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Robin Dua

Sujith Ravi

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Smart Voicemail with Action Triggers Based on Semantic Understanding

Abstract

Techniques are set forth for responding to voicemails based on language processing of voicemails to identify actions that can be performed in response to the voicemails. The actions can be presented as selectable suggestion elements that, when selected, cause certain actions to be performed in reply to the voicemail. For example, a voicemail that includes a question for the recipient can be processed in order to generate selectable suggestion elements for answering the question via text message. Some techniques described herein can identify requests (e.g., request for a document, contact information, payment, etc.) from the recipient and, in response, queries can be performed in order to identify how best to fulfill the request. When the requested information is identified, selectable suggestion elements can be presented to the recipient and, when selected, can provide the requested information to the sender of the voicemail. Other techniques can process the voicemails and cause certain application functions to be executed according to the contents of the voicemails. In some instances, a user can receive a voicemail regarding an appointment request and, in response, a calendar entry corresponding to the appointment can be created via a calendar application, or a reminder can be presented if the calendar entry already exists. Techniques are also provided for ranking actions to be performed in response to receiving voicemails, and for identifying whether a voicemail is urgent. If the contents of the voicemail indicate that the voicemail is urgent, a user can be alerted (e.g., via audio or vibration) that an urgent voicemail was received. Furthermore, the user can be presented selectable suggestion elements for promptly responding to the sender with a message (e.g., "I will call you back shortly"). Thus, assistive action(s) can be determined based on a voicemail, and automatically performed and/or presented to a voicemail recipient as selectable

suggestions to effectuate the assistive action(s). Some non-limiting examples of assistive actions include: responding to the voicemail (*e.g.*, through another communication channel) with content (*e.g.*, text, document(s)) that is contextually relevant to the voicemail; creating a reminder for the recipient; scheduling or rescheduling an appointment; making a payment; storing certain content of a voicemail and/or related content for use in a note-taking application and/or other application; and/or triggering applications in a state, and/or with populated content, that is based on content of the voicemail.

Description

Voicemail has been a medium for reliably sending audio messages to persons that may be unavailable to answer their phone calls. Typically, a voicemail can be audio that is stored in association with a profile of a sender that had attempted to contact the recipient. The recipient can then access the voicemail at a more convenient time. In some instances, a voicemail may include a request that can be promptly responded to. However, because the recipient may not be available to listen to the voicemail upon receipt, the recipient may not be aware of the request, thereby delaying any response the recipient would otherwise have to the request. Furthermore, a recipient that has a number of unopened voicemails in their inbox may not be able to prioritize their responses without listening to every voicemail, thereby further delaying responses to urgent voicemails.

In view of these and/or other considerations, techniques are described herein for automatically processing voicemails to identify actions that can be performed in response to the voicemail, even before the voicemail has been heard by the recipient.

The voicemail system described herein converts voicemails to text using language processing techniques such that the resulting text can be further processed to generate

suggestions for responding to the voicemails. Suggestions can appear as selectable elements displayed at a graphical user interface (GUI) that also displays a list of voicemail messages received. Each voicemail in the list of voicemail messages can correspond to one or more different suggestions for responding to the voicemail or performing some action to fulfill a request in the voicemail. Moreover, in some situations an action to fulfill a request in the voicemail can be taken automatically without first presenting a suggestion to the recipient. For example, a calendar entry can be automatically created based on the content of a voicemail, without first presenting the recipient with a suggestion for creating the calendar entry. Accordingly, various actions described herein as being performed in response to a recipient selecting a suggestion, can also be performed automatically without first presenting the recipient with the suggestion.

In some instances, a suggested action can be messaging the contact who left the voicemail with the recipient. In order to provide the suggestion, the contact can be identified in the recipient's device along with any messaging application (e.g., email application, instant messaging application, etc.) that has been used to communicate with the contact. For example, a phone number associated with the contact can be used to query a contact database on the recipient's device or at a cloud service to determine the latest or most common messaging application used to communicate with the contact. Furthermore, replies to the voicemail can be personalized according to how the recipient typically communicates with the contact (e.g., using emojis, gifs, or other modes of communication).

Multiple suggestions can be presented at a voicemail message interface for replying to the contact's voicemail message. The suggestions can be presented as selectable elements that include text corresponding to the message to be sent to the contact. For example, the contact can

leave the recipient a voicemail asking the recipient whether they can give the contact a ride to the airport. In response, different suggestions can be presented for replying to the contact via text message, such as “Sure, I can pick you up,” “Sorry, I can’t pick you up,” and/or “Let me call you back later.” Should the recipient select the selectable element with the text “Sure, I can pick you up,” a text message will be sent to the contact’s message application with the same text. The recipient has therefore responded to the query in the voicemail message without opening the voicemail message, thereby saving time for both the recipient and the contact. Various techniques can be utilized to generate textual suggestions for replying to a given voicemail. For example, the voicemail can be converted to text, and the text applied to a neural network model trained to predict, based on the text, one or more suggested textual suggestions for replying. For instance, the neural network model can be a recurrent neural network model trained to generate, based on text of a voicemail, an embedding of the text or type(s) of replies that are appropriate. Textual suggestion(s) that correspond to the embedding or to those type(s) can then be selected and provided as suggestions. The system may also use other machine learning models to determine the intent of the incoming messages and use this information to select appropriate response suggestions or actions that match the inferred intent.

In some instances, the suggestions can include a call-back selectable element that can include the text “Call back” and can initiate a phone call to the contact when selected. The call-back selectable element can be generated when text of the voicemail message indicates that the contact is requesting a call back from the recipient. In this way, the recipient can more readily call back the contact without having to listen to the voicemail message.

In some instances, the voicemail system can process voicemails to determine a priority of the requests in the voicemails. For example, a contact may leave a voicemail with a recipient

that includes the phrase “this is urgent” or “please respond as soon as possible.” The voicemail system can process these phrases and assign a priority to voicemail. When an urgent voicemail is identified, the voicemail system can provide a tone and/or message to the recipient in order that the recipient will check their device. The voicemail system can also provide suggestions for responding to the urgent voicemail. The suggestions can include selectable elements that can send a message (e.g., “I will call you back shortly”) or initiate a phone call to the contact.

In some instances, the voicemail system can identify requests for information in voicemails. The information requested can be documents, pictures, audio, links, contact information, and/or any other type of electronic data. For example, a contact can leave a recipient a voicemail requesting a friend’s phone number (e.g., “Could you please send me Mario’s phone number?”). The voicemail system can convert the voicemail into text and determine, from the text, that the voicemail includes a request for information. The voicemail system can search the recipient’s device, or a cloud database associated with the recipient, to identify the requested information. The voicemail system can then generate selectable elements for responding to the contact’s request, and the selectable elements can include text that is based on the requested information (e.g., “Mario’s number is 555-3216”). In some instances, the selectable elements, when selected, can send the requested information to the contact along with a message for the contact (e.g., “Attached is the document you requested [attachment]”). In this way, the recipient can save time that would otherwise be spent listening to the voicemail and searching for the requested files.

In some instances, the voicemail system can convert voicemails to text and parse the text to identify applications that can fulfill requests that are provided in the text. Such applications can include a reminder application, calendar applications, payment application, scheduling

application, email application, restaurant application, contacts application, and/or any other type of computer application. For example, a contact can leave a voicemail for a recipient as a reminder for the recipient to pick up something from the grocery store (e.g., “Don’t forget to pick up some lettuce from the grocery store after work”). The voicemail system can convert the voicemail to text and parse the text to identify commands that can be associated with applications on the recipient’s device (e.g., a reminder application). A voicemail system can then generate a suggestion element that can include text associated with a function of the application (e.g., Set a reminder to pick up lettuce after work”). When the recipient sees the suggestion element at the voicemail system interface and selects the suggestion element, the application can perform the function (e.g., the application can set a reminder that provides a notification to the recipient when the recipient leaves work). In some instances, the voicemail system can cause a reminder to be set according to time, location, or other recipient activity (e.g., the recipient driving) in response to the recipient selecting the suggestion element.

In some instances, an application triggered by the voicemail system in response to receiving a voicemail can be a calendar application or a scheduling application. Oftentimes, people receive calls to confirm appointments (e.g., a receptionists calling to confirm an appointment with a doctor). The voicemail system can determine that a voicemail has been left by a person to confirm an appointment and, in response, generate a suggestion element for creating a calendar event that includes information derived from the voicemail. For example, the voicemail system can convert the voicemail to text and parse the text to identify event related data such as event subject (e.g., doctor’s appointment), event date (e.g., next Thursday), event time (e.g., 9:00 AM PST), and/or any other data that can be derived from the voicemail. The event related data can be used to create the calendar event when the recipient selects the

suggestion element. The suggestion element can be presented with text that identifies the reminder to be set (e.g., “Set reminder for doctor’s appointment next Thursday”).

In some instances, the suggestion element provided by the voicemail system can initialize an automated assistant. The automated assistant can act as an intermediary between the voicemail system and various applications associated with the recipient in order to perform certain actions in response to receiving a voicemail. The automated assistant can create a calendar event, send a message, initialize a phone call, and/or perform any other function for responding to a voicemail. In some instances, a suggestion element provided by the voicemail system can initialize the automated assistant for interacting with the contact that left the voicemail with the recipient. In this way, the contact (e.g., a business such as a doctor’s office) can schedule an appointment with the recipient via the automated assistant when the recipient is unable to return their phone call. Alternatively, the voicemail system can be associated with a business, thereby allowing a contact (e.g., a customer of the business) to schedule appointments, make purchases, receive a message, etc., from the business’s automated assistant after leaving a voicemail with the business.

In some instances, the voicemail system can receive a voicemail that is a request for a payment from a contact or a business. Text derived from the voicemail can be used to identify a payment amount, or to enable the voicemail system to search for the payment amount (e.g., in emails, texts, the internet). The voicemail system can present the recipient with a suggestion element for making the payment using an application on the phone (e.g., “Pay \$10 to Fred”). In response to the recipient selecting the suggestion element, a payment application can be initialized in order that the recipient can confirm payment to the contact that left the voicemail.

In some instances, the voicemail system can amend data that is already stored at the recipient's device or at a cloud database associated with the recipient. For example, a co-worker of the recipient may leave a voicemail advising the recipient to amend their work presentation to include a summary section for a particular project. The voicemail system can parse text corresponding to the voicemail system in order to determine that the co-worker is seeking to amend a particular file being managed by the recipient. The voicemail system can identify recent documents edited by the recipient in order to find the presentation identified in the voicemail. The voicemail system can then generate a suggestion element that, when selected causes presentation software to execute a function for amending the presentation to include a note or reminder regarding the summary of the particular project. The suggestion element can include text (e.g., "Amend the presentation to include a project summary") that puts the recipient on notice of the action that was suggested in the email, and the action to be performed in response to selecting the suggestion element.

In other instances, certain suggestion elements can be generated for specific applications in response to a particular type of voicemail being received. For example, a voicemail can be received that includes information about changes to an order made through an application on the recipient's device. The voicemail system can use the contact information (e.g., a phone number) of the contact to determine that the contact is associated with a business that provided the application. Additionally, the voicemail system can parse the voicemail to determine that the voicemail is about changes that have been made to an order made at the application. The voicemail system can then generate a suggestion element that, when selected, initializes the application with details regarding the changes made to the order.

FIG. 1 below illustrates a system diagram 100 that includes a voicemail system 114 for providing selectable suggestion elements 108 at a user interface of a recipient's device 104. The voicemail system 114 can operate on the recipient's device 104 and/or a remote device 112 such as a server, a personal computing device, or other device capable of processing voicemails. Initially, a contact's device 102 can initialize a phone call over a network 110 and leave a voicemail at the recipient's device 104. The voicemail can be stored at the recipient's device 104 and/or stored at a remote device 112, such as a server, a personal computing device, or any other computing device that can store data. A voicemail system 114 operating at the remote device 112 (and/or remotely, *e.g.*, in the cloud) can process the voicemail immediately upon receipt of the voicemail. Alternatively, the voicemail system 114 can process batches of voicemails periodically.

In order to process the voicemails, the voicemail system 114 can use a voice-to-text engine 116 to convert the audio in the voicemail into text. When the voicemail is left in a language that is not familiar to the recipient, the voice-to-text engine 116 can convert the text into the language that is familiar to the recipient. Thereafter, the text from the voicemail can be processed by a text parser engine 118. The text parser engine 118 can annotate or otherwise mark portions of the text according to how they apply to certain actions that can be performed by the recipient's device 104. For instance, a processed voicemail 106 can be left by a contact (*e.g.*, Karen) to remind the recipient that they owe the contact money (*e.g.*, \$12.75 for a dinner). The text derived from the voicemail audio can be, for example, "don't forget to pay me \$12.75 for dinner last night." The text parser engine 118 can mark "pay" as an intent, and "dinner last night" as the subject matter for a reply. The voicemail system 114 can also identify "Karen" as

the payee based on the text “me” from the voicemail in combination with the contact name corresponding to the phone number that initialized the voicemail.

An action engine 120 of the voicemail system 114 can use the annotated text from the text parser engine 118 to generate intents for responding to the voicemail. For instance, the “pay” intent identified from the voicemail text can be mapped to an action (e.g., PAY_INTENT can be mapped to a PAY_CONTACT action) that is predefined or learned according to previous interactions with the contact. In some instances, actions can be ranked by a ranking engine 122, which can rank actions according to contact relationships (e.g., family contacts can have priority over co-worker contacts), urgency indicated in the voicemail, type of action, and/or any other metric for ranking an action.

The voicemail system 114 can cause the recipient’s device 104 to present suggestion elements 108 with the processed voicemail 106 to indicate available responses for responding to the voicemail. For instance, the suggestion elements 108 can allow the recipient to pay the contact (e.g., Pay Karen \$12.75 for dinner last night) or send a message to the contact (e.g., Send message: “I’ll call you right back”). When the recipient selects to pay the contact, the recipient can be presented with a confirmation page to confirm they would like to use a pay application to pay the contact. Additionally, when the recipient selects to send a message to the contact, a messaging application can be opened with a text field filled out with the text from the suggested element 108 (e.g., “I’ll call you right back”). The recipient can then either proceed with sending the message, or edit the text to be a different response.

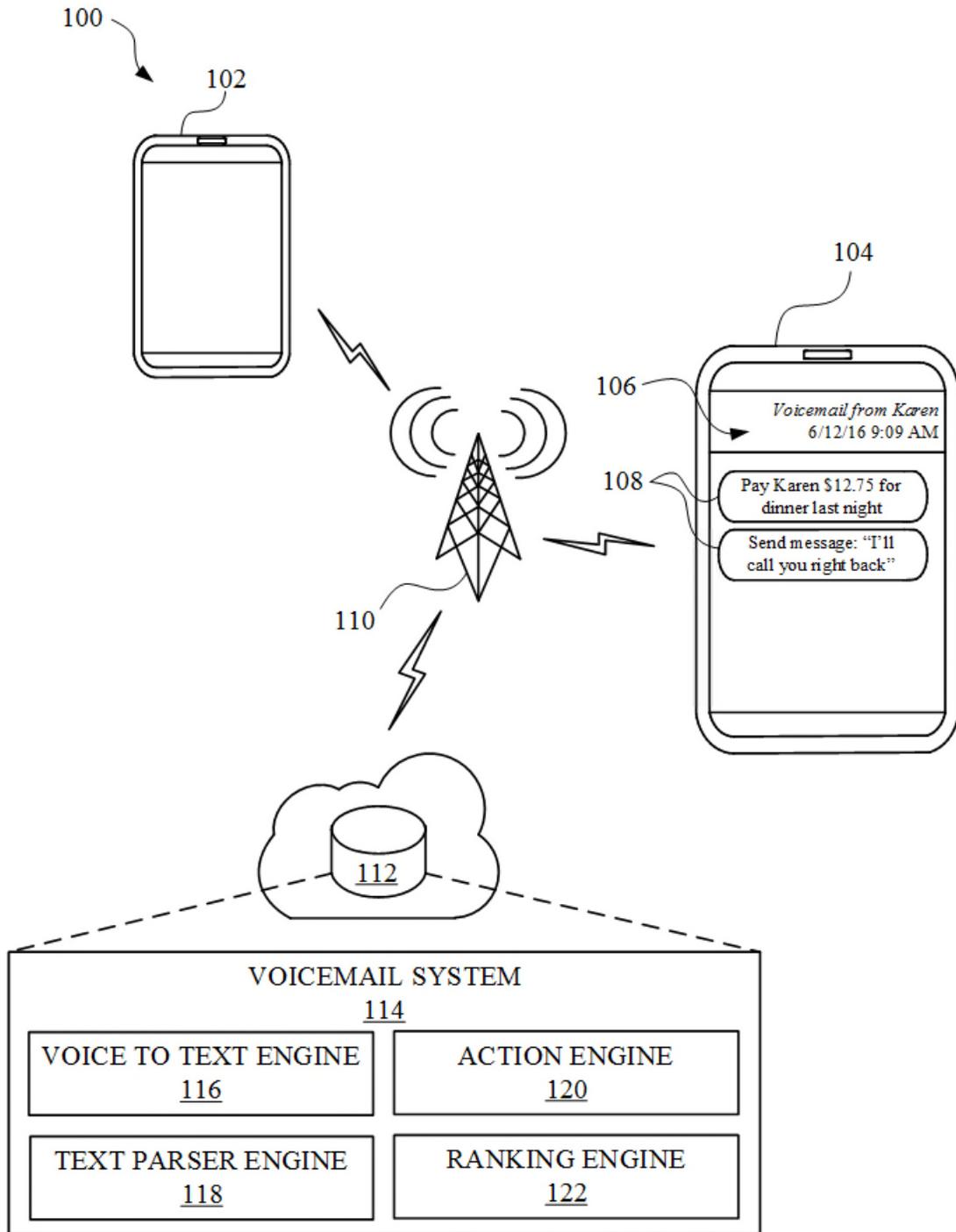


FIG. 1