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(54) **SYSTEMS AND METHODS FOR INTEGRATING THIRD PARTY SERVICES WITH A DIGITAL ASSISTANT**

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See application file for complete search history.

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(57) **ABSTRACT**

The electronic device with one or more processors and memory receives an input of a user. The electronic device, in accordance with the input, identifies a respective task type from a plurality of predefined task types associated with a plurality of third party service providers. The respective task type is associated with at least one third party service provider for which the user is authorized and at least one third party service provider for which the user is not authorized. In response to identifying the respective task type, the electronic device sends a request to perform at least a portion of a task to a third party service provider of the plurality of
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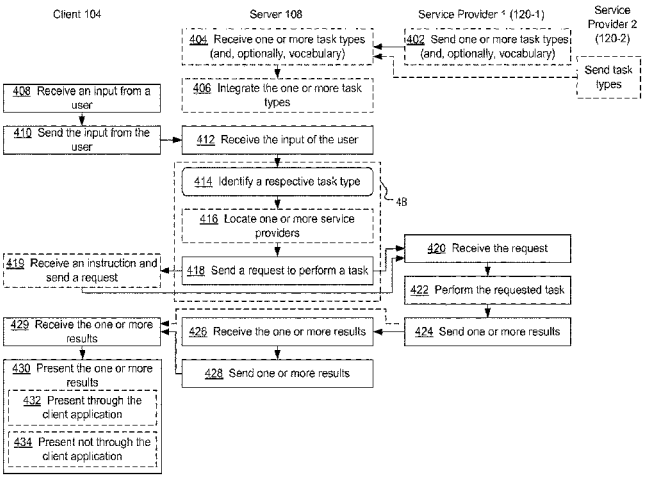

third party service providers that is associated with the respective task type.

21 Claims, 7 Drawing Sheets

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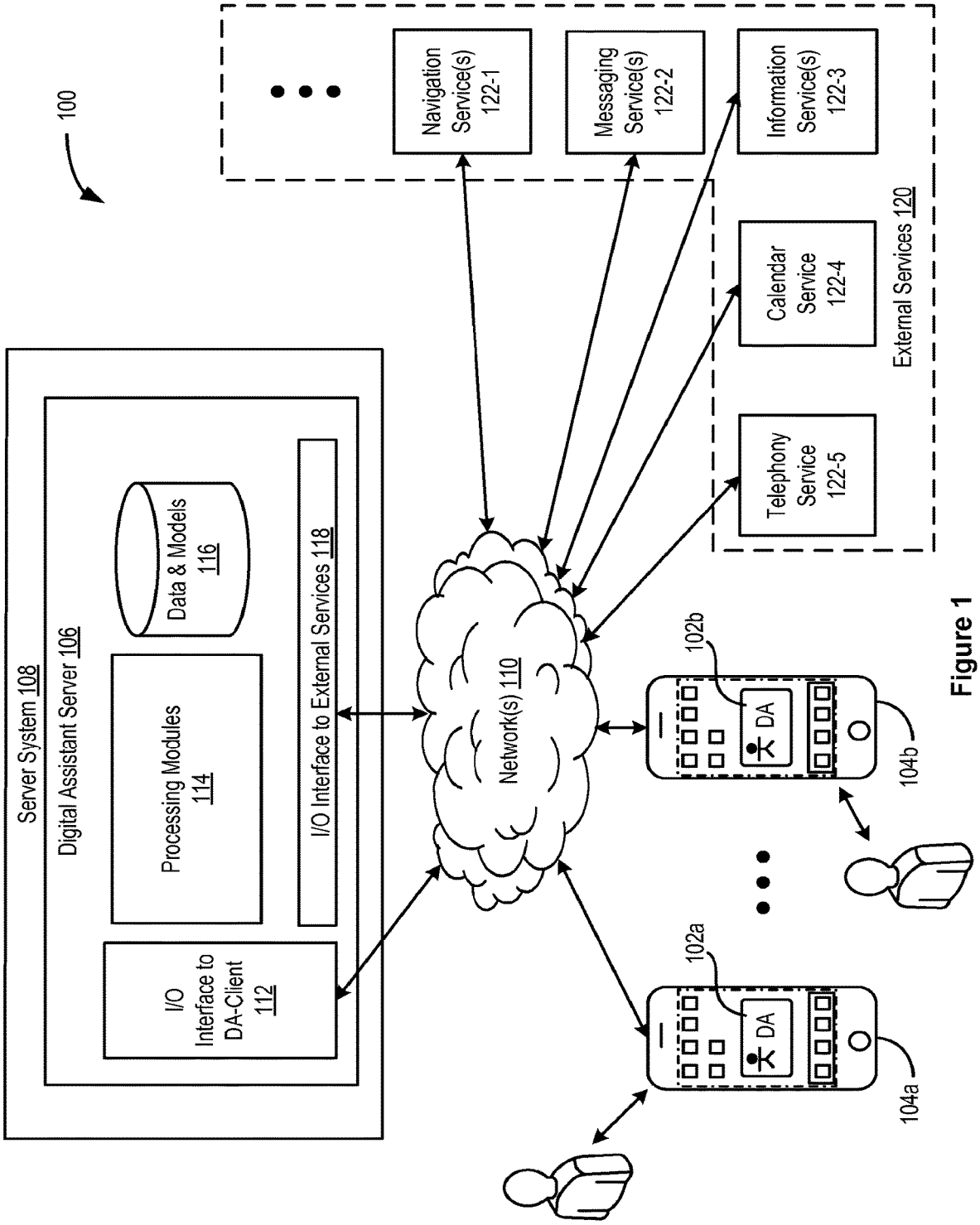
100
Server System 108
Digital Assistant Server 106
I/O Interface to DA-Client 112
Processing Modules 114
Data & Models 116
I/O Interface to External Services 118
Network(s) 110
External Services 120
Navigation Service(s) 122-1
Messaging Service(s) 122-2
Information Service(s) 122-3
Calendar Service 122-4
Telephony Service 122-5
102a
102b
104a
104b
DA

Figure 1

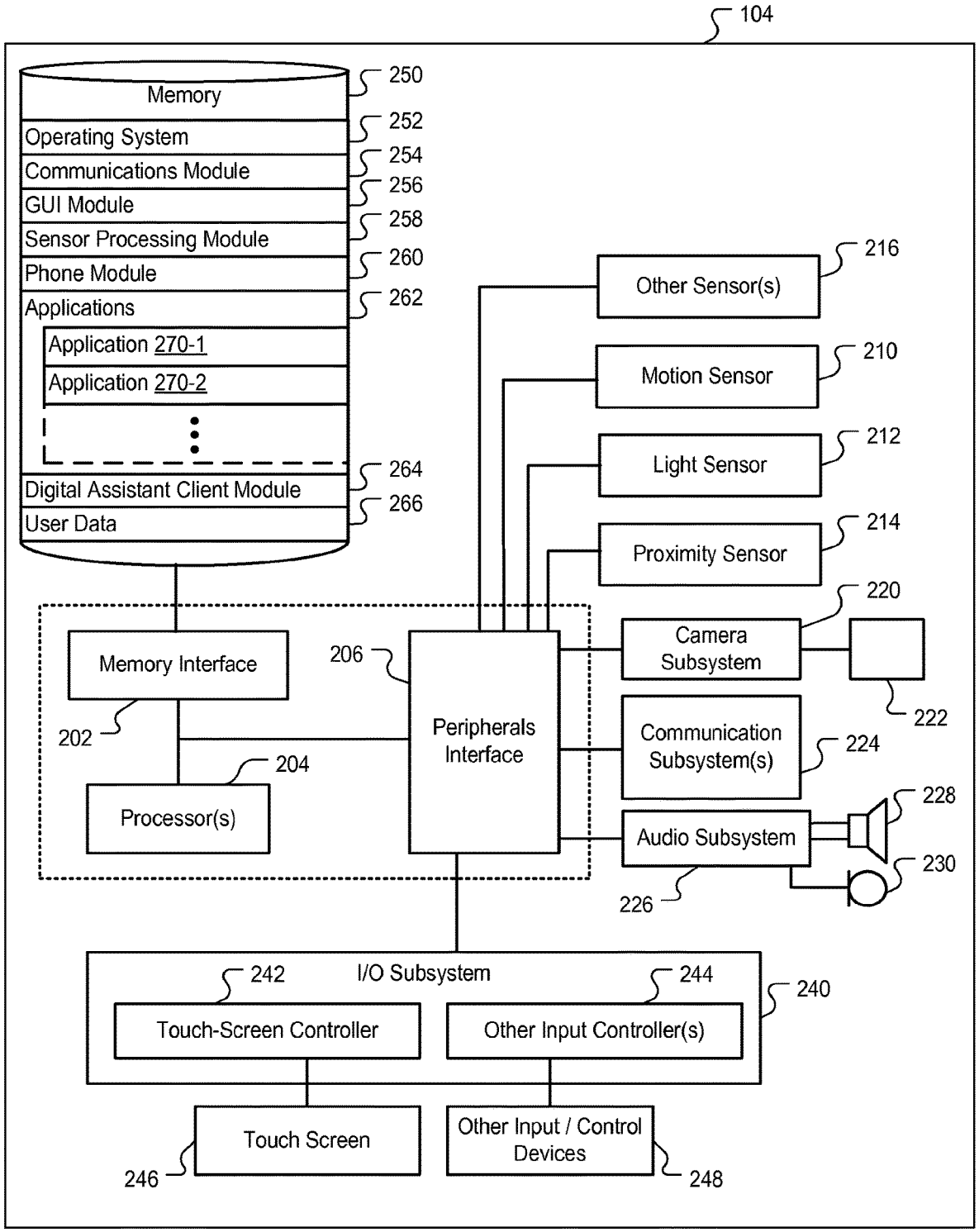
104
Memory
250
Operating System
252
Communications Module
254
GUI Module
256
Sensor Processing Module
258
Phone Module
260
Applications
262
Application 270-1
Application 270-2
264
Digital Assistant Client Module
266
User Data
Other Sensor(s)
216
Motion Sensor
210
Light Sensor
212
Proximity Sensor
214
220
Camera Subsystem
222
Memory Interface
202
206
Peripherals Interface
204
Processor(s)
Communication Subsystem(s)
224
228
Audio Subsystem
230
226
I/O Subsystem
242
244
240
Touch-Screen Controller
Other Input Controller(s)
Touch Screen
246
Other Input / Control Devices
248

Figure 2

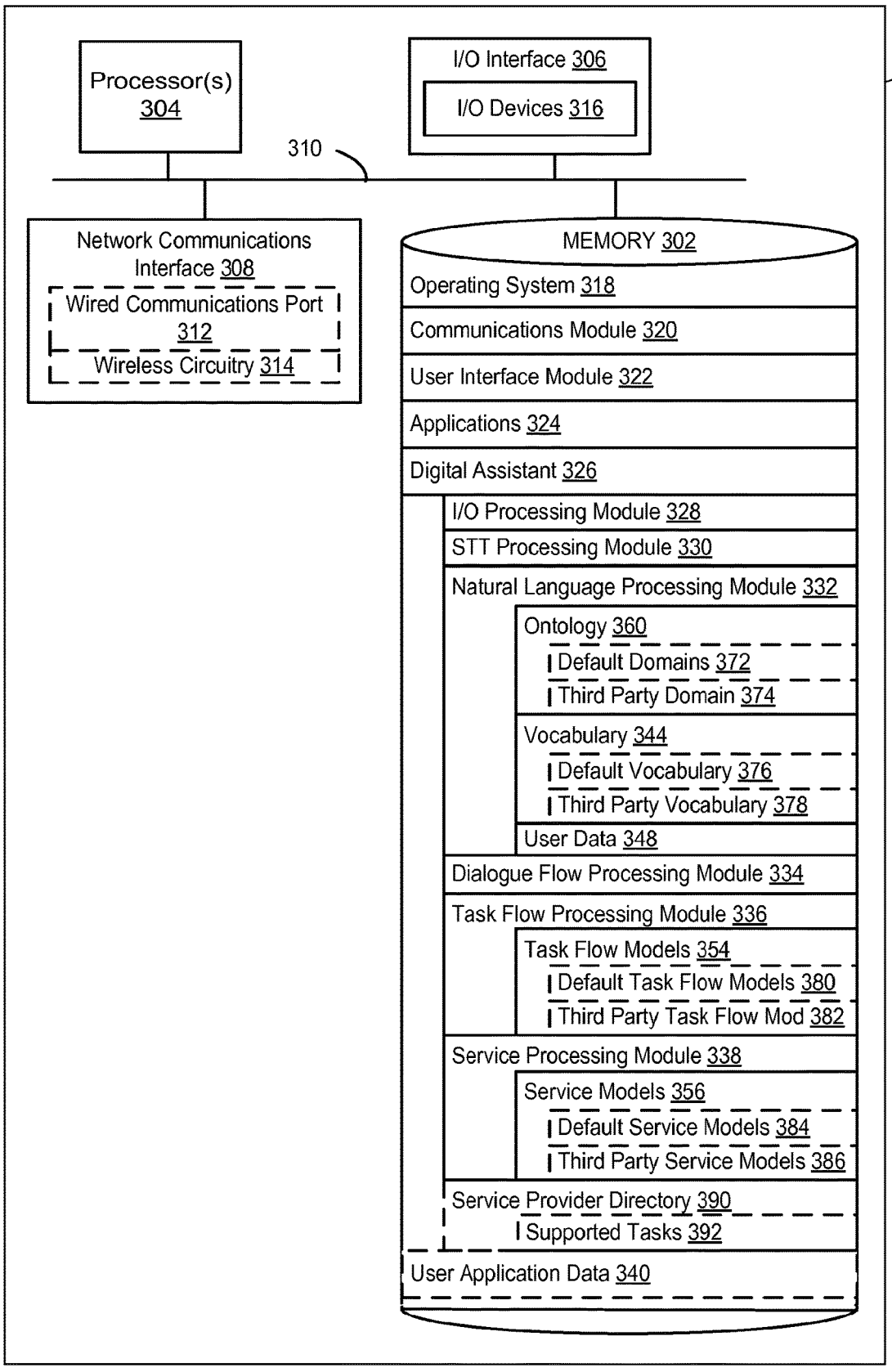
300
Processor(s) 304
I/O Interface 306
I/O Devices 316
310
Network Communications Interface 308
Wired Communications Port 312
Wireless Circuitry 314
MEMORY 302
Operating System 318
Communications Module 320
User Interface Module 322
Applications 324
Digital Assistant 326
I/O Processing Module 328
STT Processing Module 330
Natural Language Processing Module 332
Ontology 360
Default Domains 372
Third Party Domain 374
Vocabulary 344
Default Vocabulary 376
Third Party Vocabulary 378
User Data 348
Dialogue Flow Processing Module 334
Task Flow Processing Module 336
Task Flow Models 354
Default Task Flow Models 380
Third Party Task Flow Mod 382
Service Processing Module 338
Service Models 356
Default Service Models 384
Third Party Service Models 386
Service Provider Directory 390
Supported Tasks 392
User Application Data 340

Figure 3A

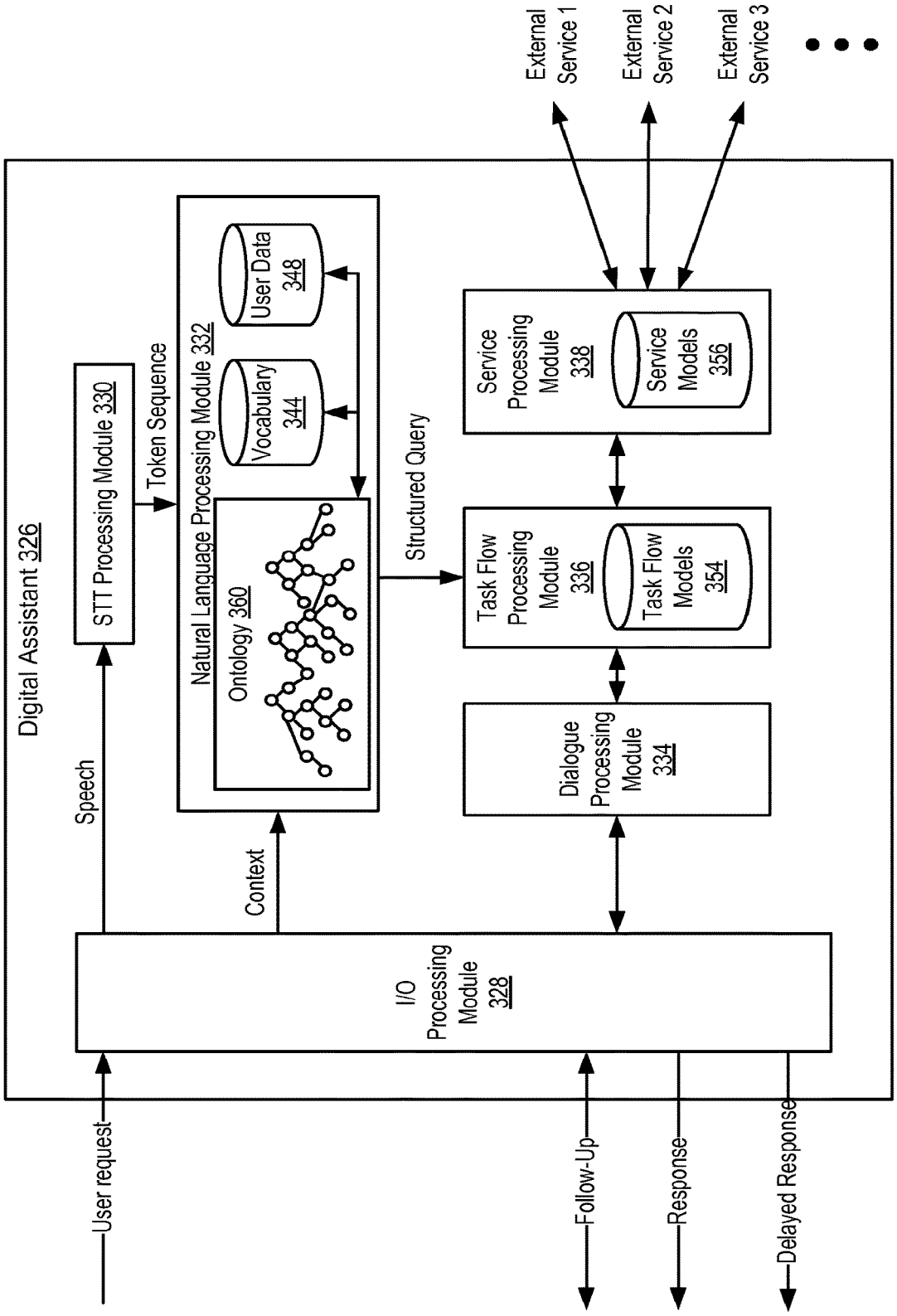
Digital Assistant 326
STT Processing Module 330
Token Sequence
Natural Language Processing Module 332
Ontology 360
Vocabulary 344
User Data 348
Structured Query
Service Processing Module 338
Service Models 356
Task Flow Processing Module 336
Task Flow Models 354
Dialogue Processing Module 334
I/O Processing Module 328
Speech
Context
External Service 1
External Service 2
External Service 3
User request
Follow-Up
Response
Delayed Response

Figure 3B

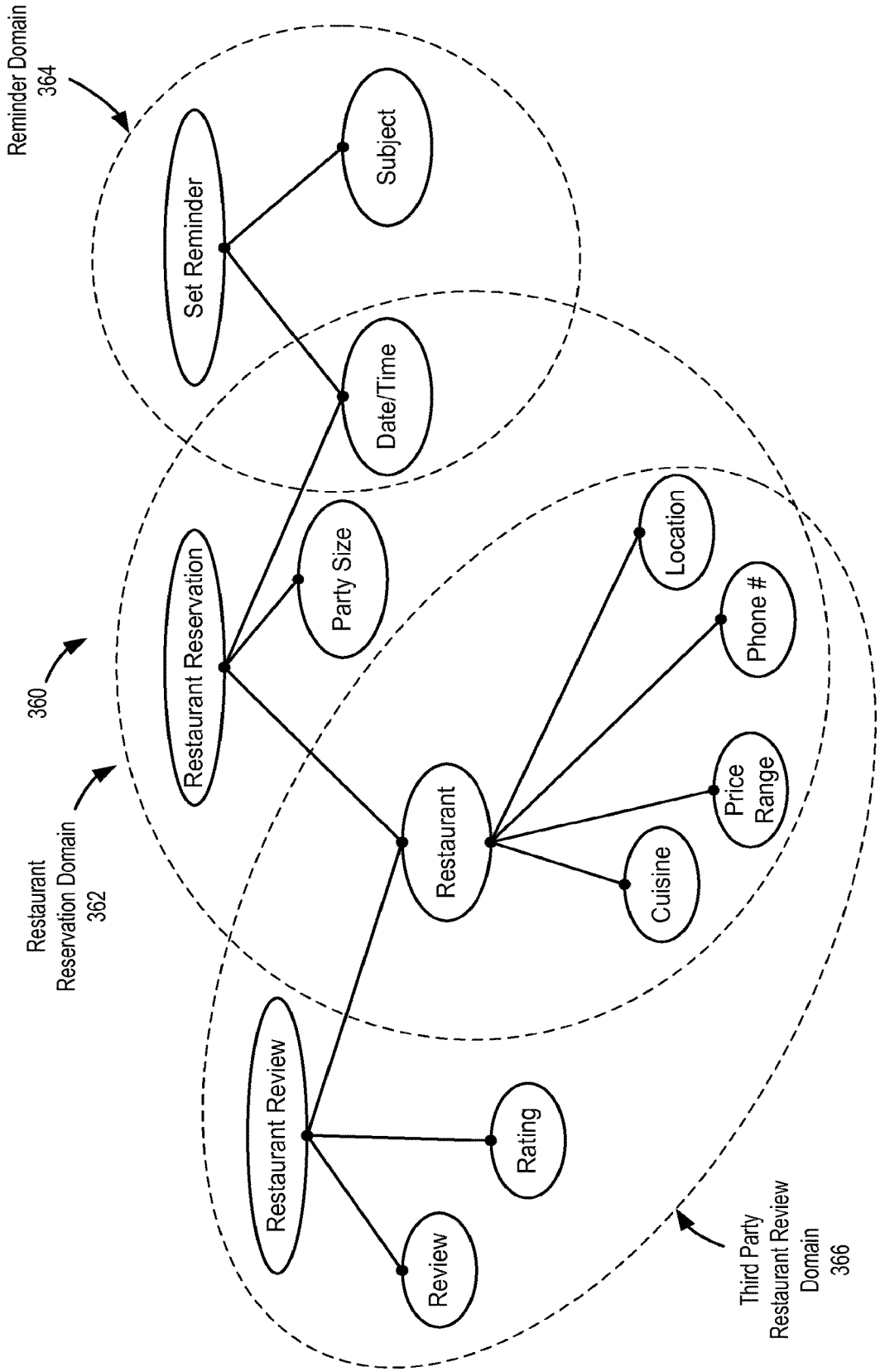
Reminder Domain
364
Set Reminder
Subject
Date/Time
360
Restaurant
Reservation Domain
362
Restaurant Reservation
Party Size
Restaurant
Location
Phone #
Price
Range
Cuisine
Restaurant Review
Rating
Review
Third Party
Restaurant Review
Domain
366

Figure 3C

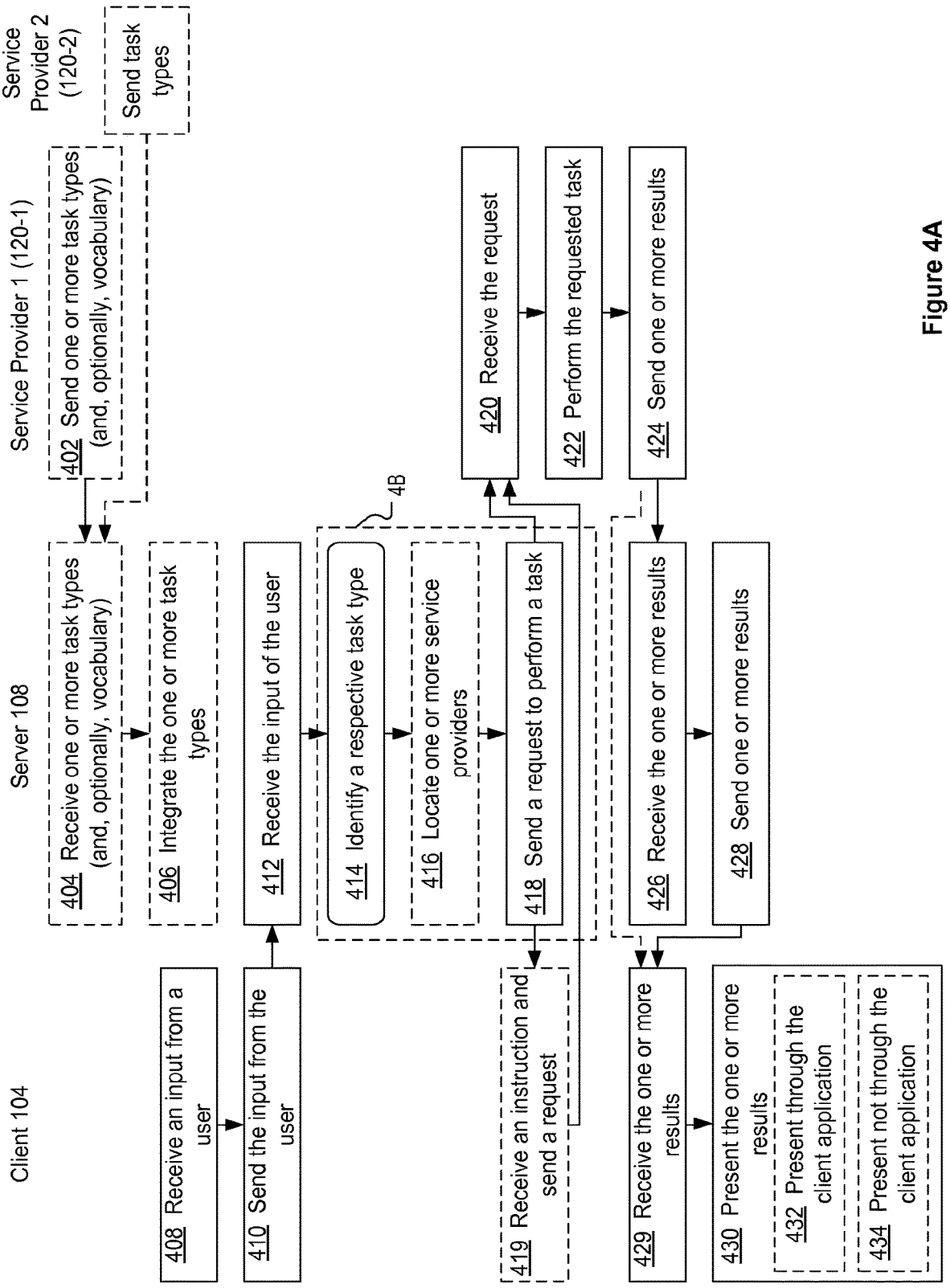
Client 104
Server 108
Service Provider 1 (120-1)
Service Provider 2 (120-2)
408 Receive an input from a user
410 Send the input from the user
404 Receive one or more task types (and, optionally, vocabulary)
406 Integrate the one or more task types
412 Receive the input of the user
402 Send one or more task types (and, optionally, vocabulary)
Send task types
4B
414 Identify a respective task type
416 Locate one or more service providers
418 Send a request to perform a task
419 Receive an instruction and send a request
420 Receive the request
422 Perform the requested task
424 Send one or more results
426 Receive the one or more results
428 Send one or more results
429 Receive the one or more results
430 Present the one or more results
432 Present through the client application
434 Present not through the client application

Figure 4A

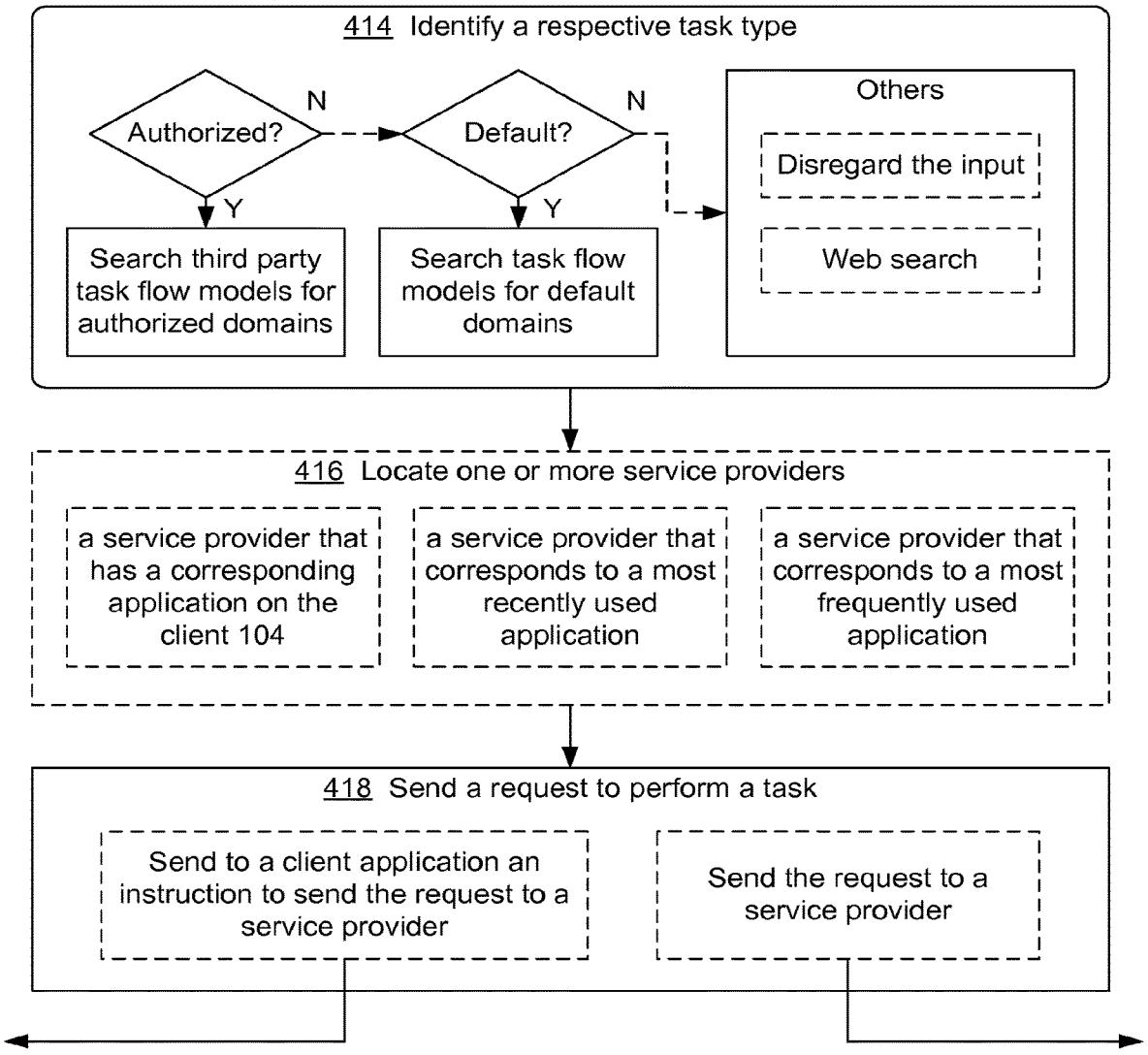
414 Identify a respective task type
Authorized?
N
Y
Default?
N
Y
Others
Disregard the input
Web search
Search third party task flow models for authorized domains
Search task flow models for default domains
416 Locate one or more service providers
a service provider that has a corresponding application on the client 104
a service provider that corresponds to a most recently used application
a service provider that corresponds to a most frequently used application
418 Send a request to perform a task
Send to a client application an instruction to send the request to a service provider
Send the request to a service provider

Figure 4B

SYSTEMS AND METHODS FOR INTEGRATING THIRD PARTY SERVICES WITH A DIGITAL ASSISTANT

RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 13/894,350, filed on May 14, 2013, entitled "Systems and Methods for Integrating Third Party Services with a Digital Assistant" which claims priority to U.S. Provisional Patent Application Ser. No. 61/799,916, filed Mar. 15, 2013, entitled "Systems and Methods for Integrating Third Party Services with a Digital Assistant" and U.S. Provisional Patent Application Ser. No. 61/647,434, filed May 15, 2012, entitled "Systems and Methods for Integrating Third Party Services with a Digital Assistant." These applications are incorporated by reference herein in their entirety.

TECHNICAL FIELD

The disclosed embodiments relate generally to digital assistant systems, and more specifically, third party computer systems and services integrated with a digital assistant system.

BACKGROUND

Just like human personal assistants, digital assistant systems can perform requested tasks and provide requested advice, information, or services. A digital assistant system's ability to fulfill a user's request is dependent on the digital assistant system's correct comprehension of the request or instructions. Recent advances in natural language processing have enabled users to interact with digital assistant systems using natural language, in spoken or textual forms. Such digital assistant systems can interpret the user's input to deduce the user's intent, translate the deduced intent into actionable tasks and parameters, execute operations or deploy services to perform the tasks, and produce output that is intelligible to the user. Ideally, the output produced by a digital assistant system should fulfill the user's intent expressed during the natural language interaction between the user and the digital assistant system.

The ability of a digital assistant system to produce satisfactory responses to user requests depends on the natural language processing, knowledge base, and artificial intelligence available to the digital assistant system. Moreover, while numerous third party systems and services currently exist, there is no efficient means for a digital assistant system to integrate efficiently with such third party computer systems and services.

SUMMARY

As described above, there is a need for digital assistant systems to integrate with third party computer systems and services that have access to databases otherwise not available to the digital assistant systems. This enables the digital assistant systems to perform tasks that the digital assistant systems cannot otherwise perform.

The embodiments disclosed herein provide methods, systems, and computer readable storage media that integrate a digital assistant system with one or more third party service provider systems to generate a response to a user request based on information or assistance obtained from at least one of the one or more third party service provider systems.

Some embodiments provide a method for processing a user input performed at an electronic device with one or more processors and memory. This method includes receiving a first set of one or more predefined task types from a service provider, and integrating the first set of one or more predefined task types with a second set of predefined task types not associated with the service provider to generate a plurality of predefined tasks. The method also includes receiving an input of a user, and, in accordance with the input, identifying a respective task type from the plurality of predefined task types. The respective task type corresponds to one of the first set of one or more predefined task types. The method further includes, in response to identifying the respective task type, sending to the service provider a request to perform at least a portion of a task associated with the input.

In some embodiments, a method for processing a user input, performed at an electronic device with one or more processors and memory, includes receiving an input of a user, and, in accordance with the input, identifying a respective task type from a plurality of predefined task types associated with a plurality of third party service providers. The respective task type is associated with at least one third party service provider for which the user is authorized and at least one third party service provider for which the user is not authorized. The method also includes, in response to identifying the respective task type, sending a request to perform at least a portion of a task to a third party service provider of the plurality of third party service providers that is associated with the respective task type.

In some embodiments, a method for processing a user input, performed at an electronic device with one or more processors and memory, includes receiving an input of a user, and, in accordance with the input, identifying a respective task type from a plurality of predefined task types. The method also includes, in response to identifying the respective task type, locating one or more service providers. Each located service provider is associated with an identification of one or more supported task types (also called herein "competencies"), and the one or more supported task types for the service provider include the respective task type. The method further includes, after locating the one or more service providers, sending a request to perform at least a portion of a task to a service provider of the one or more service providers.

In some embodiments, a method for processing a user input, performed at a server system with one or more processors and memory, includes identifying a location of a portable electronic device associated with a user, identifying a respective domain corresponding to the location of the portable electronic device associated with the user, receiving an input of the user, and, in accordance with the input, identifying a respective task type corresponding to the respective domain. The method also includes, in response to identifying the respective task type, sending a request, associated with the input, to perform at least a portion of a task to a respective service provider associated with the respective domain.

In some embodiments, the input is a voice input of the user.

In accordance with some embodiments, an electronic device includes one or more processors and memory storing one or more programs for execution by the one or more processors. The one or more programs include instructions for performing the operations of any of the methods described above. In accordance with some embodiments, a graphical user interface on an electronic device with a

display, memory, and one or more processors to execute one or more programs stored in the memory includes one or more of the elements displayed in any of the methods described above, which are updated in response to inputs, as described in any of the methods above. In accordance with some embodiments, a computer readable storage medium has stored therein instructions, which, when executed by an electronic device with one or more processors and memory, cause the device to perform the operations of any of the methods described above. In accordance with some embodiments, an electronic device includes means for performing the operations of any of the methods described above. In accordance with some embodiments, an information processing apparatus, for use in an electronic device includes means for performing the operations of any of the methods described above. In accordance with some embodiments, an electronic device includes a processing unit configured to perform the operations of any of the methods described above.

Thus, digital assistant systems are provided with new and improved methods that integrate third party service providers, thereby improving and expanding the capabilities of the digital assistant systems. Such methods and systems may complement or replace existing methods and systems.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating an environment in which a digital assistant operates in accordance with some embodiments.

FIG. **2** is a block diagram illustrating a digital assistant client system in accordance with some embodiments.

FIG. **3**A is a block diagram illustrating a standalone digital assistant system or a digital assistant server system in accordance with some embodiments.

FIG. **3**B is a block diagram illustrating functions of the digital assistant shown in FIG. **3**A in accordance with some embodiments.

FIG. **3**C is a network diagram illustrating a portion of an ontology in accordance with some embodiments.

FIGS. **4**A-**4**B are flow charts illustrating operations performed by a client system, a server system, and a service provider system in accordance with some embodiments.

Like reference numerals refer to corresponding parts throughout the drawings.

DESCRIPTION OF EMBODIMENTS

FIG. **1** is a block diagram of an operating environment **100** of a digital assistant according to some embodiments. The terms "digital assistant," "virtual assistant," "intelligent automated assistant," or "automatic digital assistant," refer to any information processing system that interprets natural language input in spoken and/or textual form to deduce user intent (e.g., identify a task type that corresponds to the natural language input), and performs actions based on the deduced user intent (e.g., perform a task corresponding to the identified task type). For example, to act on a deduced user intent, the system can perform one or more of the following: identifying a task flow with steps and parameters designed to accomplish the deduced user intent (e.g., identifying a task type), inputting specific requirements from the deduced user intent into the task flow, executing the task flow by invoking programs, methods, services, APIs, or the like (e.g., sending a request to a service provider); and generating output responses to the user in an audible (e.g., speech) and/or visual form.

Specifically, a digital assistant system is capable of accepting a user request at least partially in the form of a natural language command, request, statement, narrative, and/or inquiry. Typically, the user request seeks either an informational answer or performance of a task by the digital assistant system. A satisfactory response to the user request is generally either provision of the requested informational answer, performance of the requested task, or a combination of the two. For example, a user may ask the digital assistant system a question, such as "Where am I right now?" Based on the user's current location, the digital assistant may answer, "You are in Central Park near the west gate." The user may also request the performance of a task, for example, by stating "Please invite my friends to my girlfriend's birthday party next week." In response, the digital assistant may acknowledge the request by generating a voice output, "Yes, right away," and then send a suitable calendar invite from the user's email address to each of the user' friends listed in the user's electronic address book. There are numerous other ways of interacting with a digital assistant to request information or performance of various tasks. In addition to providing verbal responses and taking programmed actions, the digital assistant can also provide responses in other visual or audio forms (e.g., as text, alerts, music, videos, animations, etc.).

As shown in FIG. **1**, in some embodiments, a digital assistant system is implemented according to a client-server model. The digital assistant system includes a client-side portion (e.g., **102***a* and **102***b*) (hereafter "digital assistant (DA) client **102**") executed on a user device (e.g., **104***a* and **104***b*), and a server-side portion **106** (hereafter "digital assistant (DA) server **106**") executed on a server system **108**. The DA client **102** communicates with the DA server **106** through one or more networks **110**. The DA client **102** provides client-side functionalities such as user-facing input and output processing and communications with the DA server **106**. The DA server **106** provides server-side functionalities for any number of DA clients **102** each residing on a respective user device **104** (also called a client device).

In some embodiments, the DA server **106** includes a client-facing I/O interface **112**, one or more processing modules **114**, data and models **116**, and an I/O interface to external services **118**. The client-facing I/O interface facilitates the client-facing input and output processing for the digital assistant server **106**. The one or more processing modules **114** utilize the data and models **116** to determine the user's intent based on natural language input and perform task execution based on the deduced user intent.

In some embodiments, the DA server **106** communicates with external services **120** (e.g., navigation service(s) **122-1**, messaging service(s) **122-2**, information service(s) **122-3**, calendar service **122-4**, telephony service **122-5**, etc.) through the network(s) **110** for task completion or information acquisition. The I/O interface to the external services **118** facilitates such communications.

Examples of the user device **104** include, but are not limited to, a handheld computer, a personal digital assistant (PDA), a tablet computer, a laptop computer, a desktop computer, a cellular telephone, a smartphone, an enhanced general packet radio service (EGPRS) mobile phone, a media player, a navigation device, a game console, a television, a remote control, or a combination of any two or more of these data processing devices or any other suitable data processing devices. More details on the user device **104** are provided in reference to an exemplary user device **104** shown in FIG. **2**.

Examples of the communication network(s) **110** include local area networks ("LAN") and wide area networks ("WAN"), e.g., the Internet. The communication network(s) **110** may be implemented using any known network protocol, including various wired or wireless protocols, such as Ethernet, Universal Serial Bus (USB), FIREWIRE, Global System for Mobile Communications (GSM), Enhanced Data GSM Environment (EDGE), code division multiple access (CDMA), time division multiple access (TDMA), Bluetooth, Wi-Fi, voice over Internet Protocol (VoTP), Wi-MAX, or any other suitable communication protocol.

The server system **108** can be implemented on at least one data processing apparatus and/or a distributed network of computers. In some embodiments, the server system **108** also employs various virtual devices and/or services of third party service providers (e.g., third-party cloud service providers) to provide the underlying computing resources and/or infrastructure resources of the server system **108**.

Although the digital assistant system shown in FIG. **1** includes both a client-side portion (e.g., the DA client **102**) and a server-side portion (e.g., the DA server **106**), in some embodiments, a digital assistant system refers only to the server-side portion (e.g., the DA server **106**). In some embodiments, the functions of a digital assistant can be implemented as a standalone application installed on a user device. In addition, the divisions of functionalities between the client and server portions of the digital assistant can vary in different embodiments. For example, in some embodiments, the DA client **102** is a thin-client that provides only user-facing input and output processing functions, and delegates all other functionalities of the digital assistant to the DA server **106**. In some other embodiments, the DA client **102** is configured to perform or assist one or more functions of the DA server **106**.

FIG. **2** is a block diagram of a user device **104** in accordance with some embodiments. The user device **104** includes a memory interface **202**, one or more processors **204**, and a peripherals interface **206**. The various components in the user device **104** are coupled by one or more communication buses or signal lines. The user device **104** includes various sensors, subsystems, and peripheral devices that are coupled to the peripherals interface **206**. The sensors, subsystems, and peripheral devices gather information and/or facilitate various functionalities of the user device **104**.

For example, in some embodiments, a motion sensor **210**, a light sensor **212**, and a proximity sensor **214** are coupled to the peripherals interface **206** to facilitate orientation, light, and proximity sensing functions. In some embodiments, other sensors **216**, such as a positioning system (e.g., GPS receiver), a temperature sensor, a biometric sensor, and the like, are connected to the peripherals interface **206**, to facilitate related functionalities.

In some embodiments, the user device **104** includes a camera subsystem **220** coupled to the peripherals interface **206**. In some embodiments, an optical sensor **222** of the camera subsystem **220** facilitates camera functions, such as taking photographs and recording video clips. In some embodiments, the user device **104** includes one or more wired and/or wireless communication subsystems **224** provide communication functions. The communication subsystems **224** typically includes various communication ports, radio frequency receivers and transmitters, and/or optical (e.g., infrared) receivers and transmitters. In some embodiments, the user device **104** includes an audio subsystem **226** coupled to one or more speakers **228** and one or more microphones **230** to facilitate voice-enabled functions, such as voice recognition, voice replication, digital recording, and telephony functions.

In some embodiments, an I/O subsystem **240** is also coupled to the peripheral interface **206**. In some embodiments, the user device **104** includes a touch screen **246**, and the I/O subsystem **240** includes a touch screen controller **242** coupled to the touch screen **246**. When the user device **104** includes the touch screen **246** and the touch screen controller **242**, the touch screen **246** and the touch screen controller **242** are typically configured to, for example, detect contact and movement or break thereof using any of a plurality of touch sensitivity technologies, such as capacitive, resistive, infrared, surface acoustic wave technologies, proximity sensor arrays, and the like. In some embodiments, the user device **104** includes a display that does not include a touch-sensitive surface. In some embodiments, the user device **104** includes a separate touch-sensitive surface. In some embodiments, the user device **104** includes other input controller(s) **244**. When the user device **104** includes the other input controller(s) **244**, the other input controller(s) **244** are typically coupled to other input/control devices **248**, such as one or more buttons, rocker switches, thumb-wheel, infrared port, USB port, and/or a pointer device such as a stylus.

The memory interface **202** is coupled to memory **250**. In some embodiments, the memory **250** includes a non-transitory computer readable medium, such as high-speed random access memory and/or non-volatile memory (e.g., one or more magnetic disk storage devices, one or more flash memory devices, one or more optical storage devices, and/or other non-volatile solid-state memory devices).

In some embodiments, the memory **250** stores an operating system **252**, a communications module **254**, a graphical user interface module **256**, a sensor processing module **258**, a phone module **260**, and applications **262**, and a subset or superset thereof. The operating system **252** includes instructions for handling basic system services and for performing hardware dependent tasks. The communications module **254** facilitates communicating with one or more additional devices, one or more computers and/or one or more servers. The graphical user interface module **256** facilitates graphic user interface processing. The sensor processing module **258** facilitates sensor-related processing and functions (e.g., processing voice input received with the one or more microphones **228**). The phone module **260** facilitates phone-related processes and functions. The application module **262** facilitates various functionalities of user applications, such as electronic-messaging, web browsing, media processing, navigation, imaging and/or other processes and functions. In some embodiments, the user device **104** stores in the memory **250** one or more software applications **270-1** and **270-2** each associated with at least one of the external service providers.

As described above, in some embodiments, the memory **250** also stores client-side digital assistant instructions (e.g., in a digital assistant client module **264**) and various user data **266** (e.g., user-specific vocabulary data, preference data, and/or other data such as the user's electronic address book, to-do lists, shopping lists, etc.) to provide the client-side functionalities of the digital assistant.

In various embodiments, the digital assistant client module **264** is capable of accepting voice input, text input, touch input, and/or gestural input through various user interfaces (e.g., the I/O subsystem **244**) of the user device **104**. The digital assistant client module **264** is also capable of providing output in audio, visual, and/or tactile forms. For

example, output can be provided as voice, sound, alerts, text messages, menus, graphics, videos, animations, vibrations, and/or combinations of two or more of the above. During operation, the digital assistant client module **264** communicates with the digital assistant server (e.g., the digital assistant server **106**, FIG. **1**) using the communication subsystems **224**.

In some embodiments, the digital assistant client module **264** utilizes various sensors, subsystems and peripheral devices to gather additional information from the surrounding environment of the user device **104** to establish a context associated with a user input. In some embodiments, the digital assistant client module **264** provides the context information or a subset thereof with the user input to the digital assistant server (e.g., the digital assistant server **106**, FIG. **1**) to help deduce the user's intent.

In some embodiments, the context information that can accompany the user input includes sensor information, e.g., lighting, ambient noise, ambient temperature, images or videos of the surrounding environment, etc. In some embodiments, the context information also includes the physical state of the device, e.g., device orientation, device location, device temperature, power level, speed, acceleration, motion patterns, cellular signals strength, etc. In some embodiments, information related to the software state of the user device **106**, e.g., running processes, installed programs, past and present network activities, background services, error logs, resources usage, etc., of the user device **104** is also provided to the digital assistant server (e.g., the digital assistant server **106**, FIG. **1**) as context information associated with a user input.

In some embodiments, the DA client module **264** selectively provides information (e.g., at least a portion of the user data **266**) stored on the user device **104** in response to requests from the digital assistant server. In some embodiments, the digital assistant client module **264** also elicits additional input from the user via a natural language dialogue or other user interfaces upon request by the digital assistant server **106** (FIG. **1**). The digital assistant client module **264** passes the additional input to the digital assistant server **106** to help the digital assistant server **106** in intent deduction and/or fulfillment of the user's intent expressed in the user request.

In some embodiments, the memory **250** may include additional instructions or fewer instructions. Furthermore, various functions of the user device **104** may be implemented in hardware and/or in firmware, including in one or more signal processing and/or application specific integrated circuits, and the user device **104**, thus, need not include all modules and applications illustrated in FIG. **2**.

FIG. **3**A is a block diagram of an exemplary digital assistant system **300** in accordance with some embodiments. In some embodiments, the digital assistant system **300** is implemented on a standalone computer system. In some embodiments, the digital assistant system **300** is distributed across multiple computers. In some embodiments, some of the modules and functions of the digital assistant are divided into a server portion and a client portion, where the client portion resides on a user device (e.g., the user device **104**) and communicates with the server portion (e.g., the server system **108**) through one or more networks, e.g., as shown in FIG. **1**. In some embodiments, the digital assistant system **300** is an embodiment of the server system **108** (and/or the digital assistant server **106**) shown in FIG. **1**. In some embodiments, the digital assistant system **300** is implemented in a user device (e.g., the user device **104**, FIG. **1**), thereby eliminating the need for a client-server system. It should be noted that the digital assistant system **300** is only one example of a digital assistant system, and that the digital assistant system **300** may have more or fewer components than shown, may combine two or more components, or may have a different configuration or arrangement of the components. The various components shown in FIG. **3**A may be implemented in hardware, software, firmware, including one or more signal processing and/or application specific integrated circuits, or a combination of thereof.

The digital assistant system **300** includes memory **302**, one or more processors **304**, an input/output (I/O) interface **306**, and a network communications interface **308**. These components communicate with one another over one or more communication buses or signal lines **310**.

In some embodiments, the memory **302** includes a non-transitory computer readable medium, such as high-speed random access memory and/or a non-volatile computer readable storage medium (e.g., one or more magnetic disk storage devices, one or more flash memory devices, one or more optical storage devices, and/or other non-volatile solid-state memory devices).

The I/O interface **306** couples input/output devices **316** of the digital assistant system **300**, such as displays, a keyboards, touch screens, and microphones, to the user interface module **322**. The I/O interface **306**, in conjunction with the user interface module **322**, receives user inputs (e.g., voice input, keyboard inputs, touch inputs, etc.) and process them accordingly. In some embodiments, when the digital assistant is implemented on a standalone user device, the digital assistant system **300** includes any of the components and I/O and communication interfaces described with respect to the user device **104** in FIG. **2** (e.g., one or more microphones **228**). In some embodiments, the digital assistant system **300** represents the server portion of a digital assistant implementation, and interacts with the user through a client-side portion residing on a user device (e.g., the user device **104** shown in FIG. **2**).

In some embodiments, the network communications interface **308** includes wired communication port(s) **312** and/or wireless transmission and reception circuitry **314**. The wired communication port(s) receive and send communication signals via one or more wired interfaces, e.g., Ethernet, Universal Serial Bus (USB), FIREWIRE, etc. The wireless circuitry **314** typically receives and sends RF signals and/or optical signals from/to communications networks and other communications devices. The wireless communications may use any of a plurality of communications standards, protocols and technologies, such as GSM, EDGE, CDMA, TDMA, Bluetooth, Wi-Fi, VoIP, Wi-MAX, or any other suitable communication protocol. The network communications interface **308** enables communication between the digital assistant system **300** with networks, such as the Internet, an intranet and/or a wireless network, such as a cellular telephone network, a wireless local area network (LAN) and/or a metropolitan area network (MAN), and other devices.

In some embodiments, the non-transitory computer readable storage medium of memory **302** stores programs, modules, instructions, and data structures including all or a subset of: an operating system **318**, a communications module **320**, a user interface module **322**, one or more applications **324**, and a digital assistant module **326**. The one or more processors **304** execute these programs, modules, and instructions, and reads/writes from/to the data structures.

The operating system **318** (e.g., Darwin, RTXC, LINUX, UNIX, OS X, WINDOWS, or an embedded operating

system such as VxWorks) includes various software components and/or drivers for controlling and managing general system tasks (e.g., memory management, storage device control, power management, etc.) and facilitates communications between various hardware, firmware, and software components.

The communications module **320** facilitates communications between the digital assistant system **300** with other devices over the network communications interface **308**. For example, the communication module **320** may communicate with the communications module **254** of the device **104** shown in FIG. **2**. The communications module **320** also includes various software components for handling data received by the wireless circuitry **314** and/or wired communications port **312**.

In some embodiments, the user interface module **322** receives commands and/or inputs from a user via the I/O interface **306** (e.g., from a keyboard, touch screen, and/or microphone), and provides user interface objects on a display.

The applications **324** include programs and/or modules that are configured to be executed by the one or more processors **304**. For example, if the digital assistant system is implemented on a standalone user device, the applications **324** may include user applications, such as games, a calendar application, a navigation application, or an email application. If the digital assistant system **300** is implemented on a server farm, the applications **324** may include resource management applications, diagnostic applications, or scheduling applications, for example.

The memory **302** also stores the digital assistant module (or the server portion of a digital assistant) **326**. In some embodiments, the digital assistant module **326** includes the following sub-modules, or a subset or superset thereof: an input/output processing module **328**, a speech-to-text (STT) processing module **330**, a natural language processing module **332**, a dialogue flow processing module **334**, a task flow processing module **336**, and a service processing module **338**. Each of these processing modules has access to one or more of the following data and models of the digital assistant **326**, or a subset or superset thereof: ontology **360**, vocabulary index **344**, user data **348**, task flow models **354**, and service models **356**.

In some embodiments, the ontology **360** includes one or more third party domains **374**. In some embodiments, the digital assistant system **300** includes one or more default domains **372**.

In some embodiments, the one or more default domains **372** include one or more private domains. In some embodiments, the one or more third party domains **374** include one or more public domains. In some embodiments, the one or more third party domains **374** include one or more developer domains.

In some embodiments, the vocabulary **344** includes one or more third party vocabularies **378**. In some embodiments, the vocabulary **344** includes one or more default vocabularies **376**.

In some embodiments, the task flow models **354** include one or more third party task flow models **382**. In some embodiments, the task flow models **354** include one or more default task flow models **380**.

In some embodiments, the service models **356** include one or more third party service models **386**. In some embodiments, the service models **356** include one or more default service models **384**.

In some embodiments, the memory **302** also stores a service provider directory **390**. In some embodiments, the service provider directory **390** includes a list of supported tasks or competencies **392** for respective third party service provider systems.

In some embodiments, using the processing modules (e.g., the input/output processing module **328**, the STT processing module **330**, the natural language processing module **332**, the dialogue flow processing module **334**, the task flow processing module **336**, and/or the service processing module **338**), data, and models implemented in the digital assistant module **326**, the digital assistant system **300** performs at least some of the following: identifying a user's intent expressed in a natural language input received from the user; actively eliciting and obtaining information needed to fully deduce the user's intent (e.g., by disambiguating words, names, intentions, etc.); determining the task flow for fulfilling the deduced intent; and executing the task flow to fulfill the deduced intent. In some embodiments, the digital assistant also takes appropriate actions when a satisfactory response was not or could not be provided to the user for various reasons.

In some embodiments, the memory **302** also includes a user application data **340**, which identifies one or more software applications a respective user is authorized to use. In some embodiments, the user application data **340** also includes the frequency and recency (i.e., indication of how recently the one or more software applications were used) of use of the one or more software applications. In some embodiments, the user application data **340** is included in the user data **348**.

In some embodiments, a server of a third party service provider (e.g., external services **120** in FIG. **1**) also includes components shown in FIG. **3**A (e.g., ontology **360**, task flow models **354**, etc.).

As shown in FIG. **3**B, in some embodiments, the I/O processing module **328** interacts with the user through the I/O devices **316** in FIG. **3**A or with a user device (e.g., a user device **104** in FIG. **1**) through the network communications interface **308** in FIG. **3**A to obtain user input (e.g., a speech input) and to provide responses to the user input. The I/O processing module **328** optionally obtains context information associated with the user input from the user device, along with or shortly after the receipt of the user input. The context information includes user-specific data, vocabulary, and/or preferences relevant to the user input. In some embodiments, the context information also includes software and hardware states of the device (e.g., the user device **104** in FIG. **1**) at the time the user request is received, and/or information related to the surrounding environment of the user at the time that the user request was received. In some embodiments, the I/O processing module **328** also sends follow-up questions to, and receives answers from, the user regarding the user request. In some embodiments, when a user request is received by the I/O processing module **328** and the user request contains a speech input, the I/O processing module **328** forwards the speech input to the speech-to-text (STT) processing module **330** for speech-to-text conversions.

In some embodiments, the speech-to-text processing module **330** receives speech input (e.g., a user utterance captured in a voice recording) through the I/O processing module **328**. In some embodiments, the speech-to-text processing module **330** uses various acoustic and language models to recognize the speech input as a sequence of phonemes, and ultimately, a sequence of words or tokens written in one or more languages. The speech-to-text processing module **330** is implemented using any suitable speech recognition techniques, acoustic models, and lan-

guage models, such as Hidden Markov Models, Dynamic Time Warping (DTW)-based speech recognition, and other statistical and/or analytical techniques. In some embodiments, the speech-to-text processing can be performed at least partially by a third party service or on the user's device. Once the speech-to-text processing module **330** obtains the result of the speech-to-text processing (e.g., a sequence of words or tokens), it passes the result to the natural language processing module **332** for intent deduction.

The natural language processing module **332** ("natural language processor") of the digital assistant **326** takes the sequence of words or tokens ("token sequence") generated by the speech-to-text processing module **330**, and attempts to associate the token sequence with one or more "actionable intents" recognized by the digital assistant. As used herein, an "actionable intent" represents a task that can be performed by the digital assistant **326** and/or the digital assistant system **300** (FIG. **3**A), and has an associated task flow implemented in the task flow models **354**. The associated task flow is a series of programmed actions and steps that the digital assistant system **300** takes in order to perform the task. The scope of a digital assistant system's capabilities is dependent on the number and variety of task flows that have been implemented and stored in the task flow models **354**, or in other words, on the number and variety of "actionable intents" that the digital assistant system **300** recognizes. The effectiveness of the digital assistant system **300**, however, is also dependent on the digital assistant system's ability to deduce the correct "actionable intent(s)" from the user request expressed in natural language.

In some embodiments, in addition to the sequence of words or tokens obtained from the speech-to-text processing module **330**, the natural language processor **332** also receives context information associated with the user request (e.g., from the I/O processing module **328**). The natural language processor **332** optionally uses the context information to clarify, supplement, and/or further define the information contained in the token sequence received from the speech-to-text processing module **330**. The context information includes, for example, user preferences, hardware and/or software states of the user device, sensor information collected before, during, or shortly after the user request, prior interactions (e.g., dialogue) between the digital assistant and the user, and the like.

In some embodiments, the natural language processing is based on an ontology **360**. The ontology **360** is a hierarchical structure containing a plurality of nodes, each node representing either an "actionable intent" or a "property" relevant to one or more of the "actionable intents" or other "properties". As noted above, an "actionable intent" represents a task that the digital assistant system **300** is capable of performing (e.g., a task that is "actionable" or can be acted on). A "property" represents a parameter associated with an actionable intent or a sub-aspect of another property. A linkage between an actionable intent node and a property node in the ontology **360** defines how a parameter represented by the property node pertains to the task represented by the actionable intent node.

In some embodiments, the ontology **360** is made up of actionable intent nodes and property nodes. Within the ontology **360**, each actionable intent node is linked to one or more property nodes either directly or through one or more intermediate property nodes. Similarly, each property node is linked to one or more actionable intent nodes either directly or through one or more intermediate property nodes. For example, the ontology **360** shown in FIG. **3**C includes a "restaurant reservation" node, which is an actionable intent node. Property nodes "restaurant," "date/time" (for the reservation), and "party size" are each directly linked to the "restaurant reservation" node (an actionable intent node). In addition, property nodes "cuisine," "price range," "phone number," and "location" are sub-nodes of the property node "restaurant," and are each linked to the "restaurant reservation" node through the intermediate property node "restaurant." For another example, the ontology **360** shown in FIG. **3**C also includes a "set reminder" node, which is another actionable intent node. Property nodes "date/time" (for the setting the reminder) and "subject" (for the reminder) are each linked to the "set reminder" node. Since the property node "date/time" is relevant to both the task of making a restaurant reservation and the task of setting a reminder, the property node "date/time" is linked to both the "restaurant reservation" node and the "set reminder" node in the ontology **360**. The ontology **360** shown in FIG. **3**C further includes a "restaurant review" node, which is an actionable intent node. Property nodes "review" (e.g., user comments), "rating" (e.g., numerical scores), and "restaurant" are each directly linked to the "restaurant review" node. Since the property node "restaurant" is relevant to both the task of making a restaurant reservation and the task of retrieving a restaurant review, the property node "restaurant" is linked to both the "restaurant reservation" node and the "restaurant review" node in the ontology **360**.

An actionable intent node, along with its linked concept nodes, may be described as a "domain." In the present discussion, each domain is associated with a respective actionable intent, and refers to the group of nodes (and the relationships therebetween) associated with the particular actionable intent. For example, the ontology **360** shown in FIG. **3**C includes an example of a restaurant reservation domain **362**, an example of a reminder domain **364**, and an example of a third party restaurant review domain **366** within the ontology **360**. The restaurant reservation domain **362** includes the actionable intent node "restaurant reservation," property nodes "restaurant," "date/time," and "party size," and sub-property nodes "cuisine," "price range," "phone number," and "location." The reminder domain **364** includes the actionable intent node "set reminder," and property nodes "subject" and "date/time." The restaurant review domain **366** includes the actionable intent node "restaurant review," property nodes "review," "rating," and "restaurant," and sub-property nodes "cuisine," "price range," "phone number," and "location." In some embodiments, the ontology **360** is made up of many domains. Each domain may share one or more property nodes with one or more other domains. For example, the "date/time" property node may be associated with many other domains (e.g., a scheduling domain, a travel reservation domain, a movie ticket domain, etc.), in addition to the restaurant reservation domain **362** and the reminder domain **364**.

While FIG. **3**C illustrates two exemplary domains within the ontology **360**, the ontology **360** may include other domains (or actionable intents), such as "initiate a phone call," "find directions," "schedule a meeting," "send a message," and "provide an answer to a question," and so on. For example, a "send a message" domain is associated with a "send a message" actionable intent node, and may further include property nodes such as "recipient(s)", "message type", and "message body." The property node "recipient" may be further defined, for example, by the sub-property nodes such as "recipient name" and "message address."

In some embodiments, the ontology **360** includes all the domains (and hence actionable intents) that the digital assistant is capable of understanding and acting upon. In

some embodiments, the ontology **360** may be modified, such as by adding or removing domains or nodes, or by modifying relationships between the nodes within the ontology **360**.

In some embodiments, nodes associated with multiple related actionable intents may be clustered under a "super domain" in the ontology **360**. For example, a "travel" super-domain may include a cluster of property nodes and actionable intent nodes related to travels. The actionable intent nodes related to travels may include "airline reservation," "hotel reservation," "car rental," "get directions," "find points of interest," and so on. The actionable intent nodes under the same super domain (e.g., the "travels" super domain) may have many property nodes in common. For example, the actionable intent nodes for "airline reservation," "hotel reservation," "car rental," "get directions," "find points of interest" may share one or more of the property nodes "start location," "destination," "departure date/time," "arrival date/time," and "party size."

In some embodiments, each node in the ontology **360** is associated with a set of words and/or phrases that are relevant to the property or actionable intent represented by the node. The respective set of words and/or phrases associated with each node is the so-called "vocabulary" associated with the node. The respective set of words and/or phrases associated with each node can be stored in the vocabulary index **344** (FIG. **3**B) in association with the property or actionable intent represented by the node. For example, returning to FIG. **3**B, the vocabulary associated with the node for the property of "restaurant" may include words such as "food," "drinks," "cuisine," "hungry," "eat," "pizza," "fast food," "meal," and so on. For another example, the vocabulary associated with the node for the actionable intent of "initiate a phone call" may include words and phrases such as "call," "phone," "dial," "ring," "call this number," "make a call to," and so on. The vocabulary index **344** optionally includes words and phrases in different languages.

In some embodiments, the natural language processor **332** shown in FIG. **3**B receives the token sequence (e.g., a text string) from the speech-to-text processing module **330**, and determines what nodes are implicated by the words in the token sequence. In some embodiments, if a word or phrase in the token sequence is found to be associated with one or more nodes in the ontology **360** (via the vocabulary index **344**), the word or phrase will "trigger" or "activate" those nodes. When multiple nodes are "triggered," based on the quantity and/or relative importance of the activated nodes, the natural language processor **332** will select one of the actionable intents as the task (or task type) that the user intended the digital assistant to perform. In some embodiments, the domain that has the most "triggered" nodes is selected. In some embodiments, the domain having the highest confidence value (e.g., based on the relative importance of its various triggered nodes) is selected. In some embodiments, the domain is selected based on a combination of the number and the importance of the triggered nodes. In some embodiments, additional factors are considered in selecting the node as well, such as whether the digital assistant system **300** has previously correctly interpreted a similar request from a user.

In some embodiments, the digital assistant system **300** also stores names of specific entities in the vocabulary index **344**, so that when one of these names is detected in the user request, the natural language processor **332** will be able to recognize that the name refers to a specific instance of a property or sub-property in the ontology. In some embodiments, the names of specific entities are names of businesses, restaurants, people, movies, and the like. In some embodiments, the digital assistant system **300** can search and identify specific entity names from other data sources, such as the user's address book, a movies database, a musicians database, and/or a restaurant database. In some embodiments, when the natural language processor **332** identifies that a word in the token sequence is a name of a specific entity (such as a name in the user's address book), that word is given additional significance in selecting the actionable intent within the ontology for the user request.

For example, when the words "Mr. Santo" is recognized from the user request, and the last name "Santo" is found in the vocabulary index **344** as one of the contacts in the user's contact list, then it is likely that the user request corresponds to a "send a message" or "initiate a phone call" domain. For another example, when the words "ABC Café" are found in the user request, and the term "ABC Café" is found in the vocabulary index **344** as the name of a particular restaurant in the user's city, then it is likely that the user request corresponds to a "restaurant reservation" domain.

User data **348** includes user-specific information, such as user-specific vocabulary, user preferences, user address, user's default and secondary languages, user's contact list, and other short-term or long-term information for each user. The natural language processor **332** can use the user-specific information to supplement the information contained in the user input to further define the user intent. For example, for a user request "invite my friends to my birthday party," the natural language processor **332** is able to access user data **348** to determine who the "friends" are and when and where the "birthday party" would be held, rather than requiring the user to provide such information explicitly in his/her request.

Once the natural language processor **332** identifies an actionable intent (or domain) based on the user request, the natural language processor **332** generates a structured query to represent the identified actionable intent. In some embodiments, the structured query includes parameters for one or more nodes within the domain for the actionable intent, and at least some of the parameters are populated with the specific information and requirements specified in the user request. For example, the user may say "Make me a dinner reservation at a sushi place at 7." In this case, the natural language processor **332** may be able to correctly identify the actionable intent to be "restaurant reservation" based on the user input. According to the ontology, a structured query for a "restaurant reservation" domain may include parameters such as {Cuisine}, {Time}, {Date}, {Party Size}, and the like. Based on the information contained in the user's utterance, the natural language processor **332** may generate a partial structured query for the restaurant reservation domain, where the partial structured query includes the parameters {Cuisine="Sushi"} and {Time="7 pm"}. However, in this example, the user's utterance contains insufficient information to complete the structured query associated with the domain. Therefore, other necessary parameters such as {Party Size} and {Date} are not specified in the structured query based on the information currently available. In some embodiments, the natural language processor **332** populates some parameters of the structured query with received context information. For example, if the user requested a sushi restaurant "near me," the natural language processor **332** may populate a {location} parameter in the structured query with GPS coordinates from the user device **104**.

In some embodiments, the natural language processor **332** passes the structured query (including any completed param-

eters) to the task flow processing module **336** ("task flow processor"). The task flow processor **336** is configured to perform one or more of: receiving the structured query from the natural language processor **332**, completing the structured query, and performing the actions required to "complete" the user's ultimate request. In some embodiments, the various procedures necessary to complete these tasks are provided in task flow models **354**. In some embodiments, the task flow models **354** include procedures for obtaining additional information from the user, and task flows for performing actions associated with the actionable intent.

In some embodiments, the digital assistant **326** includes a template processing module. In some embodiments, the token sequence generated by the speech-to-text processing module **330** is sent to the template processing module in addition to, or instead of, the natural language processing module **332**. The template processing module has access to a plurality of predefined templates. A template typically defines a particular linguistic pattern. Exemplary templates include "play [x]," "play [x] on [y]," "buy [a] from [b]," and "forward [c] to [d]."

In some embodiments, the template processing module is directly coupled with external services. In some embodiments, the template processing module communicates with external services through the service processing module **338**. In some embodiments, the service models **356**, which include information identifying external services, are associated with a particular template. In some embodiments, a third party service provider sends a request to be associated with a particular template or a particular set of templates, and in response, the information in the service models **356** is updated to indicate that the third party service provider is associated with the particular template or the particular set of templates. In some embodiments, an application (e.g., an application installed on the device) includes information indicating that a corresponding third party service provider is associated with a particular template or a particular set of templates. In some embodiments, subsequent to installing an application, the digital assistant **326** updates the information to reflect that the corresponding third party service provider is associated with a particular template or a particular set of templates (e.g., for the device or its user).

In some embodiments, templates are grouped. For example, "play [x]" and "play [x] on [y]" can be grouped together as a set of music (and/or video) templates. In some embodiments, templates are grouped together based on contexts (e.g., location of the device). For example, a set of "in car" video templates includes video templates used while the device is in a car (e.g., templates for playing audio without video of a movie file, templates for controlling car stereo, etc.), and a set of "at home" video templates includes video templates used while the device is at home (e.g., templates for playing both video and audio data of a movie file, templates for controlling a home stereo system, etc.). In another example, a set of "moving" news templates includes news templates used while the device (or its user) is moving (e.g., templates for retrieving short stories, headlines, and/or text-only stories that are better suited for reviewing when the user is driving about town), and a set of "stationary" news templates includes news templates used while the device (or its user) is stationary (e.g., templates for retrieving long stories and/or graphics that are better suited for reviewing when the user has more time to review). In some embodiments, third party service providers are associated with one or more templates and not with some other templates. For example, new service provider XYZ may be associated with "moving" news templates, but not with "stationary" news templates, while new service provider JKL may be associated with both "moving" and "stationary" news templates.

In some embodiments, one or more templates are provided by one or more third party service providers. For example, a third party service provider sends a template to the digital assistant **326**, and the digital assistant **326** integrates the received template with the plurality of predefined templates. This allows third party service providers to create templates with a new vocabulary (e.g., "tweet [x]"). In some embodiments, the received template also includes one or more synonyms for the new vocabulary.

In some embodiments, the digital assistant **326** determines that the received input corresponds to at least one predefined template and at least one third party provided template, and selects a predefined template. In other words, a predefined template has priority over a third-party provided template.

In some embodiments, the templates include templates in multiple languages. For example, the templates may include a first template in English, and a second template in Spanish. In some embodiments, the first template corresponds to the second template (e.g., both the first template and the second template are for a same action).

In some embodiments, the digital assistant **326** receives an input that corresponds to a predefined template, and in response, sends the input to a particular third party service provider. For example, in some embodiments, the input is "play [x] on [y]" and the digital assistant **326** sends the input (e.g., a speech data or a corresponding text) to a third party service provider that corresponds to [y].

In some embodiments, the digital assistant **326** receives an input that corresponds to a particular template while displaying a user interface of an application that corresponds to a particular third party service provider, determines that the particular template is associated with the particular third party service provider, and sends the input to the particular third party service provider. For example, the digital assistant receives an input "forward [x] to [y]," while displaying a messaging application (e.g., email or SMS application), and forwards the input to a third party service provider that corresponds to the displayed or open messaging application. In some embodiments, the digital assistant **326** determines that the particular template is not associated with the particular third party service provider, and disregards the input.

In some embodiments, the digital assistant **326** receives a user input while displaying a user interface of a particular application, and determines whether the input corresponds to one or more templates associated with the particular application. In accordance with a determination that the input corresponds to one or more templates associated with the particular application, the digital assistant **326** sends the input to the third party service provider associated with the particular application. For example, the digital assistant **326** receives a user input "play [x]" while displaying a user interface of a particular music player application, and sends the input to a third party service player associated with the particular music player application (even if multiple music service providers are associated with the same template).

In some embodiments, the digital assistant **326** receives a user input, and determines that the user input corresponds to a particular template that is associated with multiple third party service providers. The digital assistant **326** selects one of the multiple third party service providers associated with the particular template, and sends the user input to the selected third party service provider. In some embodiments, the selection of a third party service provider is based on a review of the multiple third party service providers. In some

embodiments, the selection of a third party service provider is based on a priority ranking of the multiple third party service providers. In some embodiments, the priority ranking of the multiple third party service providers is based on an amount each third party service provider has agreed to pay to be listed on the priority ranking. For example, a third party service provider that makes a high bid is ranked higher than a third party service provider that makes a lower or no bid.

In some embodiments, the digital assistant **326** receives a user input, and determines that the user input corresponds to a particular template that is associated with multiple third party service providers. The digital assistant **326** sends the user input to two or more third party service providers, and receives an acknowledgement indicating whether a respective third party service provider is available. In some embodiments, the digital assistant **326** determines that only one third party service provider is available and select the available third party service provider. In some embodiments, the digital assistant **326** determines that a particular service provider has provided the acknowledgement faster than the remainder of the multiple third party service providers, and selects the particular service provider.

In some embodiments, template selection rules are published so that all third party service providers may know the template selection rules.

In some embodiments, the third party service provider includes a third party digital assistant. The third party digital assistant is similar to the digital assistant **326** described herein. In some embodiments, the third party digital assistant includes an ontology (similar to the ontology **360**), third party vocabulary (similar to vocabulary **344**), third party user data (similar to user data **348**), and one or more third party task flow models (similar to task flow models **354**). The third party service provider receives the input and processes the received input with the third party digital assistant in a manner similar to the operations of the digital assistant **326** described herein. The third party service provider provides results to the digital assistant **326**, and the digital assistant **326** causes the results to be presented to the user (e.g., in a dialogue user interface for the digital assistant **326** or as a voice output). In some embodiments, the results from the third party digital assistant are output using a voice different from a voice used for outputting results not from the third party digital assistant.

In some embodiments, the digital assistant **326** receives a request to disambiguate an input from a third party service provider. For example, the digital assistant **326** sends a user input "play Rock and Roll" to a music service provider, and the music service provider sends a request back to the digital assistant **326** to disambiguate to the digital assistant **326**. In this case, the request may include a request to disambiguate whether to play a radio station with rock and roll music or to play a song entitled "Rock and Roll."

As described above, in order to complete a structured query, the task flow processor **336** may need to initiate additional dialogue with the user in order to obtain additional information, and/or disambiguate potentially ambiguous utterances. When such interactions are necessary, the task flow processor **336** invokes the dialogue flow processing module **334** to engage in a dialogue with the user. In some embodiments, the dialogue flow processing module **334** determines how (and/or when) to ask the user for the additional information, and receives and processes the user responses. In some embodiments, the questions are provided to and answers are received from the users through the I/O processing module **328**. For example, the dialogue flow processing module **334** presents dialogue output to the user via audio and/or visual output, and receives input from the user via spoken or physical (e.g., touch gesture) responses. Continuing with the example above, when the task flow processor **336** invokes the dialogue flow processing module **334** to determine the "party size" and "date" information for the structured query associated with the domain "restaurant reservation," the dialogue flow processing module **334** generates questions such as "For how many people?" and "On which day?" to pass to the user. Once answers are received from the user, the dialogue flow processing module **334** populates the structured query with the missing information, or passes the information to the task flow processor **336** to complete the missing information from the structured query.

In some cases, the task flow processor **336** may receive a structured query that has one or more ambiguous properties. For example, a structured query for the "send a message" domain may indicate that the intended recipient is "Bob," and the user may have multiple contacts named "Bob." The task flow processor **336** will request that the dialogue flow processing module **334** disambiguate this property of the structured query. In turn, the dialogue flow processing module **334** may ask the user "Which Bob?", and display (or read) a list of contacts named "Bob" from which the user may choose.

Once the task flow processor **336** has completed the structured query for an actionable intent, the task flow processor **336** proceeds to perform the ultimate task associated with the actionable intent. Accordingly, the task flow processor **336** executes the steps and instructions in the task flow model according to the specific parameters contained in the structured query. For example, the task flow model for the actionable intent of "restaurant reservation" may include steps and instructions for contacting a restaurant and actually requesting a reservation for a particular party size at a particular time. For example, using a structured query such as: {restaurant reservation, restaurant=ABC Café, date=3/12/2012, time=7 pm, party size=5}, the task flow processor **336** may perform the steps of: (1) logging onto a server of the ABC Café or a restaurant reservation system that is configured to accept reservations for multiple restaurants, such as the ABC Café, (2) entering the date, time, and party size information in a form on the website, (3) submitting the form, and (4) making a calendar entry for the reservation in the user's calendar.

In some embodiments, the task flow processor **336** employs the assistance of a service processing module **338** ("service processor") to complete a task requested in the user input or to provide an informational answer requested in the user input. For example, the service processor **338** can act on behalf of the task flow processor **336** to make a phone call, set a calendar entry, invoke a map search, invoke or interact with other user applications installed on the user device, and invoke or interact with third party services (e.g. a restaurant reservation portal, a social networking website, a banking portal, etc.). In some embodiments, the protocols and application programming interfaces (API) required by each service can be specified by a respective service model among the services models **356**. The service processor **338** accesses the appropriate service model for a service and generates requests for the service in accordance with the protocols and APIs required by the service according to the service model.

For example, if a restaurant has enabled an online reservation service, the restaurant can submit a service model specifying the necessary parameters for making a reservation and the APIs for communicating the values of the

necessary parameter to the online reservation service. When requested by the task flow processor **336**, the service processor **338** can establish a network connection with the online reservation service using the web address stored in the service models **356**, and send the necessary parameters of the reservation (e.g., time, date, party size) to the online reservation interface in a format according to the API of the online reservation service.

As explained above, in some embodiments, the one or more default domains **372** include one or more private domains. In some embodiments, the one or more private domains include a domain that corresponds to a task that does not require an external service (e.g., external service **120** in FIG. **1**). In some embodiments, the one or more private domains include a domain that corresponds to a default service provider (e.g., a private domain corresponds to a task that requires an external service from the default service provider). For example, a private domain may include a calendar service domain that is used for storing and/or retrieving a calendar event, and the calendar service domain corresponds to a task that requires calendar event storing and/or retrieving services from a default calendar service provider. In some embodiments, a private domain is owned by a developer of the device or the digital assistant **326** (e.g., APPLE Inc.). Thus, user interfaces and content are both under control of the developer of the device or the digital assistant **326**.

As explained above, in some embodiments, the one or more third party domains **374** include one or more public domains. In some embodiments, the one or more public domains are developed by a developer of the device or the digital assistant **326**, whereas content is provided from a third party.

In some embodiments, the one or more third party domains **374** include one or more developer domains. In some embodiments, both a public domain and a developer domain correspond to tasks that require an external service from one or more third party service providers. As used herein, a third party service provider is a service provider other than a default service provider. In some embodiments, a public domain is not developed by a third party service provider (e.g., a public domain developed by a manufacturer of the device based on information available from a third party service provider). In some embodiments, a developer domain is developed by a third party service provider. In some embodiments, a developer domain corresponds to a task flow model **354** developed by a third party service provider and/or a dialogue flow model developed by a third party service provider for processing by the dialogue flow processing module **334** (FIG. **3**B). In some embodiments, the developer domain is stored at a server of a third party service provider (e.g., external services **120**).

In some embodiments, the natural language processor **332**, dialogue flow processing module **334**, and task flow processor **336** are used collectively and iteratively to deduce and define the user's intent, obtain information to further clarify and refine the user intent, and finally generate a response (e.g., provide an output to the user, or complete a task) to fulfill the user's intent.

In some embodiments, after all of the tasks needed to fulfill the user's request have been performed, the digital assistant **326** formulates a confirmation response, and sends the response back to the user through the I/O processing module **328**. If the user request seeks an informational answer, the confirmation response presents the requested information to the user. In some embodiments, the digital assistant also requests the user to indicate whether the user is satisfied with the response produced by the digital assistant **326**.

FIGS. **4**A-**4**B are flow diagrams illustrating exemplary operations undertaken by a DA server, a DA client, and a service provider (e.g., the server system **108**, the user device **104***a*, and a messaging service **122-2** in FIG. **1**). These operations are merely exemplary and fewer or less other interactions may be performed by the DA server, the DA client, and service provider(s) in various embodiments.

In some embodiments, the service provider (e.g., Service Provider **1**(**120-1**)) sends (**402**) one or more task types (e.g., "make a restaurant reservation" and/or "find a match score") to the DA server. In some embodiments, the one or more task types identify one or more task types supported by the service provider. In some embodiments, the service provider sends a vocabulary or an identification of a vocabulary. In some embodiments, the service provider sends domain information (e.g., a data model as illustrated in FIG. **3**C) regarding at least one of the one or more task types. In some embodiments, the service provider sends two or more of: the one or more task types, the vocabulary or the identification of the vocabulary, and the domain information.

Typically, a third party service provider and the digital assistant system **300** are not owned by a same person or entity. For example, the digital assistant system **300** is owned by Applicant, APPLE Inc., while the third party service provider is a server owned by a restaurant reservation service provider (e.g., OPENTABLE, Inc.).

In some embodiments, the DA server receives (**404**) and integrates (**406**) the one or more task types into the task flow models **354** (e.g., as one or more third party task flow models in the third party task flow models **382**). As described above with reference to FIG. **3**A, in some embodiments, the task flow models **354** include the third party task flow models **382** and the default task flow models **380**, which are not received from a third party service provider. In some embodiments, the task flow models **354** already include existing third party task flow models, and the DA server stores the received one or more task types with the existing third party task flow models. In some embodiments, the DA server performs a task corresponding to a task flow model in the third party task flow models **382**. For example, when the digital assistant system **300** (FIG. **3**A) is configured to support making restaurant reservations by default (i.e., not using task flow models provided by third party service provider systems), the default task flow models **380** include task flow models for making restaurant reservations. Continuing with the example, when the digital assistant system **300** is configured to provide sports scores based on third party domains **374**, the third party task flow models **382** include a flow model for retrieving sports scores (e.g., retrieving sports scores from the Service Provider **1**).

In some embodiments, the DA server receives and integrates the vocabulary or the identification of the vocabulary into the vocabulary **344** (e.g., the third party vocabulary **378**). As described above with reference to FIG. **3**A, in some embodiments, the vocabulary **344** includes the third party vocabulary **378** (or a third party vocabulary index) and the default vocabulary **376** (or a default vocabulary index), which is not received from a third party service provider. For example, in some embodiments, when the digital assistant system **300** (FIG. **3**A) is configured to support making restaurant reservations by default (i.e., not using ontology data or vocabulary provided by third party service provider systems), the one or more default vocabulary indices **376** include terms related to making restaurant reservations, such

as "restaurant," "reservation," and "party size." In some embodiments, each of these terms is separately affiliated with a list of synonyms. In some embodiments, the default vocabulary **376** also includes restaurant names and/or restaurant locations (e.g., street names). In comparison, the one or more third party vocabulary indices **378**, when the digital assistant system **300** is configured to provide sports scores based on third party domains **374**, include terms related to sports, such as types of sports (e.g., baseball, basketball, football, soccer, etc.), names of players and teams, and locations of sports events.

Similarly, in some embodiments, the DA server receives and integrates the domain information into the ontology **360** (e.g., the third party domain **374**). As described above with reference to FIG. **3**A, in some embodiments, the ontology **360** includes the third party domain **374** and the default domains **370** (e.g., the restaurant reservation domain **362** and the reminder domain **364**, FIG. **3**C), which are not received from a third party service provider. Typically, the one or more third party domains **374** correspond to one or more task types that do not correspond to the default domains **372**. For example, in some embodiments, the default domains **372** do not correspond to retrieving sports scores, but one or more third party domains **374** include a "sports scores" domain for addressing sports score queries from users.

In some embodiments, in response to receiving the one or more task types and/or the domain information, the DA server updates the service provider directory **390** and/or the supported tasks **392**. The service provider directory **390** typically includes a list of third party service providers that the DA server has access to. The supported tasks **392** typically include a list of task types supported by respective third party service providers and/or a list of third party service providers that support respective task types. For example, the DA server adds the Service Provider **1** to the service provider directory **390** and lists task types supported by the Service Provider **1** in the supported tasks **392** in connection with the Service Provider **1**.

In some embodiments, at least one of the one or more third party domains **374** (or information for the one or more third party domains **374**) is provided that is location specific. For example, in some embodiments, when the DA client **104** approaches or enters a particular hotel, the hotel's service provider system automatically provides a domain relevant to that hotel to the digital assistant system **300**. In some embodiments, the digital assistant system **300** automatically receives the domain relevant to that hotel. In other embodiments, the digital assistant system **300** asks the user whether the user wants to receive the local domain (e.g., the domain relevant to that hotel). In some embodiments, the at least one domain provided by the hotel's service provider system includes tasks or task types related to that particular hotel (e.g., finding room rates, locating restaurant facilities in the hotel, etc.).

In some embodiments, the DA client **104** generates a voice output with a voice having a first set of voice characteristics for tasks associated with default domains **372** and generates a voice output with a voice having a second set of voice characteristics for tasks associated with third party domains **374**. For example, the DA client **104** may generate a voice output with a certain female voice for tasks associated with the default domains **372**, and generate a voice output with a certain male voice for tasks associated with a third party domain **374**. Voice characteristics may include one or more of pitch, speed, and volume, and/or characteristics typical to a particular group of speakers classified based on, for example, gender (e.g., male or female), age (e.g., adult or child), and accents. In some embodiments, respective third party domains are associated with respective voices having respective sets of voice characteristics. For example, a first third party domain may be associated with a voice having a third set of voice characteristics and a second third party domain may be associated with a voice having a fourth set of voice characteristics. For example, a high-end hotel chain may have a domain associated with a refined accent.

In some embodiments, when the DA client **104** moves away from a predefined location, the DA client automatically removes one or more domains associated with the predefined location. For example, when the DA client **104** moves away from the hotel, the DA client automatically removes one or more domains provided by the hotel's service provider system. In some other embodiments, the DA client retains a predefined number of recently used third party domains (e.g., before receiving a new third party domain, the DA client removes a third party domain stored in the DA client that was used last, also known as the first-in-first-out (FIFO)). In some embodiments, the DA client removes a third party domain based on a frequency of use (e.g., removes a domain that is least frequently used) instead of the time of last use. In yet other embodiments, the DA server asks the DA client whether it wants to remove the one or more domains provided by the hotel's server provider system. In some embodiments, a list of the one or more third party domains **374** available to the DA client is stored in the DA server, and based on the response from the DA client, the DA server removes one or more third party domains from the list. In other embodiments, the list of the one or more third party domains **374** available to the DA client is stored on the DA client, and the DA client removes one or more third party domains from the list.

While these operations (e.g., the operations **402**, **404**, and **406**) are typically performed before a user provides an input (i.e., prior to receiving an input from a user) that would initiate the particular task, these may also be performed in real time after a user provides input.

In some embodiments, another service provider (e.g., Service Provider **2** (**120-2**)) also sends task types supported by that service provider to the DA server, and the DA server integrates these into the task flow models **354** and/or the service provider directory **390**, as described above. However, until the server **108** identifies a task type corresponding to that service provider, the server **108** typically does not send a request to that service provider.

At anytime thereafter, the DA client receives (**408**) an input (e.g., a voice input) from the user. In some embodiments, the DA client receives the input through one or more microphones. For example, the DA client may receive a voice command of the user, such as "book a restaurant at 7 pm." In some embodiments, the DA client receives the input through a touch-sensitive surface. The DA client sends (**410**) the input from the user to the DA server, and may also send contextual information, such as the location of the DA client.

The DA server receives (**412**) the input of the user, and identifies (**414**) a respective task type as described below in reference to FIG. **4**B. In some embodiments, when the input of the user is a voice command, the DA server receives the input as an audio file (or as a string of text corresponding to the speech if the DA client includes a text-to-speech engine). As described above with reference to FIG. **3**B, in some embodiments, the DA server uses the digital assistant **326** (FIG. **3**B) to identify the respective task type. For example, the DA server may determine from the input of the user that

the user wants to make a restaurant reservation (i.e., identify "making a restaurant reservation" as a requested task type). For example, when the user input is "book a restaurant tonight," the identified task type is a restaurant reservation that corresponds to at least one restaurant reservation service provider, and when the user input is "what is the latest Giants' score," the identified task type is retrieving sports scores.

In some embodiments, the device identifies the respective task type in accordance with a vocabulary (or an identification of a vocabulary, such as associating an existing vocabulary with a new task or domain) received from the third party service provider. For example, after receiving an inquiry from the user, "where is Jeremy Lin playing today," the device may determine that the term, Jeremy Lin, matches an entry in a third party vocabulary index from a sports game schedule service provider as an athlete's name, and identify that retrieving a location of a sports game is the requested task. Similarly, after receiving an inquiry from the user, "where is the Hunger Games playing today," the device may determine that the term, the Hunger Games, matches an entry in a third party vocabulary index from a movie schedule/ticketing service provider as a movie title, and identify that retrieving a location of the movie screening is the requested task.

In some embodiments, the DA server locates (**416**) one or more service providers that can perform the identified task type. In some embodiments, the DA server locates the one or more service providers that can perform the identified task type in accordance with information in the service provider directory **390** and/or the list of supported tasks or competencies **392**. By using competencies, the DA server can more efficiently identify service providers that are suitable for an identified task type. For example, two restaurant reservation service providers (e.g., a first restaurant reservation service provider and a second restaurant reservation service provider) may have one or more supported task types including making restaurant reservations, indicating that the two restaurant reservation service providers can provide restaurant reservation services. In another example, one or more supported task types associated with a particular service provider may include "sports schedules," indicating that the particular service provider can provide information about sports game schedules.

In some embodiments, when the DA server locates two or more service providers that can perform the identified task type, the DA server selects one of the two or more service providers. In some other embodiments, the DA server selects multiple service providers of the two or more service providers. In some embodiments, the DA server sends (**418**) a request to the one or more selected service providers, typically one service provider, to perform a task of the identified task type. Alternatively, in other embodiments, the DA server sends the request to the DA client **104**, and the DA client receives the request and sends (**419**) the request to the one or more selected service providers. In some embodiments, the respective service provider is configured to complete the task. In some other embodiments, the task requires multiple service providers. For example, the task may be "buy tickets for a most popular movie starring actor X." Performing this task may require receiving information from, or performing a task with, a movie ranking service provider, a movie database service provider, and a movie ticket purchase service provider. In other words, each service provider performs a portion of the task, and the device integrates information from multiple selected service providers.

In some embodiments, the DA server locates one or more default service providers that correspond to private domains and one or more third party service providers, both the one or more default service providers and the one or more third party service providers capable of performing the identified task type, and selects one or more default service providers.

The service provider then receives (**420**) the request, performs (**422**) the requested task, and sends (**424**) one or more results relating to the performance of the requested task to the DA server **108**.

The DA server **108** receives (**426**) the one or more results from the service provider, and sends (**428**) one or more of the one or more results to the DA client **104**.

Alternatively, the service provider sends the one or more results directly back to the client **104** (shown by broken arrow between **424** and **429**).

The DA client **104** receives (**429**) the one or more results, and presents (**430**) the one or more received results to the user (e.g., as an audio output or a visual display). In some embodiments, the DA client **104** presents (**432**) at least a portion of the one or more received results to the user through a user interface of a software application (e.g., **270-1** or **270-2**, FIG. **2**) other than the digital assistant client module **264**. In some embodiments, the DA client **104** presents (**434**) at least a portion of the one or more received results to the user not through a user interface of a software application other than the digital assistant client module **264** (e.g., through a user interface of the digital assistant client module **264** or through an audio interface not associated with any particular software application). In some embodiments, the DA client **104** outputs speech of the one or more received results.

FIG. **4**B is a flow diagram providing additional details of certain operations illustrated in FIG. **4**A.

In some embodiments, identifying (**414**) a respective task type includes determining whether the user is authorized to use services of one or more third party service providers. In some embodiments, the user is deemed to be authorized for a particular third party service provider when the user is authorized to use a software application associated with the particular third party service provider. For example, if the user has bought an application for a particular service provider (e.g., a restaurant rating service provider), then the user is deemed to be authorized to use services of the particular service provider (and corresponding third party domains **374**). If the user is authorized for the one or more third party service providers, the DA server searches the domains (e.g., one or more third party domains **374**) in the ontology **360**. Once the DA server identifies a relevant domain, the DA server uses an appropriate task flow model associated with the relevant domain (and corresponding to the one or more authorized third party service providers).

In some embodiments, the DA server identifies one or more private domains (e.g., default domains **372**) and one or more third party domains (e.g., third party domains **374**) and uses an appropriate task flow model associated with a private domain. In other words, in some embodiments, the DA server selects a private domain over a third party domain when both the private domain and the third party domain correspond to the input.

In some embodiments, if the user is not authorized for the one or more third party service providers, or if no authorized third party domain corresponds to the input of the user, the DA server determines whether to search default domains. For example, the DA server determines whether the default domains include a domain that corresponds to the input of the user. If the DA server determines to search the default

domains (e.g., the DA server determines that the default domains include a domain that corresponds to the input of the user), the DA server searches the default domains to identify a respective default task flow model that corresponds to the input of the user, and processes the respective default task flow model.

In some embodiments, if the DA server determines not to search the default domains, or if no default domain corresponds to the input of the user, the DA server may perform other actions, such as searching a search engine or a knowledge engine or disregarding the input.

In some embodiments, if the DA server determines not to punt the input of the user, the DA server disregards the input.

In some embodiments, the DA server **108** communicates with the DA client **104**. In some embodiments, the DA client **104** stores in the memory **250** one or more software applications **270-1** and **270-2** that corresponds to third party service providers (e.g., ZAGAT software application and YELP application that correspond to different restaurant review providers). As explained above, in some embodiments, the DA server includes the user application data **340**.

In some embodiments, the DA server **340** selects a service provider based on one or more software applications that the user is authorized to use, as explained in detail below. In some embodiments, locating (**416**) the one or more service providers includes locating a third party service provider for which a corresponding application is stored in the DA client (FIG. **1**). For example, the digital assistant system **300** may have access to a plurality of restaurant review providers. This is based on an assumption that the user of the DA client **104** is interested in receiving information from the third party service provider, because the user of the DA client **104** chose to store (e.g., install) the corresponding application on the DA client **104**. In some embodiments, when the DA client **104** is authorized to use the ZAGAT software application but not the MICHELIN GUIDE application, the DA server selects ZAGAT as a restaurant review provider, and sends a request for restaurant reviews to a ZAGAT server. One reasoning is that the user of the DA client **104** is assumed to have a preference for the ZAGAT restaurant reviews, because the user is authorized to use the ZAGAT software application, but not the MICHELIN GUIDE application.

Although the above example describes the DA client **104** having the software application corresponding to the service provider system, in some embodiments, the DA client **104** need not store the software application corresponding to the service provider system. For example, the user may have purchased the software application, but have not yet downloaded or installed the software application on the DA client **104**, or the user may have installed the software application on another DA client owned by the user. Alternatively, the user may have an existing account (e.g., a subscription or a license) with the service provider system. In some embodiments, the user application data **340** identifies one or more software applications the user is authorized to use. In some embodiments, the user application data **340** also identifies one or more service providers that correspond to the one or more software applications the user is authorized to use (e.g., websites or company names associated with the one or more software applications). In some embodiments, the user application data **340** identifies one or more service providers that the user is authorized to use other than default service providers (e.g., service providers all users of the digital assistant system **300** are authorized to use).

In some embodiments, the digital assistant system **300** has access to two or more service provider systems that support a same task type. For example, the two or more service provider systems may be configured to perform tasks of the same task type (e.g., both ZAGAT and YELP for providing restaurant reviews).

In some embodiments, locating (**416**) the one or more service providers includes locating a service provider that corresponds to a software application that the user has purchased (e.g., ZAGAT over YELP). In some embodiments, locating (**416**) the one or more service providers includes locating a third party service provider that corresponds to a most recently used application. In some embodiments, locating (**416**) the one or more service providers includes locating a third party service provider that corresponds to a most frequently used application.

In some embodiments, locating (**416**) the one or more service providers include multiple service providers. For example, the DA server may select ZAGAT and YELP out of three restaurant review providers, ZAGAT, YELP, and MICHELIN GUIDE, and combine results provided by both ZAGAT and YELP. Alternatively, the DA server may ask the user to choose a preference between ZAGAT and YELP. In some embodiments, the DA server stores the user preference (e.g., in the user data **348**). For example, the user may choose to allow certain service providers to provide results to the user. Additionally, or alternatively, the user may choose to block some other service providers from providing results to the user. In some embodiments, the user selects a number of times a particular provider is permitted to provide results (e.g., once per day). In some embodiments, the user selects a number of results a particular provider is permitted to provide in response to each input.

In some embodiments, locating (**416**) the one or more service providers includes selecting one or more service providers based on an identity of the user. For example, when two news service providers ("XYZ News" and "XYZ Kids") are located, a news service provider is selected based on the identity of the user (e.g., if the user is an adult, select "XYZ News" that is designed for adults, and if the user is a child, select "XYZ Kids" that is designed for children). In some embodiments, the identity of the user is determined from a user profile stored in the device. In some embodiments, the identity of the user is determined from one or more recently used applications, time of day, types of inputs, etc.

In some embodiments, sending (**418**) a request to perform a task includes sending the request to one or more selected service providers. In turn, the DA server receives (**426**) the one or more results from one or more of the one or more selected service providers. For example, in some embodiments, the DA server sends the request to multiple service providers (e.g., multiple airlines for ticket pricing) and receives results from a subset of the multiple service providers (e.g., during a predefined time period). This allows the DA server to utilize results provided by those service providers that respond quickly, and avoid unacceptable delays, in waiting for the results, that degrade the user experience.

Then, the DA server sends (**428**) one or more of the one or more results to the DA client **104** for presentation (e.g., visual or audio) to the user. The DA client **104** receives the one or more results sent by the DA server, and presents (**430**) at least a portion of the one or more results to the user.

In some embodiments, sending (**418**) the request includes sending to a third party software application stored in the DA client an instruction to send the request to one or more service providers (e.g., including one or more third party service providers). In turn, the DA client, in response to

receiving the instruction from the DA server, sends the request to one or more service providers. Then, the DA client receives one or more results from one or more of the one or more service providers, and presents (**430**) at least a portion of the one or more results to the client.

In some embodiments, the DA client presents the results through the third party software application stored in the DA client (e.g., the results are displayed in the user interface of the third party software application). For example, the results from the ZAGAT service provider are presented on the user interface of the ZAGAT application stored on the DA client. In some embodiments, the DA client presents the results not through the third party software application (e.g., the results are displayed in the user interface of the digital assistant client module **264**, FIG. **2**). For example, the results from the ZAGAT service provider are presented on the user interface of the digital assistant client module **264**.

The foregoing description, for purpose of explanation, has been described with reference to specific embodiments. However, the illustrative discussions above are not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated.

What is claimed is:

1. A method of processing a user input, the method performed at an electronic device with one or more processors and memory, the method comprising:

at the electronic device:

receiving a first set of one or more predefined task types from a service provider;

integrating the first set of one or more predefined task types with a second set of predefined task types not associated with the service provider to generate a plurality of predefined task types;

receiving an input of a user specifying a task;

selecting, based on the user input, a task type from the plurality of predefined task types, the task type corresponding to one of the first set of the one or more predefined task types and to the task; and,

in response to selecting the task type, sending to the service provider a request to perform at least a portion of the task.

2. The method of claim **1**, wherein the input is a voice input of the user that has been converted to text.

3. The method of claim **1**, further comprising:

prior to receiving the input of the user, receiving from the service provider an identification of a vocabulary; and

selecting the task type in accordance with the identification of the vocabulary.

4. The method of claim **3**, further comprising, associating the vocabulary with the first set of the one or more predefined task types.

5. The method of claim **3**, wherein receiving the identification of the vocabulary includes receiving the vocabulary.

6. The method of claim **3**, wherein receiving the identification of the vocabulary includes receiving an identification of a vocabulary accessible to the electronic device prior to receiving the identification of the vocabulary.

7. The method of claim **1**, further comprising:

obtaining one or more results corresponding to the input from the service provider; and

providing at least a subset of the one or more results for presentation to the user.

8. The method of claim **1**, wherein:

the electronic device is a portable electronic device of the user; and

the portable electronic device does not store a software application corresponding to the service provider.

9. The method of claim **8**, wherein the portable electronic device is a phone.

10. An electronic device, comprising:

one or more processors;

a memory; and

one or more programs, wherein the one or more programs are stored in the memory and configured to be executed by the one or more processors, the one or more programs including instructions for:

receiving a first set of one or more predefined task types from a service provider;

integrating the first set of one or more predefined task types with a second set of predefined task types not associated with the service provider to generate a plurality of predefined task types;

receiving an input of a user specifying a task;

selecting, based on the user input, a task type from the plurality of predefined task types, the task type corresponding to one of the first set of the one or more predefined task types and to the task; and,

in response to selecting the task type, sending to the service provider a request to perform at least a portion of the task.

11. The electronic device of claim **10**, wherein the input is a voice input of the user that has been converted to text.

12. The electronic device of claim **10**, wherein the one or more programs further include instructions for:

prior to receiving the input of the user, receiving from the service provider an identification of a vocabulary; and

selecting the task type in accordance with the identification of the vocabulary.

13. The electronic device of claim **12**, wherein the one or more programs further include instructions for: associating the vocabulary with the first set of one or more predefined task types.

14. The electronic device of claim **12**, wherein receiving the identification of the vocabulary includes receiving the vocabulary.

15. The electronic device of claim **12**, wherein receiving the identification of the vocabulary includes receiving an identification of a vocabulary accessible to the electronic device prior to receiving the identification of the vocabulary.

16. A non-transitory computer readable storage medium storing one or more programs, the one or more programs comprising instructions, which when executed by one or more processors of an electronic device, cause the device to:

receive a first set of one or more predefined task types from a service provider;

integrate the first set of one or more predefined task types with a second set of predefined task types not associated with the service provider to generate a plurality of predefined tasks;

receive an input of a user specifying a task;

select, based on the user input, a task type from the plurality of predefined task types, the task type corresponding to one of the first set of the one or more predefined task types and to the task; and,

in response to selecting the task type, send to the service provider a request to perform at least a portion of the task.

17. The non-transitory computer readable storage medium of claim 16, wherein the input is a voice input of the user that has been converted to text.

18. The non-transitory computer readable storage medium of claim 16, wherein the one or more programs further cause the device to:

prior to receiving the input of the user, receive from the service provider an identification of a vocabulary; and

select the task type in accordance with the identification of the vocabulary.

19. The non-transitory computer readable storage medium of claim 18, wherein the one or more programs further cause the device to: associating the vocabulary with the first set of the one or more predefined task types.

20. The non-transitory computer readable storage medium of claim 18, wherein receiving the identification of the vocabulary includes receiving the vocabulary.

21. The non-transitory computer readable storage medium of claim 18, wherein receiving the identification of the vocabulary includes receiving an identification of a vocabulary accessible to the electronic device prior to receiving the identification of the vocabulary.

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