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## Fulfilling User Queries via the User's Social and Professional Networks

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## **Fulfilling User Queries via the User's Social and Professional Networks**

### **ABSTRACT**

The queries virtual assistants can respond to are limited by the information sources available to the virtual assistant. As a result, when a user query cannot be satisfactorily answered from such sources, the user receives a suboptimal answer or is told that an answer cannot be provided. This disclosure describes techniques that, with user permission, leverage a user's personal and professional networks to respond to user queries to a virtual assistant. A classifier is used to determine if a particular query is best handled by a person in the user's networks. In such cases, the virtual assistant facilitates correspondence with the individual and can optionally take action based on the response received. Integrating the user's networks within the interactive flow of seeking information via a virtual assistant can enhance the user experience (UX) by improving the quality, accuracy, and utility of the provided responses.

### **KEYWORDS**

- Virtual assistant
- Social network
- Professional network
- Professional expertise
- Human in the loop
- Query handling
- Query classifier
- Query fulfillment
- Voice based interaction

## BACKGROUND

Users often perform tasks and seek information by interacting with voice-based virtual assistants provided via devices such as smartphones, smart speakers, smartwatches, etc. Such interactions allow users to achieve their goals with natural, conversational interactions.

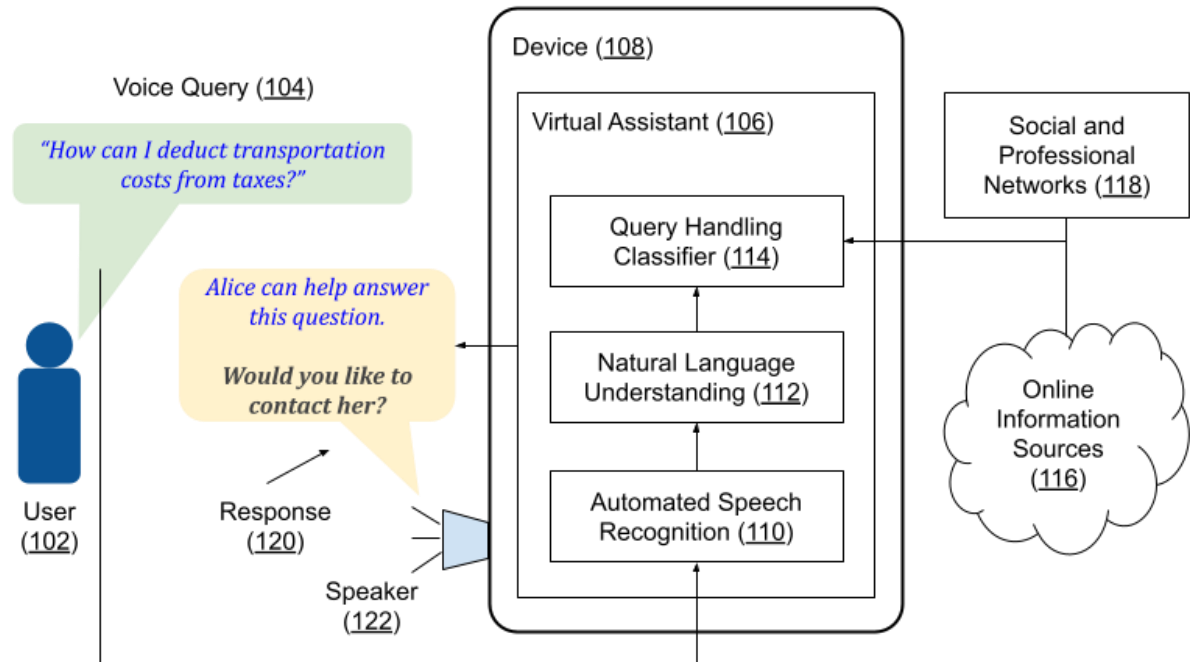
In some cases, a user's question directed at a virtual assistant may be best answered by another person in the user's social or professional networks instead of being handled via online information sources. For instance, a user might ask the virtual assistant, "How can I deduct transportation costs from taxes?" Pertinent information for answering the question may not be present in information corpora (e.g., web pages) available to the virtual assistant. However, a person in the user's social or professional networks who has relevant tax-related expertise may readily be able to answer the question.

Currently, the answers to user queries available via virtual assistants are obtained only from available online information sources. As a result, when a user's question cannot be satisfactorily answered from such sources, the user receives a suboptimal answer or is told that an answer cannot be provided, even when a person in the user's social or professional networks is well suited to provide the answer.

## DESCRIPTION

This disclosure describes techniques for leveraging a user's personal and professional networks to provide answers to queries to a virtual assistant that are best handled by an individual within these networks rather than relying on other information sources available to the virtual assistant. With user permission, when it is determined that the most suitable answer to the user query can likely be provided by a person in the user's networks, the virtual assistant

response can facilitate getting in touch with the individual(s) in question and taking action on the response from the person(s).



**Fig. 1: Suggesting an individual from a user's network to handle the user's query**

Fig. 1 shows an example of operational implementation of the techniques described in this disclosure. A user (102) issues a voice query (104) to a virtual assistant (106) available via a device (108). With user permission, the audio can be processed using automated speech recognition (ASR, 110) to convert it to a text form followed by applying natural language understanding (NLU, 112) to interpret the semantics of the text.

The NLU output can be passed to an appropriately trained machine learning classifier (114). If it is determined by the classifier that the available responses to the query obtained from available online information source (116) are unsatisfactory the output of the classifier indicates that the query is to be handled by suggesting a person from the user's social and professional networks (118). In the example of Fig. 1, the query ("how can I deduct transportation costs from

taxes?”) pertains to taxes. With user permission, the classifier accesses the user’s contacts and determines that a friend Alice, who is a tax professional, is likely to know the answer to the query. The device speaker (122) or other interface (e.g., display) is used to deliver the corresponding response (120) along with an option for the user to initiate contact with Alice.

If the user chooses to contact the relevant individual(s), a conversation can be initiated with the selected person via any suitable modes, such as a social network or messaging application, using an application programming interface (API) provided by a social network/messaging provider, automating steps within communication apps, etc. While composing the message to initiate contact, the user can be asked for relevant additional information such as “What details do you wish to add?” “Is this an acceptable message?” etc. Upon user confirmation, the message can be sent to the contact and the query considered fulfilled for the time being.

The user can permit the virtual assistant to detect when the contact responds to the message. Such detection can be performed via the virtual assistant analyzing an incoming notification, via an API, etc. Upon detecting a response, the virtual assistant can alert the user and optionally perform one or more of the following actions:

- Reading the entire response or query-relevant segments of the response from the contact;
- Combining query-relevant information from the response with that from other sources (e.g., web pages); and
- Offering to ask follow-up questions via the same interaction flow, depending on whether the information within the response is adequate.

Depending on the query and the corresponding response, the virtual assistant can perform an action automatically based on the received response. For instance, if the user’s query seeks

music recommendations, the response can be parsed to detect song suggestions which can then be added automatically to the user's playlist. Similarly, the response to a query about parts needed for car repair can lead to the virtual assistant adding the suggested parts to a shopping cart or to-do list automatically upon receiving the response.

The appropriate way to handle a query can be determined based on attributes in the query itself. Alternatively, or in addition, query handling can be based on a comparison between the responses obtained via the information sources available to the virtual assistant and responses that can likely be obtained from the user's networks. If users permit, the comparison can be done by computing respective quality and/or confidence scores for the responses obtained from available information sources, and for the match between the query and one or more individuals in the user's networks. Query fulfillment can be routed to whichever of the two scores is higher. Alternatively, depending on the scores, the user can be provided the response obtained from the information sources available to the virtual assistant while simultaneously suggesting that the user reach out to someone in their networks for additional detail and/or verification.

The degree of match between a query with individuals in the user's networks can be determined based on one or more of the following:

- Applying appropriate transformation to the user query via suitably trained machine learning models (e.g., the query "How can I deduct transportation costs from taxes?" can be transformed to obtain relevant professions, such as "tax advisor," "accountant," etc.);
- Analyzing content publicly posted by individuals in the user's networks via suitably trained machine learning classifiers to check whether it indicates query-relevant expertise or experiences (e.g., a query about coffee machines can be deemed suitable for those in

the user's networks who have posted content about coffee or indicated that they own a coffee machine);

- Ranking individuals in the network based on the nature of their interactions with the user (e.g., frequency, recency, etc.) and/or availability for responding to the query (e.g., time zone, work hours, vacation, etc.); and
- Evaluating second and third degree connections within the network, i.e., those not directly connected to the user but connected to the user's connections.

The techniques described in this disclosure can be implemented in virtual assistants provided via any device and can incorporate various social network platforms used for maintaining personal and/or professional connections. User queries to the virtual assistant via various modes such as audio, text, graphical user interface, etc. can all be analyzed to determine suitable responses. The threshold values for the various scores mentioned herein can be set by the developers and/or determined dynamically at runtime.

A virtual assistant application that incorporates the described features can enable users to leverage the expertise and experience of people in their networks when seeking information, especially for queries that are best delegated to human experts because they require specialized or nuanced knowledge regarding a topic. Integrating the user's networks within the interactive flow of seeking information via a virtual assistant can enhance user experience (UX) by improving the quality, accuracy, and utility of the provided responses and saving the user the time and effort of trying to find the answer through further queries or by manually identifying a person within their networks that can help.

Further to the descriptions above, a user may be provided with controls allowing the user to make an election as to both if and when systems, programs or features described herein may

enable collection of user information (e.g., information about a user's queries, social network, social actions or activities, profession, a user's preferences, or a user's current location), and if the user is sent content or communications from a server. In addition, certain data may be treated in one or more ways before it is stored or used, so that personally identifiable information is removed. For example, a user's identity may be treated so that no personally identifiable information can be determined for the user, or a user's geographic location may be generalized where location information is obtained (such as to a city, ZIP code, or state level), so that a particular location of a user cannot be determined. Thus, the user may have control over what information is collected about the user, how that information is used, and what information is provided to the user.

## CONCLUSION

This disclosure describes techniques that, with user permission, leverage a user's personal and professional networks to respond to user queries to a virtual assistant. A classifier is used to determine if a particular query is best handled by a person in the user's networks. In such cases, the virtual assistant facilitates correspondence with the individual and can optionally take action based on the response received. Integrating the user's networks within the interactive flow of seeking information via a virtual assistant can enhance the user experience (UX) by improving the quality, accuracy, and utility of the provided responses.