbf{110}_1$ may operate a suggestion service system client $\mathbf{113}_1$ (e.g., which may be standalone or part of another application, such as part of a web browser) to interact with the suggestion service system **120**. Further, an additional computing device $\mathbf{110}_N$ may take the form of an in-vehicle computing device of the vehicle **100**A. Although not depicted, the additional computing device $\mathbf{110}_N$ may include the same or similar components as the computing device $\mathbf{110}_1$. For example, the additional computing device $\mathbf{110}_N$ may include respective instances of a user interface engine to detect and process user input, one or more sensors to generate corresponding sensor data, and/or a suggestion service system client to interact with the suggestion service system **120**. Moreover, although only the computing device $\mathbf{110}_1$ and the in-vehicle computing device $\mathbf{110}_N$ are depicted in FIG. **1**, it should be understood that is for the sake of example and additional or alternative computing devices may be provided.

In various implementations, the suggestion service system **120** may include interface engine **121**, request handling engine **122**, user context engine **123**, vehicle context engine **124**, suggestion engine **125**, system health check engine **126**, and versioning application programming interface (API) engine **127** as shown in FIG. **1**. In some implementations, one or more of the engines **121-127** of the suggestion service system **120** may be omitted. In some implementations, all or aspects of one or more of the engines **121-127** of the suggestion service system **120** may be combined. In some implementations, one or more of the engines **121-127** of the suggestion service system **120** may be implemented in a component that is executed, in part or exclusively, remotely from one or more of the computing devices $\mathbf{110}_{1\text{-}N}$. In some implementations, one or more of the engines **121-127** of the suggestion service system **120**, or any operative portion thereof, may be implemented in a component that is executed, in part or exclusively, locally by one or more of the computing devices $\mathbf{110}_{1\text{-}N}$.

Referring to FIG. **2**, a process flow of an example automated assistant suggestion service that demonstrates various aspects of FIG. **1** is depicted. The interface engine **121** (not depicted in FIG. **2**) can facilitate the exchange of data to and/or from the one or more of the engines **121-127** depicted in FIGS. **1** and **2**. For the sake of example, assume that a given OEM application, of the OEM application(s) **181**, that associated with an OEM of the vehicle **100**A of FIG. **1** generates and transmits an OEM request **281**A for suggestion(s) to the suggestion service system **120**. The request handling engine **122** can receive the OEM request **281**A, and determine that the OEM request **281**A is a request for the suggestion(s) to be provided for presentation to the user of the vehicle **100**A. Further, the request handling engine **122** can generate request data **222** based on the OEM request **281**A, and transmit the request data **222** to the system health check engine **126** and/or the versioning API engine **127**.

In various implementations, the system health check engine **126** can initialize and perform a recurring system health check of the suggestion service system **120**. Further, the system health check engine **126** can store data associated with the recurring system health in system health check database **126**A. In performing the recurring system health check of the suggestion service system **120**, the system health check engine **126** can ensure that connections over one or more of the networks **195** and between the automated assistant application, the OEM application(s) **181**, the first-party application(s) **182**, and/or the third-party application(s) **183** are maintained. In instances where the system health check engine **126** determines that one or more of these connections has failed, the system health check engine **126** can cause the failed connections to be re-established. In some of those instances, the system health check engine **126** can generate a signal (not depicted in FIG. **2**) that causes the suggestion engine **125** to obtain the suggestion(s) after the failed connections are re-established.

Initializing and performing the recurring system health check of the suggestion service system **120** is described in more detail herein (e.g., with respect to FIGS. **3** and **4**).

Notably, the system health check of the suggestion service system **120** described herein can be performed as a background process, such as while the suggestion service system **120** is being utilized to provide the suggestion(s) and/or while the suggestion service system **120** is dormant. Further, the system health check of the suggestion service system **120** described herein can be recurring in that the system health check of the suggestion service system **120** may be performed in a periodic manner or aperiodic manner (e.g., triggered based on one or more). By performing the system health check described herein, the system health check engine **127** can ensure that connections over one or more of the networks **195** and between the suggestion service system **120** of the automated assistant application and the OEM application(s) **181**, the first-party application(s) **182**, and/or the third-party application(s) **183** are maintained. Notably, these various applications are utilized in the process of providing the suggestion(s) to the user of the vehicle **100**A. As a result, potential failures of the suggestion service system **120** of the automated assistant application in receiving request(s), obtaining suggestion(s) based on the request(s), and causing the suggestion(s) to be provided for presentation to the user of the vehicle **100**A due to connectivity issues and/or other issues can be mitigated, thereby improving the suggestion service system **120** of the automated assistant application.

In additional or alternative implementations, the versioning API engine **127** can enforce compatibility between different versions of the automated assistant application, the OEM application(s) **181**, the first-party application(s) **182**, and/or the third-party application(s) **183**. For example, the versioning API engine **127** can determine whether the automated assistant application, the OEM application(s) **181**, the first-party application(s) **182**, and/or the third-party application(s) **183** are fully compatible, backwards compatible, and/or forwards compatible based on, for instance, corresponding major version indicators, corresponding minor version indicators, and/or other version indicators of corresponding versions of these applications. In implementations where the versioning API engine **127** determines one or more of these applications are fully compatible, the versioning API engine **127** can process the request data **222**, using an API, to generate processed request data **227**, and pass the processed request data **227** along to the suggestion engine **125**. In implementations where the versioning API engine **127** determines one or more of these applications are backwards compatible, the versioning API engine **127** can process the request data **222**, using a backwards compatibility version of a versioning API stored in versioning API(s) database **127**A, to generate a processed request data **227**, and pass the processed request data **227** along to the suggestion engine **125**. In implementations where the versioning API engine **127** determines one or more of these applications are forwards compatible, the versioning API engine **127** can process the request data **222**, using a forwards compatibility version of the versioning API stored in the versioning API(s) database **127**A, to generate a processed request data **227**, and pass the processed request data **227** along to the suggestion engine **125**. Determining whether these applications are fully compatible, backwards compatible, and/or forwards compatible, and subsequent processing of the request based thereon is described in more detail herein (e.g., with respect to FIGS. **5** and **6**).

Notably, the different APIs and/or versioning APIs can each include one or more corresponding unique components that perform different functions in the processing of the request data **222**. In implementations where the backwards compatibility version of the versioning API and/or the forwards compatibility version of the versioning API are utilized by the versioning API engine, these unique components can utilize a mapping between the different versions of the different applications. By enforcing compatibility between these applications as described herein, the versioning API engine **127** can ensure that the suggestion service system **120** of the automated assistant application is capable of processing requests from the OEM application(s) **181**, the first-party application(s) **182**, and/or the third-party application(s) **183** and without burdening these applications and/or developer(s) thereof in maintaining version compatibility. Notably, these various applications are utilized in the process of providing the suggestion(s) to the user of the vehicle **100**A. As a result, potential failures of the suggestion service system **120** of the automated assistant application in receiving request(s), obtaining suggestion(s) based on the request(s), and causing the suggestion(s) to be provided for presentation to the user of the vehicle **100**A due to versioning issues and/or other issues can be mitigated, thereby improving the suggestion service system **120** of the automated assistant application.

The suggestion engine **125** can process at least the processed request data **227** to obtain suggestion(s) **225**. In some implementations, the suggestion engine **125** can obtain the suggestion(s) **225** from suggestion(s) database **125**A and based on the processed request data **227**. In additional or alternative implementations, the suggestion engine **125** can obtain the suggestion(s) **225** from the first-party application(s) **182** and/or the third-party application(s) **183** based on the suggestion engine **125** generating and transmitting requests to the first-party application(s) **182** and/or the third-party application(s) **183**. In these implementations, the requests generated and transmitted to the first-party application(s) **182** and/or the third-party application(s) **183** can be generated based on the processed request data **227**. Further, the suggestion engine **125** can transmit the suggestion(s) **225** to the given OEM application, of the OEM application(s) **181**, that associated with an OEM of the vehicle **100**A of FIG. **1**, and the given OEM application can cause the suggestion(s) **225** to be provided for presentation to the user of the vehicle **100**A. In some implementations, the suggestion engine **125** can additionally, or alternatively, store the suggestion(s) **225** in the suggestion(s) database **125**A. In some versions of those implementations, the suggestion(s) **225** can be retrieved and re-transmitted to the given OEM application (e.g., in implementations where a connection between the given OEM application and the automated assistant application fails).

In various implementations, the suggestion engine **125** can additionally or alternatively process other signal(s) and/or data in obtaining the suggestion(s). For example, the suggestion engine **125** can additionally, or alternatively, process OEM data **281**B from the given OEM application, user context signals(s) **223** obtained generated by the user context engine **123**, vehicle context signal(s) **224** generated by the vehicle context engine **124**, first-party data **282** generated by the first-party application(s), third-party data **283** generated by the third-party application(s), and/or any other signal(s) and/or data that is available to the suggestion engine **125**. For instance, the OEM data **281**B can be transmitted to the suggestion engine **125** along with the processed request data **227** and/or as a separate transmission

as shown in FIG. **2**. Further, the OEM data **281**B can include any information that is accessible by the given OEM application and that is utilizable by the suggestion engine **125** in obtaining the suggestion(s) **225**, such as what suggestions (if any) are being currently displayed at in-vehicle computing device of the vehicle **100**A and/or other data. Similarly, the first-party data **282** and the third-party data **283** can include any information that is accessible by the first-party application(s) **182** and the third-party application(s) **183**, respectively, and that is utilizable by the suggestion engine **125** in obtaining the suggestion(s) **225**, such as user account data, application usage information, and/or other data.

Also, for instance, the user context signal(s) **223** can characterize a state of the user of the vehicle **100**A. The state of the user of the vehicle **100**A can include, for example, the user driving the vehicle **100**A, the user being a passenger of the vehicle **100**A, or an engagement level of the user while the vehicle **100**A is moving. The state of the user of the vehicle **100**A can additionally or alternatively include, for example, an origin location of the user, a destination location of the user, a route that the user is predicted to follow from the origin location to the destination location, and/or any other signals that characterizes the state of the user. Accordingly, it should be understood that the user context signal(s) **223** can be generated by the sensor(s) $\mathbf{112}_1$ of the computing device $\mathbf{110}_1$, sensor(s) of the in-vehicle computing device $\mathbf{110}_N$, sensor(s) of the vehicle **100**A, and/or any other data, such as the first-party data **282** from the first-party application(s) **182** and/or the third-party data **283** from the third-party application(s) **183**.

Also, for instance, the vehicle context signal(s) **224** can characterize a state of the vehicle **100**A. The state of the vehicle **100**A can include, for example, the vehicle **100**A being powered to an "on" state, whether the vehicle **100**A is moving, whether the vehicle **100**A is stopped, whether the vehicle **100**A is parked, whether the vehicle **100**A is following a particular route, or whether the vehicle **100**A includes additional occupants that are in addition to the user of the vehicle **100**A. The state of the user of the vehicle **100**A can additionally or alternatively include, for example, information associated with operation of the vehicle **100**A, such as how much of an energy source (e.g., gas, battery, etc.) is available to the vehicle **100**A, whether any dashboard indicators are illuminated, and/or any other signals that characterize the state of the vehicle. Accordingly, it should be understood that the vehicle context signal(s) **224** can be generated by the sensor(s) of the in-vehicle computing device $\mathbf{110}_N$, sensor(s) of the vehicle **100**A, and/or any other data, such as the OEM data **281**B from the given OEM application.

Turning now to FIG. **3**, a flowchart illustrating an example method **300** of initializing a health check of an automated assistant suggestion service is depicted. For convenience, the operations of the method **300** are described with reference to a system that performs the operations. This system of the method **300** includes at least one processor, at least one memory, and/or other component(s) of computing device(s) (e.g., computing device(s) $\mathbf{110}_{1\text{-}N}$ of FIG. **1**, suggestion service system **120** of FIG. **1**, computing device **810** of FIG. **8**, remote server(s), and/or other computing devices). While operations of the method **300** are shown in a particular order, this is not meant to be limiting. One or more operations may be reordered, omitted, and/or added.

At block **352**, the system receives, from an OEM application of a vehicle of a user, a request for one or more suggestions to be provided for presentation to the user via an in-vehicle computing device of the vehicle of the user. In some implementations, the request may be received based on one or more contextual signals associated with the vehicle and/or the user of the vehicle as indicated at block **352**A. The one or more contextual signals may be generated based on sensor data instances of sensor data generated by sensors in communication with the in-vehicle computing device and/or other computing devices of the user (e.g., a mobile computing device of the user), generated based on user interactions of the user of the vehicle with the in-vehicle computing device and/or the other computing devices of the user, and/or based on another data associated with the vehicle and/or the user of the vehicle. For example, the OEM application can generate and transmit the request to the system in response to determining that one or more contextual signals associated with the vehicle and/or the user of the vehicle trigger a need to provide one or more of the suggestions for presentation to the user. For instance, a state of the vehicle can trigger the need to provide one or more of the suggestions for presentation to the user, where the state of the vehicle includes the vehicle being powered on, the vehicle moving, the vehicle stopping, the vehicle being parked, the vehicle following a particular route, and/or the vehicle including additional occupants beyond the user. Additionally, or alternatively, a state of the user can trigger the need to provide one or more of the suggestions for presentation to the user, where the state of the user includes whether the user is driving the vehicle, whether the user is a passenger of the vehicle, whether the user is an authorized user of the vehicle, and/or or an engagement level of the user while the vehicle is moving.

In additional or alternative implementations, the request may be received based on a duration of time lapsing since a prior request as indicated at block **352**B. The duration of time can be a regular interval of time at which suggestions are requested (e.g., every two minutes, every five minutes, etc.). In various implementations, an OEM associated with the OEM application may specify whether to provide one or more of the suggestions in a contextual manner as described with respect to block **352**A, in a periodic manner as described with respect to block **352**B, and/or in any other manner.

At block **354**, the system obtains, via a suggestion service of the automated assistant application, one or more of the suggestions to be provided for presentation to the user based on the request. The system obtains the suggestion at least in part based on OEM data that can be received along with the request. For example, the OEM data can include one or more of the contextual signals associated with the vehicle and/or the user of the vehicle described above. In some implementations, one or more of the suggestions are obtained using one or more first-party applications as indicated at block **354**A. For instance, the system can obtain one or more of the suggestions from other software applications that share a common publisher with the automated assistant application. In additional or alternative implementations, one or more of the suggestions are obtained using one or more third-party applications as indicated at block **354**B. For instance, the system can obtain one or more of the suggestions from other software applications that do not share a common publisher with the automated assistant application, including the OEM application and/or other third-party applications. In additional or alternative implementations, the system can obtain one or more of the suggestions from one or more databases that include pre-cached suggestions (e.g., suggestion(s) database **125**A of FIG. **1**).

At block **356**, the system initializes a recurring system health check of the suggestion service of the automated

assistant application to ensure a connection is maintained between at least the OEM application and the suggestion service of the automated assistant. The recurring system health check of the suggestion service of the automated assistant application is described in greater detail herein (e.g., with respect to system health check engine **126** of FIGS. **1** and **2**, with respect to method **400** of FIG. **4**, etc.). Notably, the recurring system health check of the suggestion service can be initialized and performed as a background process in that the system can continue obtaining suggestion (s) based on OEM request(s) while the system simultaneously initializes and performs the recurring system health check of the suggestion service.

At block **358**, the system transmits, to the OEM application, one or more of the suggestions to cause one or more of the suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle of the user. The OEM application can provide one or more of the suggestions for visual display to the user via a display of the in-vehicle computing device and/or for audible presentation to the user via speaker(s) of the in-vehicle computing device. Some non-limiting examples of providing one or more of the suggestions for display to the user are shown in FIG. **7**.

At block **360**, the system determines whether an additional request for one or more additional or alternative suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle of the user is received. If, at an iteration of block **360**, the system determines that the additional request is not received, then the system continues monitoring for the additional request at block **360**. If, at an iteration of block **360**, the system determines that the additional request is received, then the system returns to block **354** to obtain, via the suggestions service, one or more of the additional or alternative suggestions to be provided for presentation to the user based on the additional request. The system may continue performing iterations of the method **300** of FIG. **3** based on further additional requests that are received.

Turning now to FIG. **4**, a flowchart illustrating an example method **400** of performing the health check of the automated assistant suggestion service from FIG. **3** is depicted. For example, the method **400** of FIG. **4** can be initialized at block **356** of the method **300** of FIG. **3** and can be performed as a background process in a recurring manner. For convenience, the operations of the method **400** are described with reference to a system that performs the operations. This system of the method **400** includes at least one processor, at least one memory, and/or other component(s) of computing device(s) (e.g., computing device(s) $\mathbf{110}_{1\text{-}N}$ of FIG. **1**, suggestion service system **120** of FIG. **1**, computing device **810** of FIG. **8**, remote server(s), and/or other computing devices). While operations of the method **400** are shown in a particular order, this is not meant to be limiting. One or more operations may be reordered, omitted, and/or added.

At block **452**, the system identifies a corresponding timestamp associated with a first time instance, of a plurality of time instances, the first time instance corresponding to a time that: the request is received at block **352** of the method **300** of FIG. **3** and/or the recurring system health check is initialized at block **356**. Put another way, the system can identify an initial time instance the request was received and/or that the system health check to ensure that the system health check is subsequently performed in a recurring manner.

At block **454**, the system stores, in one or more databases accessible by the automated assistant application, the corresponding timestamp in association with one or more of the suggestions. For example, the system can store one or more of the suggestions along with an indication of when one or more of the suggestions were provided for presentation to the user as indicated by the corresponding timestamp. In other implementations, the system can store the corresponding timestamp without any association to one or more of the suggestions. For example, the system can store the corresponding timestamp solely for the purpose of ensuring that the system health check is subsequently performed in a recurring manner.

At block **456**, the system identifies a subsequent time instance of the plurality time instances and that is subsequent to the first time instance. The subsequent time instance can be any time instance that is subsequent to the first time instance. For example, the system can identify the subsequent time instance based on a periodic time interval (e.g., every second, every minute, and/or any other periodic time interval). Also, for example, the system can identify the subsequent time instance based on one or more contextual signals associated with the vehicle and/or the user of the vehicle, such that the system identifies the subsequent time instance in an aperiodic manner.

At block **458**, the system determines whether a difference between the first time instance and the subsequent time instance satisfies a temporal threshold. In some implementations, the temporal threshold may be static, whereas in other implementations, the temporal threshold may be dynamic. In various implementations, the OEM of the vehicle may provide input that enables the OEM to define the temporal threshold as static and/or dynamic in different contextual scenarios.

If, at an iteration of block **458**, the system determines that the difference between the first time instance and the subsequent time instance fails to satisfy the temporal threshold, the system returns to block **456** to identify a further subsequent time instance of the plurality of time instances and that is subsequent to both the first time instance and the subsequent time instance. The system may continue performing iterations of the operations of blocks **456** and **458** until it is determined that a given subsequent time instance satisfies the temporal threshold with respect to the first time instance. If, at an iteration of block **458**, the system determines that the difference between the first time instance and the subsequent time instance satisfies the temporal threshold, then the system proceeds to block **460**.

At block **460**, the system tests the connection between at least the OEM application and the suggestion service of the automated assistant application. In some implementations, the system may additionally or alternatively test the connection between one or more of the third-party applications, that are optionally utilized in obtaining one or more of the suggestions, and the suggestion service of the automated assistant application as indicated at block **460**A. For example, the system can utilize any known technique to test the connection between the suggestion service of the automated assistant application, and the OEM application and/or one or more of the third-party applications. Further, the system may identify one or more parameters associated with the connection between the suggestion service of the automated assistant application, and the OEM application and/or one or more of the third-party applications, such as latency, a download speed, an upload speed, and/or any other parameters associated with these connections.

At block **462**, the system determines whether the connection between at least the OEM application and the suggestion service of the automated assistant application is maintained based on the testing of the connection between the

suggestion service of the automated assistant application, and the OEM application and/or one or more of the third-party applications. If, at an iteration of block **462**, the system determines that the connection between at least the OEM application and the suggestion service of the automated assistant application is maintained, then the system returns to block **452** to perform an additional iteration of the method **400** of FIG. **4**. If, at an iteration of block **462**, the system determines that the connection between at least the OEM application and the suggestion service of the automated assistant application is not maintained, then the system proceeds to block **464**.

At block **464**, the system re-establishes the connection between at least the OEM application and the suggestion service of the automated assistant application. Notably, in some implementations, the system may determine that the connection between the suggestion service of the automated assistant application and the OEM application is maintained, but the connection between the suggestion service of the automated assistant application and one or more of the third-party applications has failed. In these implementations, the system may return to block **452** with respect to the OEM application, but proceed to block **464** with respect to one or more of the third-party applications. In additional or alternative implementations, the system may determine that the connection between the suggestion service of the automated assistant application and the OEM application has failed, but the connection between the suggestion service of the automated assistant application and one or more of the third-party applications is maintained. In these implementations, the system may return to block **452** with respect to one or more of the third-party applications, but proceed to block **464** with respect to the OEM application.

At block **466**, the system retrieves and re-transmits, to the OEM application, one or more of the suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle of the user. The system returns to block **452** to perform an additional iteration of the method **400** of FIG. **4**. Accordingly, by performing the recurring system health check of the suggestion service of the automated assistant as described herein, the system can ensure that the suggestion service of the automated assistant is robust to connectivity issues and/or other problems that may result in connectivity issues.

Turning now to FIG. **5**, a flowchart illustrating an example method **500** of ensuring compatibility between an OEM version of an OEM application and an automated assistant version of an automated assistant application is depicted. For convenience, the operations of the method **500** are described with reference to a system that performs the operations. This system of the method **500** includes at least one processor, at least one memory, and/or other component(s) of computing device(s) (e.g., computing device(s) $\mathbf{110}_{1\text{-}N}$ of FIG. **1**, suggestion service system **120** of FIG. **1**, computing device **810** of FIG. **8**, remote server(s), and/or other computing devices). While operations of the method **500** are shown in a particular order, this is not meant to be limiting. One or more operations may be reordered, omitted, and/or added.

At block **552**, the system receives, from an OEM application of a vehicle of a user, a request for one or more suggestions to be provided for presentation to the user via an in-vehicle computing device of the vehicle of the user. In some implementations, the request may be received based on one or more contextual signals associated with the vehicle and/or the user of the vehicle as indicated at block **552**A. In additional or alternative implementations, the request may be received based on a duration of time lapsing since a prior request as indicated at block **552**B. The operations of these blocks may be implemented in the same or similar manner described with respect to blocks **352**, **352**A, and **352**B of the method **300** of FIG. **3**, respectively.

At block **554**, the system identifies an OEM version of the OEM application and an automated assistant version of the automated assistant application. The OEM version of the OEM application indicates at least a major OEM version indicator and a minor version indicator. Further, the automated assistant version of the automated assistant application indicates at least a major assistant application version indicator and a minor automated assistant version indicator. For example, assume the OEM version of the OEM application corresponds to version 1.6 of the OEM application. In this example, "1" corresponds to the major OEM version indicator and "6" corresponds to the minor OEM version indicator. Also, for example, assume the automated assistant version of the automated assistant application corresponds to version 2.3 of the automated assistant application. In this example, "2" corresponds to the major automated assistant version indicator and "3" corresponds to the minor automated assistant version indicator. In some implementations, the OEM version of the OEM application and/or the automated assistant version of the automated assistant application may include additional or alternative version indicators that indicate patch releases, bug fixes, and/or any other indicators.

In some implementations, the OEM version of the OEM application and/or the automated assistant version of the automated assistant application can be provided the respective parties (e.g., a third-party associated with the OEM application, such as the OEM, and a first-party associated with the automated assistant application, such as a publisher of the automated assistant). In additional or alternative implementations, the OEM version of the OEM application and/or the automated assistant version of the automated assistant application can include semantic versions of the OEM version of the OEM application provided by the OEM and/or the automated assistant version of the automated assistant application provided by the publisher of the automated assistant. In these implementations, the system can increment the major version indicators when incompatible changes are made to the OEM version of the OEM application and/or the automated assistant version of the automated assistant application, increment the minor version indicators when compatible changes are made to the OEM version of the OEM application and/or the automated assistant version of the automated assistant application, and/or increment other version indicators when other changes are made.

At block **556**, determines whether the OEM version of the OEM application is fully compatible with the automated assistant version of the automated assistant application. The system may determine whether the OEM version of the OEM application is fully compatible with the automated assistant version of the automated assistant application based on comparing the major OEM version indicator of the OEM version with the major automated assistant version indicator of the automated assistant version and/or based on comparing the minor OEM version indicator of the OEM version with the minor automated assistant version indicator of the automated assistant version. For example, assume the OEM version of the OEM application corresponds to version 2.0 of the OEM application and assume the automated assistant version of the automated assistant application corresponds to version 2.0 of the automated assistant applica-

tion. In this example, the system may determine that the OEM version of the OEM application is fully compatible with the automated assistant version of the automated assistant application based on the matching major version indicators of "2" (and optionally further based on the matching minor version indicators of "0"). As another example, assume the OEM version of the OEM application corresponds to version 1.0 of the OEM application and assume the automated assistant version of the automated assistant application corresponds to version 2.0 of the automated assistant application. In this example, the system may determine that the OEM version of the OEM application is not fully compatible with the automated assistant version, but rather that the OEM version of the OEM application is backwards compatible with the automated assistant version. As another example, assume the OEM version of the OEM application corresponds to version 2.0 of the OEM application and assume the automated assistant version of the automated assistant application corresponds to version 1.0 of the automated assistant application. In this example, the system may determine that the OEM version of the OEM application is not fully compatible with the automated assistant version, but rather that the OEM version of the OEM application is forwards compatible with the automated assistant version.

If, at an iteration of block **556**, the system determines that the OEM version of the OEM application is not fully compatible with the automated assistant version of the automated assistant application the system proceeds to block **558**. At block **558**, the system processes, using a versioning API, the request to ensure compatibility between the OEM version of the OEM application and the automated assistant version of the automated assistant application. The processing of the request using the versioning API is described in greater detail herein (e.g., with respect to versioning API engine **127** of FIGS. **1** and **2**, with respect to method **600** of FIG. **6**, etc.). Notably, the system may not process the request using the versioning API in implementations where it is determined that the OEM version of the OEM application is fully compatible with the automated assistant version of the automated assistant application. If, at an iteration of block **556**, the system determines that the OEM version of the OEM application is fully compatible with the automated assistant version of the automated assistant application the system proceeds to block **560**.

At block **560**, the system obtains, via a suggestion service of the automated assistant application, one or more suggestions to be provided for presentation to the user. The system can obtain one or more of the suggestions in the same or similar manner described with respect to blocks **354**, **354**A, and/or **354**B of the method **300** of FIG. **3**. At block **562**, the system transmits, to the OEM application, one or more of the suggestions to cause one or more of the suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle of the user. The system can transmit one or more of the suggestions to the OEM in the same or similar manner described with respect to block **358** of the method **300** of FIG. **3**.

At block **564**, the system determines whether an additional request for one or more additional or alternative suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle of the user is received. If, at an iteration of block **564**, the system determines that the additional request is not received, then the system continues monitoring for the additional request at block **564**. If, at an iteration of block **564**, the system determines that the additional request is received, then the system returns to block **554** to identify the OEM version of the OEM application and the automated assistant version of the automated assistant application. The system may continue performing iterations of the method **500** of FIG. **5** based on further additional requests that are received.

Turning now to FIG. **6**, a flowchart illustrating an example method **600** of ensuring compatibility between the OEM version of the OEM application and the automated assistant version of the automated assistant application from FIG. **5** is depicted. For example, the method **600** of FIG. **6** can be utilized at block **558** of the method **500** of FIG. **5**. For convenience, the operations of the method **600** are described with reference to a system that performs the operations. This system of the method **500** includes at least one processor, at least one memory, and/or other component(s) of computing device(s) (e.g., computing device(s) $\mathbf{110}_{1\text{-}N}$ of FIG. **1**, suggestion service system **120** of FIG. **1**, computing device **810** of FIG. **8**, remote server(s), and/or other computing devices). While operations of the method **600** are shown in a particular order, this is not meant to be limiting. One or more operations may be reordered, omitted, and/or added.

At block **652**, the system determines a type of compatibility between the OEM version of the OEM application and the automated assistant version of the automated assistant application. The type of compatibility between the OEM version of the OEM application and the automated assistant version of the automated assistant application can be determined using any technique described herein (e.g., with respect to versioning API engine **127** of FIGS. **1** and **2**, with respect to method **500** of FIG. **5**, etc.) and/or other techniques.

If, at an iteration of block **652**, the system determines that the OEM version of the OEM application is backwards compatible with the automated assistant version of the automated assistant application, then the system proceeds to block **654**. At block **654**, the system selects a backwards compatibility version of the versioning API to ensure backwards compatibility between the OEM version of the OEM application and the automated assistant version of the automated assistant application. The backwards compatibility version of the versioning API can include one or more components that are unique to the backwards compatibility version of the versioning API. These components can utilize unique mappings to enforce backwards compatibility between the OEM version of the OEM application and the automated assistant version of the automated assistant application. At block **656**, the system processes, using the backwards compatibility version of the versioning API, the request.

If, at an iteration of block **652**, the system determines that the OEM version of the OEM application is forwards compatible with the automated assistant version of the automated assistant application, then the system proceeds to block **658**. At block **658**, the system selects a forwards compatibility version of the versioning API to ensure forwards compatibility between the OEM version of the OEM application and the automated assistant version of the automated assistant application. Similarly, the forwards compatibility version of the versioning API can include one or more components that are unique to the forwards compatibility version of the versioning API and that are distinct from one or more of the components of the backwards compatibility version of the versioning API. These components can utilize unique mappings to enforce forwards compatibility between the OEM version of the OEM application and the automated assistant version of the automated assistant application. At

block **660**, the system processes, using the forwards compatibility version of the versioning API, the request.

Put another way, even though the OEM version of the OEM application is not fully compatible with the automated assistant version of the automated assistant application, techniques described herein can utilize different versioning APIs to enforce compatibility between the OEM version of the OEM application and the automated assistant version of the automated assistant application. Although FIGS. **5** and **6** are primarily described with respect to versioning between the OEM version of the OEM application and the automated assistant version of the automated assistant application, it should be understood that is for the sake of example and is not meant to be limiting. For instance, the same or similar techniques can be utilized to enforce compatibility between one or more corresponding third-party versions of one or more of the third-party applications and the automated assistant version of the automated assistant application.

Accordingly, techniques of the methods of FIGS. **3-6** can be utilized to improve the suggestion service of the automated assistant application. Although the recurring system health check of FIGS. **3** and **4**, and the versioning of FIGS. **5** and **6** are described as separate techniques to improve the suggestion service of the automated assistant application, it should be understood that is for the sake of simplicity and is not meant to be limiting. Rather, it should be understood that these techniques can be utilized in conjunction with one another and/or other techniques to improve the suggestion service of the automated assistant application.

Turning now to FIG. **7**, a non-limiting example of a display **720** of an in-vehicle computing device $\mathbf{110}_N$ that illustrates various suggestions provided for presentation to a user of a vehicle **100**A is depicted. The display **720** may include a plurality of disparate portions that are dedicated to different applications. For example, the display **720** of FIG. **7** includes a first portion **722** of the display **720** that is dedicated to an OEM application of an OEM of the vehicle **100**A executing at least in part at the in-vehicle computing device $\mathbf{110}_N$, a second portion **724** of the display **720** that is dedicated to an automated assistant application associated with an automated assistant executing at least in part at the in-vehicle computing device $\mathbf{110}_N$, and a third portion **726** of the display **720** that is dedicated to a third-party media application associated with an example music streaming service. Although the display **720** of the of the in-vehicle computing device $\mathbf{110}_N$ is shown in FIG. **7** is shown as having a particular configuration (e.g., multiple disparate portions dedicated to various applications), it should be understood that is for the sake of example and is not meant to be limiting. For instance, the display **720** may be configured in any desirable manner and specific to unique OEMs.

For the sake of example, assume that a user of the vehicle **100**A enters the vehicle and turns the vehicle **100**A to an "on" state prior to commuting to work on a weekday morning. In this example, a request for one or more suggestions to be provided for presentation to the user of the vehicle **100**A can be transmitted to a suggestion service of the automated assistant application that is executing at least in part at the in-vehicle computing device $\mathbf{110}_N$. In some implementations, the request may be transmitted to the suggestion service of the automated assistant application based on the OEM application determining one or more textual signals associated with the vehicle **100**A and/or the user of the vehicle **100**A satisfy one or more criteria, such as a vehicle state of the vehicle **100**A indicating it has powered to the "on" state or a user state of the user of the vehicle **100**A indicating the user has entered the vehicle (e.g., based on one or more occupancy sensors of the vehicle **100**A). In additional or alternative implementations, the request may be transmitted to the suggestion service of the automated assistant application based on the OEM application as part of providing suggestions in a periodic manner.

Further, the suggestion service of the automated assistant application can transmit one or more of the suggestions to the OEM application and cause the OEM application to provide one or more of the suggestions for presentation to the user. For example, as shown in the example of FIG. **7**, the first portion **722** of the display **720** that is dedicated to the OEM application includes a first suggestion **722**A of "Check traffic along route to work", a second suggestion **722**B of "Listen to local news", a third suggestion **722**C of "Call spouse", a fourth suggestion **722**D "Check fuel level", and a fifth suggestion **722**E of "Check tire pressure". Further, the second portion **724** of the display **720** that is dedicated to an automated assistant application includes a suggestion **724**A of "Press here for additional suggestions" that, when selected (e.g., via spoken input or touch input) can cause an additional request for one or more additional suggestions to be provided for presentation to the user of the vehicle **100**A to be transmitted to the suggestion service of the automated assistant application. Moreover, the third portion **726** of the display **720** that is dedicated to a third-party media application includes a suggestion **726**A of "Press here to play your artist" that, when selected (e.g., via spoken input or touch input) can cause music by a favorite artists of the user of the vehicle **100**A to be played backed back for audible presentation to the user of the vehicle **100**A via one or more speakers of the in-vehicle computing device $\mathbf{110}_N$. The user of the vehicle **100**A can select any of the above suggestions to cause corresponding actions associated with the suggestions to be initiated by the automated assistant application, the OEM application, and/or the third-party media application.

Notably, although the suggestions shown in FIG. **7** may be generated by the suggestion service of the automated assistant application, the suggestions are provided to the OEM application and/or the third-party media application to enable these various applications to provide the respective suggestions for presentation to the user of the vehicle **100**A. Put another way, the automated assistant can donate the suggestions to various other applications upon request, and the various other applications can present the respective suggestions via respective portions of the display **720**. Further, even if connections between the suggestion service of the automated assistant application, and the OEM application and/or the third-party media application fail, and/or versions these applications are not fully compatible, techniques described herein enable the suggestion service of the automated assistant to be robust to these connectivity and/or versioning issues, thereby resulting in an improved suggestion service for vehicles.

Turning now to FIG. **8**, a block diagram of an example computing device **810** that may optionally be utilized to perform one or more aspects of techniques described herein is depicted. In some implementations, one or more computing devices, one or more vehicles, and/or other component(s) may comprise one or more components of the example computing device **810**.

Computing device **810** typically includes at least one processor **814** which communicates with a number of peripheral devices via bus subsystem **812**. These peripheral devices may include a storage subsystem **824**, including, for example, a memory subsystem **825** and a file storage subsystem **826**, user interface output devices **820**, user interface

input devices **822**, and a network interface subsystem **816**. The input and output devices allow user interaction with computing device **810**. Network interface subsystem **816** provides an interface to outside networks and is coupled to corresponding interface devices in other computing devices.

User interface input devices **822** may include a keyboard, pointing devices such as a mouse, trackball, touchpad, or graphics tablet, a scanner, a touchscreen incorporated into the display, audio input devices such as voice recognition systems, microphones, and/or other types of input devices. In general, use of the term "input device" is intended to include all possible types of devices and ways to input information into computing device **810** or onto a communication network.

User interface output devices **820** may include a display subsystem, a printer, a fax machine, or non-visual displays such as audio output devices. The display subsystem may include a cathode ray tube (CRT), a flat-panel device such as a liquid crystal display (LCD), a projection device, or some other mechanism for creating a visible image. The display subsystem may also provide non-visual display such as via audio output devices. In general, use of the term "output device" is intended to include all possible types of devices and ways to output information from computing device **810** to the user or to another machine or computing device.

Storage subsystem **824** stores programming and data constructs that provide the functionality of some or all of the modules described herein. For example, the storage subsystem **824** may include the logic to perform selected aspects of the methods disclosed herein, as well as to implement various components depicted in FIGS. **1** and **2**.

These software modules are generally executed by processor **814** alone or in combination with other processors. Memory **825** used in the storage subsystem **824** can include a number of memories including a main random-access memory (RAM) **830** for storage of instructions and data during program execution and a read only memory (ROM) **832** in which fixed instructions are stored. A file storage subsystem **826** can provide persistent storage for program and data files, and may include a hard disk drive, a floppy disk drive along with associated removable media, a CD-ROM drive, an optical drive, or removable media cartridges. The modules implementing the functionality of certain implementations may be stored by file storage subsystem **826** in the storage subsystem **824**, or in other machines accessible by the processor(s) **814**.

Bus subsystem **812** provides a mechanism for letting the various components and subsystems of computing device **810** communicate with each other as intended. Although bus subsystem **812** is shown schematically as a single bus, alternative implementations of the bus subsystem **812** may use multiple busses.

Computing device **810** can be of varying types including a workstation, server, computing cluster, blade server, server farm, or any other data processing system or computing device. Due to the ever-changing nature of computers and networks, the description of computing device **810** depicted in FIG. **8** is intended only as a specific example for purposes of illustrating some implementations. Many other configurations of computing device **810** are possible having more or fewer components than the computing device depicted in FIG. **8**.

In situations in which the systems described herein collect or otherwise monitor personal information about users, or may make use of personal and/or monitored information), the users may be provided with an opportunity to control whether programs or features collect user information (e.g., information about a user's social network, social actions or activities, profession, a user's preferences, or a user's current geographic location), or to control whether and/or how to receive content from the content server that may be more relevant to the user. Also, certain data may be treated in one or more ways before it is stored or used, so that personal identifiable information is removed. For example, a user's identity may be treated so that no personal identifiable information can be determined for the user, or a user's geographic location may be generalized where geographic location information is obtained (such as to a city, ZIP code, or state level), so that a particular geographic location of a user cannot be determined. Thus, the user may have control over how information is collected about the user and/or used.

In some implementations, a method implemented by one or more processors is provided, and includes receiving, from an original equipment manufacturer (OEM) application of a vehicle of a user, a request for one or more suggestions to be provided for presentation to the user via an in-vehicle computing device of the vehicle of the user; in response to receiving the request for one or more of the suggestions to be provided for presentation to the user: obtaining, via a suggestion service of the automated assistant application, one or more of the suggestions to be provided for presentation to the user; and initializing a recurring system health check of the suggestion service of the automated assistant application to ensure a connection is maintained between at least the OEM application and the suggestion service of the automated assistant application; and subsequent to obtaining one or more of the suggestions to be provided for presentation to the user: transmitting, to the OEM application, one or more of the suggestions. Transmitting one or more of the suggestions to the OEM application causes one or more of the suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle of the user.

These and other implementations of technology disclosed herein can optionally include one or more of the following features.

In some implementations, the request for one or more of the suggestions to be provided for presentation to the user may be received at a first time instance, of a plurality of time instances, and the recurring system health check of the suggestion service of the automated assistant application may be initialized at the first time instance. In some versions of those implementations, initializing the recurring system health check of the suggestion service of the automated assistant application may include identifying a corresponding timestamp associated with the first time instance; storing, in one or more databases accessible by the automated assistant application, the corresponding timestamp, associated with the first time instance, in association with one or more of the suggestions to be provided for presentation to the user based on the request received at the first time instance; and performing the recurring system health check of the suggestion service of the automated assistant application. In some further versions of those implementations, performing the recurring system health check of the suggestion service of the automated assistant application may include determining whether a difference between the first time instance and a second time instance, of the plurality of time instances, satisfies a temporal threshold, the second time instance being subsequent in time to the first time instance; and in response to determining that the difference between the first time instance and the second time instance satisfies the temporal threshold: testing the connection

between at least the OEM application and the suggestion service of the automated assistant application.

In yet further versions of those implementations, the method may further include, in response to determining that the connection between at least the OEM application and the suggestion service of the automated assistant application is maintained: identifying an additional corresponding timestamp associated with the second time instance; storing, in one or more of the databases accessible by the automated assistant application, the additional corresponding timestamp associated with the second time instance in association with one or more of: one or more of the suggestions to be provided for presentation to the user based on the request received at the first time instance, or one or more additional suggestions to be provided for presentation to the user based on an additional request received at the second time instance; and continue performing the recurring system health check of the suggestion service of the automated assistant application.

In additional or alternative yet further versions of those implementations, the method may further include, in response to determining that the connection between at least the OEM application and the suggestion service of the automated assistant application has failed: re-establishing the connection between at least the OEM application and the suggestion service of the automated assistant application; retrieving, from one or more of the databases accessible by the automated assistant application, one or more of the suggestions stored in association with the corresponding timestamp associated with the first time instance; and re-transmitting, to the OEM application, one or more of the suggestions, wherein re-transmitting one or more of the suggestions to the OEM application causes one or more of the suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle of the user.

In additional or alternative yet further versions of those implementations, the method may further include, in response to determining that the difference between the first time instance and the second time instance fails to satisfy the temporal threshold: determining whether a difference between the first time instance and a third time instance, of the plurality of time instances, satisfies the temporal threshold, the third time instance being subsequent in time to both the first time instance and the second time instance; and in response to determining that the difference between the first time instance and the third time instance satisfies the temporal threshold: testing the connection between at least the OEM application and the suggestion service of the automated assistant application.

In some implementations, the recurring system health check of the suggestion service of the automated assistant application may further ensure an additional connection is maintained between at least one or more additional third-party applications and the suggestion service of the automated assistant application. The one or more additional third-party application may be in addition to the OEM application and are in addition to the automated assistant application.

In some implementations, the request for one or more of the suggestions to be provided for presentation to the user may be received from the OEM application based on one or more contextual signals associated with the vehicle or the user of the vehicle. In some versions of those implementations, one or more of the contextual signals associated with the vehicle or the user of the vehicle may include one or both of: a state of the vehicle determined based on one or more sensor data instances generated by one or more corresponding sensors of the vehicle, or a state of the user of the vehicle determined based on one or more sensor data instances generated by one or more corresponding sensors of the vehicle or generated by one or more corresponding sensors of a mobile computing device of the user. In some further versions of those implementations, the state of the vehicle may include one or more of: the vehicle being powered on, the vehicle moving, the vehicle stopping, the vehicle being parked, the vehicle following a particular route, or the vehicle including additional occupants beyond the user. In additional or alternative further versions of those implementations, the state of the user of the vehicle may include one or more of: the user driving the vehicle, the user being a passenger of the vehicle, or an engagement level of the user while the vehicle is moving.

In some implementations, the request for one or more of the suggestions to be provided for presentation to the user may be received from the OEM application based on a duration of time lapsing since a prior request.

In some implementations, transmitting one or more of the suggestions to the OEM application may cause one or more of the suggestions to be provided for visual presentation to the user via an in-vehicle display of the in-vehicle computing device. In some versions of those implementations, one or more of the suggestions may be provided for visual presentation to the user via an OEM portion of the in-vehicle display that is associated with the OEM application and that is in addition to an automated assistant portion of the in-vehicle display that is associated with the automated assistant application.

In some implementations, transmitting one or more of the suggestions to the OEM application may cause one or more of the suggestions to be provided for audible presentation to the user via one or more in-vehicle speakers of the in-vehicle computing device of the vehicle of the user.

In some implementations, a method implemented by one or more processors is provided, and includes receiving, from an original equipment manufacturer (OEM) application of a vehicle of a user, a request for one or more suggestions to be provided for presentation to the user via an in-vehicle computing device of the vehicle of the user; in response to receiving the request for one or more of the suggestions to be provided presentation to the user: determining whether an OEM version of the OEM application is fully compatible with an automated assistant version of the automated assistant application; in response to determining that the OEM version of the OEM application is not fully compatible with the automated assistant version of the automated assistant application: processing, using a versioning application programming interface (API), the request to ensure compatibility between the OEM version of the OEM application and the automated assistant version of the automated assistant application; and obtaining, based on the processing using the versioning API and via a suggestion service of the automated assistant application, one or more of the suggestions to be provided for presentation to the user; and subsequent to obtaining one or more of the suggestions to be provided for presentation to the user based on the processing using the versioning API: transmitting, to the OEM application, one or more of the suggestions. Transmitting one or more of the suggestions to the OEM application causes one or more of the suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle of the user.

These and other implementations of technology disclosed herein can optionally include one or more of the following features.

In some implementations, the OEM version of the OEM application may indicate at least a major OEM version indicator and a minor OEM version indicator, and the automated assistant version of the automated assistant application may indicate at least a major automated assistant version indicator and a minor automated assistant version indicator.

In some versions of those implementations, determining that the OEM version of the OEM application is not fully compatible with the automated assistant version of the automated assistant application may include determining that the OEM version of the OEM application is backwards compatible with the automated assistant version of the automated assistant application based on comparing one or more of: the major OEM version indicator and the major automated assistant version indicator, or the minor OEM version indicator and the minor automated assistant version indicator. In some further versions of those implementations, the method may further include, in response to determining that the OEM version of the OEM application is backwards compatible with the automated assistant version of the automated assistant application: processing, using a backwards compatibility version of the versioning API, the request to ensure backwards compatibility between the OEM version of the OEM application and the automated assistant version of the automated assistant application. In yet further versions of those implementations, the backwards compatibility version of the versioning API may include one or more components that are unique to the backwards compatibility version of the versioning API.

In some versions of those implementations, determining that the OEM version of the OEM application is not fully compatible with the automated assistant version of the automated assistant application may include determining that the OEM version of the OEM application is forwards compatible with the automated assistant version of the automated assistant application based on comparing one or more of: the major OEM version indicator and the major automated assistant version indicator, or the minor OEM version indicator and the minor automated assistant version indicator. In some further versions of those implementations, the method may further include, in response to determining that the OEM version of the OEM application is forwards compatible with the automated assistant version of the automated assistant application: processing, using a forwards compatibility version of the versioning API, the request to ensure forwards compatibility between the OEM version of the OEM application and the automated assistant version of the automated assistant application. In yet further versions of those implementations, the forwards compatibility version of the versioning API may include one or more components that are unique to the forwards compatibility version of the versioning API.

In some implementations, the method may further include, in response to receiving the request for one or more of the suggestions to be provided presentation to the user, determining whether one or more corresponding third-party versions of one or more third-party applications is fully compatible with the automated assistant version of the automated assistant application; and in response to determining that one or more of the corresponding third-party versions of one or more of the third-party applications is not fully compatible with the automated assistant version of the automated assistant application: processing, using the versioning API, the request to ensure compatibility between one or more of the corresponding third-party versions of one or more of the third-party applications and the automated assistant version of the automated assistant application.

In some versions of those implementations, the OEM version of the OEM application may indicate at least a major OEM version indicator and a minor OEM version indicator, the automated assistant version of the automated assistant application may indicate at least a major automated assistant version indicator and a minor automated assistant version indicator, and the one or more corresponding third-party versions of the one or more third-party applications may each indicate at least a corresponding major third-party version indicator and a corresponding minor third-party version indicator.

In some further versions of those implementations, determining that the one or more corresponding third-party versions of the one or more third-party applications is not fully compatible with the automated assistant version of the automated assistant application may include determining that one or more of the corresponding third-party versions of one or more of the third-party applications is backwards compatible or forwards compatible with the automated assistant version of the automated assistant application based on comparing one or more of: the corresponding major third-party version indicators and the major automated assistant version indicator, or the corresponding minor third-party version indicators and the minor automated assistant version indicator.

In yet further versions of those implementations, the method may further include, in response to determining that one or more of the corresponding third-party versions of one or more of the third-party applications is backwards compatible with the automated assistant version of the automated assistant application: processing, using a backwards compatibility version of the versioning API, the request to ensure forwards compatibility between one or more of the corresponding third-party versions of one or more of the third-party applications and the automated assistant version of the automated assistant application; and in response to determining that one or more of the corresponding third-party versions of one or more of the third-party applications is forwards compatible with the automated assistant version of the automated assistant application: processing, using a forwards compatibility version of the versioning API, the request to ensure forwards compatibility between one or more of the corresponding third-party versions of one or more of the third-party applications and the automated assistant version of the automated assistant application.

In even yet further versions of those implementations, the backwards compatibility version of the versioning API may include one or more components that are unique to the backwards compatibility version of the versioning API, and the forwards compatibility version of the versioning API may include one or more additional components that are unique to the forwards compatibility version of the versioning API.

In addition, some implementations include one or more processors (e.g., central processing unit(s) (CPU(s)), graphics processing unit(s) (GPU(s), and/or tensor processing unit(s) (TPU(s)) of one or more computing devices, where the one or more processors are operable to execute instructions stored in associated memory, and where the instructions are configured to cause performance of any of the aforementioned methods. Some implementations also include one or more non-transitory computer readable storage media storing computer instructions executable by one

or more processors to perform any of the aforementioned methods. Some implementations also include a computer program product including instructions executable by one or more processors to perform any of the aforementioned methods.

It should be appreciated that all combinations of the foregoing concepts and additional concepts described in greater detail herein are contemplated as being part of the subject matter disclosed herein. For example, all combinations of claimed subject matter appearing at the end of this disclosure are contemplated as being part of the subject matter disclosed herein.

What is claimed is:

1. A method implemented by one or more processors executing an automated assistant application, the method comprising:

receiving, from an original equipment manufacturer (OEM) application of a vehicle of a user, a request for one or more suggestions to be provided for presentation to the user via an in-vehicle computing device of the vehicle of the user;

in response to receiving the request for one or more of the suggestions to be provided for presentation to the user:

obtaining, via a suggestion service of the automated assistant application, one or more of the suggestions to be provided for presentation to the user; and

initializing a recurring system health check of the suggestion service of the automated assistant application to ensure a connection is maintained between at least the OEM application and the suggestion service of the automated assistant application,

wherein the request for one or more of the suggestions to be provided for presentation to the user is received at a first time instance, of a plurality of time instances, and

wherein the recurring system health check of the suggestion service of the automated assistant application is initialized at the first time instance; and

performing the recurring system health check of the suggestion service of the automated assistant application to ensure the connection is maintained between at least the OEM application and the suggestion service of the automated assistant application, wherein performing the recurring system health check comprises:

determining whether a difference between the first time instance and a second time instance, of the plurality of time instances, satisfies a temporal threshold,

wherein the second time instance is subsequent in time to the first time instance, and

wherein the second time instance is determined based on a predicted time that the OEM application is predicted to request, from the suggestion service of the automated assistant application, one or more additional suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle;

determining that the difference between the first time instance and the second time instance satisfies the temporal threshold; and

in response to determining that the difference between the first time instance and the second time instance satisfies the temporal threshold:

testing the connection between at least the OEM application and the suggestion service of the automated assistant application; and

subsequent to obtaining one or more of the suggestions to be provided for presentation to the user:

transmitting, to the OEM application, one or more of the suggestions, wherein transmitting one or more of the suggestions to the OEM application causes one or more of the suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle of the user.

2. The method of claim **1**, wherein initializing the recurring system health check of the suggestion service of the automated assistant application comprises:

identifying a corresponding timestamp associated with the first time instance; and

storing, in one or more databases accessible by the automated assistant application, the corresponding timestamp, associated with the first time instance, in association with one or more of the suggestions to be provided for presentation to the user based on the request received at the first time instance.

3. The method of claim **2**, further comprising:

determining, based on testing the connection between at least the OEM application and the suggestion service of the automated assistant application, that the connection between at least the OEM application and the suggestion service of the automated assistant application is maintained; and

in response to determining that the connection between at least the OEM application and the suggestion service of the automated assistant application is maintained:

identifying an additional corresponding timestamp associated with the second time instance;

storing, in one or more of the databases accessible by the automated assistant application, the additional corresponding timestamp associated with the second time instance in association with one or more of:

one or more of the suggestions to be provided for presentation to the user based on the request received at the first time instance, or

one or more additional suggestions to be provided for presentation to the user based on an additional request received at the second time instance; and

continue performing the recurring system health check of the suggestion service of the automated assistant application.

4. The method of claim **2**, further comprising:

determining, based on testing the connection between at least the OEM application and the suggestion service of the automated assistant application, that the connection between at least the OEM application and the suggestion service of the automated assistant application has failed; and

in response to determining that the connection between at least the OEM application and the suggestion service of the automated assistant application has failed:

re-establishing the connection between at least the OEM application and the suggestion service of the automated assistant application;

retrieving, from one or more of the databases accessible by the automated assistant application, one or more of the suggestions stored in association with the corresponding timestamp associated with the first time instance; and

re-transmitting, to the OEM application, one or more of the suggestions, wherein re-transmitting one or more

of the suggestions to the OEM application causes one or more of the suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle of the user.

5. The method of claim **1**, wherein the recurring system health check of the suggestion service of the automated assistant application further ensures an additional connection is maintained between at least one or more additional third-party applications and the suggestion service of the automated assistant application, wherein the one or more additional third-party applications are in addition to the OEM application and are in addition to the automated assistant application.

6. The method of claim **1**, wherein the request for one or more of the suggestions to be provided for presentation to the user is received from the OEM application based on one or more contextual signals associated with the vehicle or the user of the vehicle.

7. The method of claim **6**, wherein one or more of the contextual signals associated with the vehicle or the user of the vehicle comprise one or both of: a state of the vehicle determined based on one or more sensor data instances generated by one or more corresponding sensors of the vehicle, or a state of the user of the vehicle determined based on one or more sensor data instances generated by one or more corresponding sensors of the vehicle or generated by one or more corresponding sensors of a mobile computing device of the user.

8. The method of claim **7**,

wherein the state of the vehicle comprises one or more of: the vehicle being powered on, the vehicle moving, the vehicle stopping, the vehicle being parked, the vehicle following a particular route, or the vehicle including additional occupants beyond the user, or

wherein the state of the user of the vehicle comprises one or more of: the user driving the vehicle, the user being a passenger of the vehicle, or an engagement level of the user while the vehicle is moving.

9. A system comprising:

at least one processor; and

memory storing instructions that, when executed, cause the at least one processor to:

receive, from an original equipment manufacturer (OEM) application of a vehicle of a user, a request for one or more suggestions to be provided for presentation to the user via an in-vehicle computing device of the vehicle of the user;

in response to receiving the request for one or more of the suggestions to be provided for presentation to the user:

obtain, via a suggestion service of the automated assistant application, one or more of the suggestions to be provided for presentation to the user; and

initialize a recurring system health check of the suggestion service of the automated assistant application to ensure a connection is maintained between at least the OEM application and the suggestion service of the automated assistant application,

wherein the request for one or more of the suggestions to be provided for presentation to the user is received at a first time instance, of a plurality of time instances, and

wherein the recurring system health check of the suggestion service of the automated assistant application is initialized at the first time instance; and

perform the recurring system health check of the suggestion service of the automated assistant application to ensure the connection is maintained between at least the OEM application and the suggestion service of the automated assistant application, wherein the instructions to perform the recurring system health check comprise instructions to:

determine whether a difference between the first time instance and a second time instance, of the plurality of time instances, satisfies a temporal threshold,

wherein the second time instance is subsequent in time to the first time instance, and

wherein the second time instance is determined based on a predicted time that the OEM application is predicted to request, from the suggestion service of the automated assistant application, one or more additional suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle;

determine that the difference between the first time instance and the second time instance satisfies the temporal threshold; and

in response to determining that the difference between the first time instance and the second time instance satisfies the temporal threshold:

test the connection between at least the OEM application and the suggestion service of the automated assistant application; and

subsequent to obtaining one or more of the suggestions to be provided for presentation to the user:

transmit, to the OEM application, one or more of the suggestions, wherein transmitting one or more of the suggestions to the OEM application causes one or more of the suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle of the user.

10. The system of claim **9**, wherein the instructions to initialize the recurring system health check of the suggestion service of the automated assistant application comprise instructions to:

identify a corresponding timestamp associated with the first time instance; and

store, in one or more databases accessible by the automated assistant application, the corresponding timestamp, associated with the first time instance, in association with one or more of the suggestions to be provided for presentation to the user based on the request received at the first time instance.

11. The system of claim **10**, wherein the instructions further cause the at least one processor to:

determine, based on testing the connection between at least the OEM application and the suggestion service of the automated assistant application, that the connection between at least the OEM application and the suggestion service of the automated assistant application is maintained; and

in response to determining that the connection between at least the OEM application and the suggestion service of the automated assistant application is maintained:

identify an additional corresponding timestamp associated with the second time instance;

store, in one or more of the databases accessible by the automated assistant application, the additional corresponding timestamp associated with the second time instance in association with one or more of:

one or more of the suggestions to be provided for presentation to the user based on the request received at the first time instance, or

one or more additional suggestions to be provided for presentation to the user based on an additional request received at the second time instance; and

continue performance of the recurring system health check of the suggestion service of the automated assistant application.

12. The system of claim **10**, wherein the instructions further cause the at least one processor to:

determine, based on testing the connection between at least the OEM application and the suggestion service of the automated assistant application, that the connection between at least the OEM application and the suggestion service of the automated assistant application has failed; and

in response to determining that the connection between at least the OEM application and the suggestion service of the automated assistant application has failed:

re-establish the connection between at least the OEM application and the suggestion service of the automated assistant application;

retrieve, from one or more of the databases accessible by the automated assistant application, one or more of the suggestions stored in association with the corresponding timestamp associated with the first time instance; and

re-transmit, to the OEM application, one or more of the suggestions, wherein re-transmitting one or more of the suggestions to the OEM application causes one or more of the suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle of the user.

13. The system of claim **9**, wherein the recurring system health check of the suggestion service of the automated assistant application further ensures an additional connection is maintained between at least one or more additional third-party applications and the suggestion service of the automated assistant application, wherein the one or more additional third-party applications are in addition to the OEM application and are in addition to the automated assistant application.

14. A non-transitory computer-readable storage medium storing instructions that, when executed, cause one or more processors to be operable to perform operations, the operations comprising:

receiving, from an original equipment manufacturer (OEM) application of a vehicle of a user, a request for one or more suggestions to be provided for presentation to the user via an in-vehicle computing device of the vehicle of the user;

in response to receiving the request for one or more of the suggestions to be provided for presentation to the user:

obtaining, via a suggestion service of the automated assistant application, one or more of the suggestions to be provided for presentation to the user; and

initializing a recurring system health check of the suggestion service of the automated assistant application to ensure a connection is maintained between at least the OEM application and the suggestion service of the automated assistant application,

wherein the request for one or more of the suggestions to be provided for presentation to the user is received at a first time instance, of a plurality of time instances, and

wherein the recurring system health check of the suggestion service of the automated assistant application is initialized at the first time instance; and

performing the recurring system health check of the suggestion service of the automated assistant application to ensure the connection is maintained between at least the OEM application and the suggestion service of the automated assistant application, wherein performing the recurring system health check comprises:

determining whether a difference between the first time instance and a second time instance, of the plurality of time instances, satisfies a temporal threshold,

wherein the second time instance is subsequent in time to the first time instance, and

wherein the second time instance is determined based on a predicted time that the OEM application is predicted to request, from the suggestion service of the automated assistant application, one or more additional suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle;

determining that the difference between the first time instance and the second time instance satisfies the temporal threshold; and

in response to determining that the difference between the first time instance and the second time instance satisfies the temporal threshold:

testing the connection between at least the OEM application and the suggestion service of the automated assistant application; and

subsequent to obtaining one or more of the suggestions to be provided for presentation to the user:

transmitting, to the OEM application, one or more of the suggestions, wherein transmitting one or more of the suggestions to the OEM application causes one or more of the suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle of the user.

15. The non-transitory computer-readable storage medium of claim **14**, wherein initializing the recurring system health check of the suggestion service of the automated assistant application comprises:

identifying a corresponding timestamp associated with the first time instance; and

storing, in one or more databases accessible by the automated assistant application, the corresponding timestamp, associated with the first time instance, in association with one or more of the suggestions to be provided for presentation to the user based on the request received at the first time instance.

16. The non-transitory computer-readable storage medium of claim **15**, the operations further comprising:

determining, based on testing the connection between at least the OEM application and the suggestion service of the automated assistant application, that the connection between at least the OEM application and the suggestion service of the automated assistant application is maintained; and

in response to determining that the connection between at least the OEM application and the suggestion service of the automated assistant application is maintained:

identifying an additional corresponding timestamp associated with the second time instance;

storing, in one or more of the databases accessible by the automated assistant application, the additional corresponding timestamp associated with the second time instance in association with one or more of:

one or more of the suggestions to be provided for presentation to the user based on the request received at the first time instance, or

one or more additional suggestions to be provided for presentation to the user based on an additional request received at the second time instance; and

continue performing the recurring system health check of the suggestion service of the automated assistant application.

17. The non-transitory computer-readable storage medium of claim **15**, the operations further comprising:

determining, based on testing the connection between at least the OEM application and the suggestion service of the automated assistant application, that the connection between at least the OEM application and the suggestion service of the automated assistant application has failed; and

in response to determining that the connection between at least the OEM application and the suggestion service of the automated assistant application has failed:

re-establishing the connection between at least the OEM application and the suggestion service of the automated assistant application;

retrieving, from one or more of the databases accessible by the automated assistant application, one or more of the suggestions stored in association with the corresponding timestamp associated with the first time instance; and

re-transmitting, to the OEM application, one or more of the suggestions, wherein re-transmitting one or more of the suggestions to the OEM application causes one or more of the suggestions to be provided for presentation to the user via the in-vehicle computing device of the vehicle of the user.

18. The non-transitory computer-readable storage medium of claim **14**, wherein the recurring system health check of the suggestion service of the automated assistant application further ensures an additional connection is maintained between at least one or more additional third-party applications and the suggestion service of the automated assistant application, wherein the one or more additional third-party applications are in addition to the OEM application and are in addition to the automated assistant application.

19. The non-transitory computer-readable storage medium of claim **14**, wherein the request for one or more of the suggestions to be provided for presentation to the user is received from the OEM application based on one or more contextual signals associated with the vehicle or the user of the vehicle.

20. The non-transitory computer-readable storage medium of claim **19**, wherein one or more of the contextual signals associated with the vehicle or the user of the vehicle comprise one or both of: a state of the vehicle determined based on one or more sensor data instances generated by one or more corresponding sensors of the vehicle, or a state of the user of the vehicle determined based on one or more sensor data instances generated by one or more corresponding sensors of the vehicle or generated by one or more corresponding sensors of a mobile computing device of the user.

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