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ASSISTANT GENERATED ANSWERS USING SUPPLEMENTAL DATA

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ABSTRACT

A virtual, intelligent, or computational assistant (e.g., also referred to simply as an "assistant") is described that relies on supplemental data (e.g., contextual information, user information, etc.) to decipher, and determine answers to, user queries. With explicit permission from a user, the assistant may access a user's location history, calendar, e-mail, messages, past assistant interactions, contacts, photos, search history, sensor data, and other contextual or user information to answer a user query. The supplemental data can be stored locally on a device that is executing the assistant or in a cloud computing environment that is accessible to the assistant from the device. This way, the assistant is enabled to understand and generate answers to more complex, compound, and often personal queries even if the assistant has never before received or generated an answer to the queries.

DESCRIPTION

Virtual, intelligent, or computational assistants (e.g., also referred to simply "assistants") execute on counter-top computing devices, mobile phones, automobiles, and many other types of computing devices. Assistants output useful information, respond to user queries, or otherwise perform certain operations to help users complete real-world and/or virtual tasks. The usefulness of an assistant may depend on what information the assistant already knows about its users or what information the assistant has access to.

The example system shown in FIG. 1 provides an assistant architecture that that relies on supplemental data, including contextual information and user information, when determining answers to user queries. That is, with explicit permission from a user, the assistant may access a

user's location history, calendar, e-mail, messages, past assistant interactions, contacts, photos, and other contextual or user information that is outside the assistant's typical control, to answer a user query. In other words, the assistant may rely on supplemental data from external data sources to identify user information that can be used to decipher and form responses to complex, compound and/or personal user queries. The contextual information can be stored locally on a device that is executing the assistant or in a could computing environment that is accessible to the assistant from the device. This way, the assistant is enabled to understand and generate answers to more complex, compound, and often personal queries even if the assistant has never before received or generated an answer to the queries.

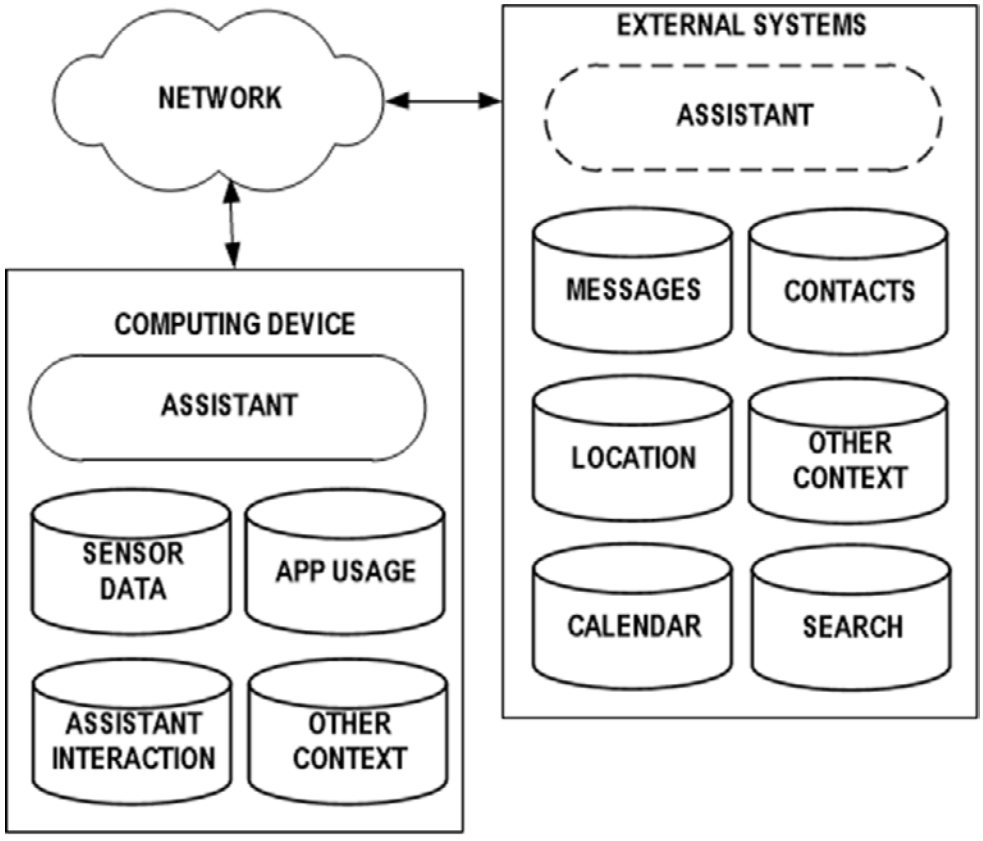

FIG. 1

The system of FIG. 1 includes one or more external systems and a computing device communicating across a network to provide an assistant service that maintains and has access to

user information. The network of FIG. 1 represents a combination of any one or more public or private communication networks, for instance, television broadcast networks, cable or satellite networks, cellular networks, Wi-Fi networks, broadband networks, and/or other type of network for transmitting data (e.g., telecommunications and/or media data) between various computing devices, systems, and other communications and media equipment.

The computing device represents any type of computing device that is configured to execute an assistant and communicate on a network. The external systems represent any type of server or other computing system that is configured to support the assistants executing at the computing device. The external systems and computing device can be personal or In some examples, the computing device and external systems may be shared assets of multiple users. Examples of the computing device and the external systems include servers, mainframes, cloud computing environments, mobile phones, tablet computers, wearable computing devices, countertop computing devices, home automation computing devices, laptop computers, desktop computers, televisions, stereos, automobiles, and all other type of mobile and non-mobile computing device that is configured to execute an assistant.

The computing device and external systems may store or provide access to supplemental data including personal information about users. Examples of personal information include: sensor data, calendars, location histories, search histories, messages, e-mails, preferences, notes, lists, contacts, other communications, interests, application usage data, past assistant interactions, etc. After receiving explicit permission from a user, the computing device and external systems may store the supplemental data and enable an assistant, or other applications, executing at the computing device and external systems to access the supplemental data.

The external systems and the computing device treat the supplemental data so the supplemental data is protected, encrypted, or otherwise not susceptible to hacking or unauthorized use. The supplemental data may be stored locally at the computing device and/or remotely (e.g., in a cloud computing environment provided by the external systems and which is accessible via the network of FIG. 1).

The computing device includes an assistant that executes across the external systems and the computing device to provide assistant services to users of the computing device. Examples of assistant services include: setting up reminders, creating calendar entries, booking travel, online ordering, sending messages or other communications, controlling televisions, lights, thermostats, appliances, or other computing devices, providing navigational instructions, or any other conceivable task or operation that may be performed by an assistant. The assistant relies on the supplemental data stored on the computing device or the external systems when interpreting, and determining answers to, user queries.

As one example, a user of the computing device may provide a query to the assistant by asking the assistant "where did I have dinner when I went to Hawaii"? The assistant may determine the query to be a question about a location – more specifically a query for obtaining a location of the user during a specific time period (e.g., dinner time when last in Hawaii). As the assistant may have no previously stored knowledge of where the user ate dinner when in Hawaii, or for that matter, when the user was in Hawaii last, the assistant may need to rely on supplemental data. Using the supplemental data, the assistant may first determine when the user was last in Hawaii and then with that information, further query the supplemental data for clues where the user ate dinner during the time he or she was in Hawaii.

For example, the assistant may query the location history of the user to find a range of time when the location of the user corresponds to a location in Hawaii. Using the identified time range, the assistant may query the user's e-mail, messaging, social media, photos, calendar, or other supplemental data to identify names of restaurants or dinner locations during that time range. The assistant may identify an e-receipt that was e-mailed to the user after the user paid for a meal at a restaurant during the time the user was in Hawaii as well as a calendar entry in the user's calendar that refers to dinner. In some examples, the assistant may determine that the user was at a location associated with a restaurant for an appropriate amount of time to consume a meal and during a time of day associated with when the user typically eats dinner. The assistant may output, as a response to the user's query, an indication of the name of the restaurant listed in the e-receipt as well as the name of the restaurant listed in the dinner entry on the calendar. For example, the assistant may output a voice prompt that states "When you were in Hawaii it appears you ate at Acme Seafood Palace the first night and Beta Thai the second night."

As one example, a user of the computing device may provide a query to the assistant by asking the assistant "what size spark plug does my mower need"? The assistant may determine the query to be a question about an item – more specifically a query for obtaining details regarding the user's lawn mower. As the assistant may have no previously stored knowledge of what size spark plug the user's lawn mower needs, or for that matter, what type of lawn mower the user owns, the assistant may need to rely on supplemental data. Using the supplemental data, the assistant may first determine what type of mower the user owns and then access additional supplemental data to identify the spark plug size for the mower's engine.

For example, the assistant may query a search history or online purchasing history of the user to find references to lawn mowers, small engine parts, etc. The assistant may query the

user's e-mail to identify any references to lawn mower purchases or parts. The assistant may identify a search query in the user's search history that states "model 1234 oil filter" and a second query that states "model 1234 blade". The assistant may determine that an oil filter and blade are common replacement parts for a lawn mower and therefore deduce that the user owns a model 1234 mower. Before searching for the specific spark plug size, the assistant may ask the user to confirm the assistant's assumption. The assistant may output a prompt to the user "you have a model 1234 mower right"? After the user response "yes", the assistant may perform an internet search via the network to identify the spark plug size for a model 1234 mower. The assistant may output, as a response to the user's query, an indication of the size of the spark plug the user found. For example, the assistant may output a voice prompt that states "The model 1234 mower take an XYZ size spark plug."

As yet another example, example, a user of the computing device may provide a query to the assistant by asking the assistant "what else should we try to see tomorrow that we didn't already see today"? The assistant may determine the query to be a question about attractions at a future location during a specific time period (e.g., tomorrow). Using the supplemental data, the assistant may first predict where the user will be the next day and what sort of attractions are at that location, and second, filter out attractions that the assistant has figured out the user has already been to or seen.

For example, the assistant may query the current or recent location history of the user to determine where the user traveled to that day. The assistant may also query the user's photos, messages, social media posts, etc. to identify specific locations or landmarks visited that day. The assistant may determine that the location history indicates the user crisscrossed throughout a particular city in a foreign country. From the photos the user took, the assistant may identify zoo

animals and a beach. The assistant may query the internet for interesting places to visit in the particular city and determine that the city's zoo and beach are among the top destinations. Rather than recommend visiting the zoo or the beach again however, the assistant may recommend one of the other top destinations, e.g., a memorial or a museum. For instance, the assistant may output a response to the query as "looks like you already hit up the beach and the zoo, you should try the memorial in the morning and then the museum, both of which are open all day tomorrow."

By relying on supplemental data, the assistant can understand, and generate answers to, more complex, compound, and often personal queries even if queries are new queries that have never been received or answered by the assistant. The above examples are just some use cases for the assistant architecture shown in FIG. 1, the assistant architecture has many other applications and use cases.